University of Dhaka

Department of Computer Science and Engineering

CURRICULUM OF
BACHELOR OF SCIENCE IN COMPUTER SCIENCE AND ENGINEERING
(B.SC. ENGG. IN CSE)

ACADEMIC YEAR: 2023 - 2024 AND ONWARD

Preface

Welcome to the curriculum description of the Bachelor of Science in Computer Science and Engineering (shortly, B.Sc. Engg. in CSE) degree program of the Department of Computer Science and Engineering (CSE) under the Faculty of Engineering and Technology (FoET) of the University of Dhaka (DU). In this dynamic and rapidly evolving field, we are excited to offer a comprehensive curriculum that blends the realms of Computer Science and Computer Engineering. This 4-year undergraduate engineering degree program is designed following the principles and practices of Outcome Based Education (OBE) aiming to equip students with the knowledge, skills, and attitudes necessary for 21^{st}-century workplaces and to excel them in the age of rapidly progressing industrial revolutions.

The convergence of computer science and computer engineering has revolutionized industries and reshaped the way we perceive and interact with technology. From enabling understanding of core theories of computer science to applying them in solving practical problems related to intelligent data collection, data processing, knowledge development and thereby optimizing business operations and creating self-learning machines. Nowadays, the applications of computers, software, networks, and data centers are limitless. As the students embark on this educational journey, they will explore the core theories, techniques, and applications that underpin solving complex engineering problems in these rapidly transformative domains.

The curriculum is meticulously crafted to strike a balance between theoretical foundations and practical hands-on experience. The students will explore a wide spectrum of subjects, ranging from basic science, mathematics, fundamentals of electronics and electrical engineering, programming, data structures, algorithms, microprocessors and microcontrollers, operating systems, computer networks, software engineering, artificial intelligence, computer graphics, cloud computing, information security, quantum computing, and many more. It also incorporates a basic understanding of engineering project management, professional ethics, history of the emergence of Bangladesh, and ICT business entrepreneurship. Our experienced faculty members, who are accomplished experts in the field, will guide the students through both the theoretical complexities and real-world implications of computing, communications, AI-driven automation, and knowledge engineering.

Throughout the program, the students will have the opportunity to sharpen their skills, collaborate on projects, and gain exposure to industry practices. The program's capstone projects will challenge the students to apply their accumulated knowledge and skills to solve real-world problems, preparing the students to make meaningful contributions to various domains upon graduation.

At the University of Dhaka, we value research-driven comprehensive education. Beyond technical expertise, we emphasize critical thinking, critical analysis, vertical and horizontal communications in teamwork, ethical considerations, and effective negotiation as essential pillars of success in emerging fields

of computing. Following the principles of Outcome Based Education (OBE) system, our goal is to nurture well-rounded professionals who not only excel in their technical capacities but also possess the ability to collaborate, innovate, and lead in a rapidly changing global landscape.

As per the current trend, computer science and engineering is not just a field of study, rather it avenues to shape demanding professionals in the practical workplace including chief technology officer (CTO), sloutions architect, software architect, system analyst, software engineer, AI engineer, information security architect, data scientist, network engineer, etc. The skills the students acquire here will empower them to be at the forefront of innovation, tackling challenges, and creating solutions that have a positive impact on society, especially in improving the quality of human life.

We are excited to accompany our students on this transformative adventure as the students will explore the frontiers of computing machines, programming languages, complex computation systems, Internet technologies, artificial intelligence, machine learning, and data science. Through dedication, curiosity, and hard work, our students will undoubtedly contribute to a future driven by ubiquitous computing systems.

Contents

I ♦ Part A

1 Title of the Academic Program

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

2 Name of the University

University of Dhaka

3 Vision of the University

Cultivation of knowledge, skills, and attitudes and thereby enabling individuals as dynamic human capital poised to make a lasting national and global impact.

4 Mission of the University

The mission of the University of Dhaka is split into 6 parts as follows:

- **UM1 (Transformative Education)** To provide transformative education by enabling students to embrace lifelong learning, and fostering a sustainable knowledge-based society through the continuous pursuit of scholarship and technology.
- **UM2 (Collaborative Research and Innovation)** To build Collaborative research and innovation hubs, leveraging partnerships to expand the boundaries of technological advancement.
- **UM3 (Education Ecology)** To develop an educational ecosystem that fosters excellence, transparency, and accountability.
- **UM4 (Community Engagement)** To engage with relevant stakeholders and communities in building a just, fair, and sustainable world.
- **UM5 (Ethical Responsibility)** To empower students to become ethically responsible global citizens for positive societal impact.
- **UM6 (National Heritage)** To instill a deep sense of national heritage and pride, cultivating a connection to our historical roots and global inheritance.

5 Name of the Program Offering Entity (Department/Faculty/Institute)

The name of the program offering department is the *Department of Computer Science and Engineering* under the *Faculty of Engineering and Technology* of the *University of Dhaka*.

6 Vision of the Program Offering Entity

The department envisions empowering students with cutting-edge knowledge and skills in Computer Science and Engineering and nurturing their potential to become problem solvers, architects, ethical leaders, and trailblazers in the globally evolving landscape of computer science and engineering.

7 Mission of the Program Offering Entity

Department of Computer Science and Engineering will venture:

- **PM1**: Educating students on the state-of-the-art knowledge and skills required for the design, development, and innovation of computers, software, networks, and intelligent application systems.
- **PM2**: Empowering students with research and innovation skills including investigation, critical thinking, analysis, synthesizing, and evaluation to bring positive changes in different fields such as transportation, healthcare, finance, education, climate science, and more, contributing to the betterment of the society.
- **PM3**: Preparing graduates to excel as leading professionals with social and environmental responsibilities, ethics, and human values.
- **PM4**: Enhancing the life-long learning capacity of students by engaging them in new technological problem-solving, design, and development activities.

8 Objectives of the Program Offering Entity

The objective of the Department of Computer Science and Engineering of University of Dhaka is to provide students with a comprehensive and cutting-edge education in these rapidly advancing fields. The program aims to equip students with the knowledge, skills, and practical experiences necessary to become proficient Computer Scientists and Computer Engineering professionals. By integrating theoretical foundations with hands-on training, the course seeks to foster critical thinking, problem-solving abilities, design of computer systems, software development, Internet technologies, and a strong understanding of data analysis techniques, machine learning algorithms, and AI applications.

The objectives of the program are noted as follows:

- **Foundational Knowledge**: To provide students with a strong foundational knowledge of the key concepts, theories, and principles underlying Computer Science and Engineering majors. This includes understanding computation systems and software, algorithms, networking and the Internet, AI methods, machine learning techniques, and data analysis.
- **Technical Skills**: To equip students with practical, hands-on technical skills required for addressing complex engineering problems using emerging computation tools and technologies. This includes

programming languages like Assembly, C/C++, Java, Python, HTML/CSS, PHP, and proficiency in relevant software libraries and frameworks.

- **Problem-Solving and Critical Thinking**: To develop students' problem-solving and critical thinking abilities, enabling them to analyze complex computation problems, handle large and complex datasets, identify patterns, make data-driven decisions, and address real-world challenges through designing efficient databases, using diverse algorithms, AI and data science techniques.
- **Ethics and Responsibility to the Society**: To instill ethical considerations and responsible engineering practices in students. This includes addressing issues related to bias in AI algorithms, data privacy, transparency, and the societal impact of AI technologies. Graduates should be able to develop AI solutions with ethical considerations in mind.

By fulfilling these objectives and goals, the Department of Computer Science and Engineering of University of Dhaka strives to produce skilled and ethical professionals who can put lasting national and global impact.

9 Description of the Program

The Bachelor of Science in Computer Science and Engineering is an undergraduate academic degree program designed to provide students with a comprehensive understanding of the theories, principles, techniques, and applications of computer systems. This program aims to equip students with the knowledge and skills necessary to design computers, software and network systems, analyze, interpret, and leverage large sets of data to make informed decisions and develop AI and ML-driven solutions across various domains.

The program's curriculum containing 150 credits combines foundational courses in computer science, computer engineering, mathematics, basics of electrical and electronic engineering, statistics, and humanities with specialized courses in the areas of AI and Data Engineering, hardware and software systems, network and distributed systems, and theoretical computer science. Here is a general overview of the program's components:

a. **Foundation Courses**:

- **Programming**: Students learn programming languages such as Assembly, C/C++, Java, PHP, HTML/CSS, database, and network programming that are widely used in developing intelligent software systems.
- **Mathematics and Statistics**: Courses cover topics like differential equations, linear algebra, calculus, vector, geometry, probability, and statistics, which form the basis of solving computing problems, data analysis, and machine learning algorithms.
- **Electrical and Electronic Engineering Fundamentals**: One physics with laboratory and two courses - Introduction to basic electrical circuits and Electronic devices and circuits with corresponding laboratories help to grow foundation knowledge and skills working with electrical and electronic stuff.

b. **Core Computer Science and Engineering Courses**: The program is designed to provide knowledge and skills on cutting-edge Computer Science, Computer Engineering, and Computer Technologies. The following courses can be considered as highlights of the program.

- **Data Structure and Algorithms**: Courses on Data Structure, Design and Analysis of Algorithms, Algorithm Engineering, and Database Systems build a strong foundation of technologies required for data storage and data processing.
- **Microprocessor and Microcontrollers**: A good set of courses on Discrete Mathematics, Digital Logic Design, Computer Architecture, Microprocessor, Microcontrollers, and Embedded Systems equips students with operational details of computing devices and embedded programs.
- **Software Systems Engineering**: The Object Oriented Design and Programming, Software Engineering, Web Engineering and Technology courses along with correspondinglaboratories significantly support students in designing and developing application software systems.
- **Artificial Intelligence and Machine Learning**: The inclusion of Artificial Intelligence and Machine Learning courses opens doors to address complex real-world challenging problems in real-time environments.
- **Network and Distributed Systems**: The studies on Operating Systems, Data and Telecommunications, Computer Networking, Information Security, Internet of Things, and Parallel and Distributed Systems courses would help students to build secured and efficient information network systems.

c. **Elective or Specialization Courses**: A large set of specialization courses has been designed to be offered as elective courses to meet the diverse interests of the students. Each student will take 2 such courses with laboratories and 1 without lab. These courses would help students in growing their knowledge and skills in depth in their area of interest.

d. **Capstone Projects and Industrial Experience**:

- Students will be working on capstone projects where they apply computing, networking, AI and ML techniques to address real-world problems.
- Internships with industry partners are expected to provide hands-on exposure to the field.

e. **Soft Skills and Communication**: The inclusion of presentations, demonstrations, and teamwork activities in the laboratories gives strong emphasis on communication skills so that the students can effectively present findings and insights to both technical and non-technical audiences.

f. **Humanities**: Four courses including History of Emergence of Bangladesh, IT Project Management, Professional Ethics and Environment, and ICT Business Entrepreneurship help to grow students with professionalism and responsibility to society.

Graduates of the Bachelor of Science in Computer Science and Engineering degree program will be well-prepared for careers in technology innovation, transportation, healthcare, finance, e-commerce, and more, where distributed software and network systems, Artificial Intelligence and data-driven decision-making are becoming increasingly essential.

10 Program Educational Objectives (PEOs)

Graduates of the Bachelor of Science in Computer Science and Engineering degree program are expected to attain the following Program Educational Objectives (PEO) within 3 to 5 years of graduation.

- **PEO1**: Graduates will demonstrate leadership roles as Computer professionals and continue to acquire knowledge, skills, and experiences to address new challenges in the field of computer science and engineering.
- **PEO2**: Graduates will retain the pursuit of knowledge, skills, intelligence, and interdisciplinary learning in a multicultural environment for achieving top-notch academic scholarships and professional careers.
- **PEO3**: Graduates will design and develop computing, software, and network technologies with a focus on sustainability to offer a better place for humanity while they will practice ethical and responsible usage of technologies.

11 Program Learning Outcomes (PLOs)/Program Outcomes (POs)

Graduates of the Bachelor of Science in Computer Science and Engineering degree program are expected to attain the following Program Outcomes (POs) by the time of graduation.

- **PO1 - Foundational Knowledge**: Apply a profound understanding of basic science, mathematics, and core principles of computer, computing, and communications to tackle complex engineering problems within the field effectively. Utilize theoretical insights and practical skills to devise innovative solutions.
- **PO2 -Problem Analysis and Modeling**: Identify, formulate, and rigorously analyze complex engineering problems in computer science and engineering domains. This involves extensive computing and scientific issues, literature review, and the application of mathematical, statistical, and computational algorithmic techniques to derive substantiated conclusions.
- **PO3 - Algorithm Design and Implementation**: Design solutions for complex computer science and engineering problems and design systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. (K5)
- **PO4 - Investigation**: Conduct investigations of complex problems using research-based knowledge (K8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
- **PO5 - Modern Tool Usage**: Apply a cutting-edge array of computing, communication and artificial intelligence techniques to develop innovative software application models, network systems and other AI applications. Understand the use of prediction and modeling techniques for complex engineering activities and their limitations.
- **PO6 - Computer Engineers and Society**: Apply reasoning informed by computer science and engineering knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems. (K7)
- **PO7 - Environment and Sustainability**: Understand and evaluate the sustainability and impact of professional engineering work in solving complex computer science and engineering problems in societal and environmental contexts. (K7).

- **PO8 - Ethics**: Apply ethical principles and commit to professional ethics, responsibilities, and the norms of professional practice.
- **PO9 - Individual Work and Teamwork**: Function effectively as an individual and as a member or leader of diverse teams and in multidisciplinary settings.
- **PO10 - Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO11 - Project Management and Finance**: Demonstrate knowledge and understanding of the computation, software and network systems, and AI principles and apply these to one's work as a member or a leader of a team to manage projects in multidisciplinary environments.
- **PO12 - Life-Long Learning**: Recognize the need for and have the preparation and ability to engage in independent, life-long learning for adaptability in the broadest context of technological change

12 Mapping Mission of the University with PEOs

The mapping between the mission of the university (please refer to Section 4) and PEOs (please refer to Section 10) is shown as follows. The cells marked with '√' denote a mapping.

		Program Educational Objectives		
		PEO1	PEO2	PEO3
Mission of the University	UM1	√		√
	UM2	√		
	UM3		√	
	UM4			√
	UM5			√
	UM6	√	√	

13 Mapping PLOs with the PEOs

The aforementioned PLOs/POs and their mapping with the PEOs are presented in the following Table. The cells marked with '√' denote a mapping.

		Program Educational Objectives (PEOs)		
		PEO1	PEO2	PEO3
Program Outcomes (POs)	PO1	√		
	PO2	√		
	PO3	√		
	PO4		√	
	PO5		√	
	PO6			√
	PO7			√
	PO8			√
	PO9		√	
	PO10	√		
	PO11			√
	PO12		√	

14 Mapping Courses with the PLOs

The mapping of courses with the PLOs/POs is presented in the following Table. Here, the courses are only identified by course codes. For details of the course information, please refer to Section 15. The cells in the following table marked with '√' denote a mapping.

		Program Outcomes (POs)											
Sl	Course Code	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	CSE 1101	√	√	√									
2	CSE 1103		√		√					√			
3	CSE 1104	√	√							√			
4	CSE 1201	√	√								√		
5	CSE 1202	√	√							√			
6	CSE 1203	√	√								√		
7	CSE 1204	√	√		√								
8	EEE 1209		√			√							√
9	EEE 1210		√			√							√
10	CSE 2101	√	√		√								
11	CSE 2102	√	√					√					
12	CSE 2103		√			√							√

13	CSE 2104		√			√							√
14	CSE 2105	√	√		√								
15	CSE 2106			√		√	√						
16	CSE 2201	√	√					√					
17	CSE 2202	√	√			√							
18	CSE 2203	√	√								√		
19	CSE 2204	√	√		√								
20	CSE 2205	√	√		√								
21	CSE 2206	√	√			√							
22	CSE 3101		√	√							√		
23	CSE 3102	√	√		√								
24	CSE 3103	√	√		√								
25	CSE 3104	√				√					√		
26	CSE 3105		√	√		√	√		√	√	√	√	
27	CSE 3109		√	√							√		
28	CSE 3110			√		√			√				
29	CSE 3201	√		√					√				
30	CSE 3202			√	√	√							
31	CSE 3203		√		√						√		
32	CSE 3204	√	√	√									
33	CSE 3205		√	√					√				
34	CSE 3206		√	√		√	√		√	√	√		
35	CSE 4100	√	√	√	√	√	√	√	√	√	√	√	√
36	CSE 4101	√	√			√							
37	CSE 4102		√	√		√							
38	CSE 4103	√	√						√				
39	CSE 4104		√		√	√							
40	CSE 4110		√			√	√	√	√		√		√
41	CSE 4201	√					√						
42	CSE 4202	√							√				
43	HUM 4203	√					√						
44	HUM 4205	√					√						
45	CSE 4210	√	√	√	√	√	√	√	√	√	√	√	√

Summary	√	√	√	√	√	√	√	√	√	√	√	√

II ♦ Part B

15 Structure of the Curriculum

a. **Duration of the program**: 4 Years/8 Semesters.

b. **Admission Requirements**: General Undergraduate Admission guidelines of the Science Unit will be applicable. Some important eligibility criteria are described as follows:

- Candidates having a minimum GPA of 3.50 (including 4th subject) separately in SSC and HSC examinations held in recent designated years from the Science/Agricultural Science branch of any education board of Bangladesh or Alim in Science branch from Madrasa Board or IGCSE/O-level and IAL/GCE/A-level or equivalent foreign degree and a minimum total GPA of 8.0 in these two will be eligible to apply. For IGCSE/O-level and IAL/GCE/A-level and any foreign degree holders, the equivalent grades will be calculated and thus the eligibility will be determined.
- Candidates having a minimum GPA of 3.0 (including 4th subject) separately in SSC and HSC examinations held in recent designated years from the Arts/General or Business Education branches of any education board of Bangladesh and a minimum total GPA of 7.5 in these two will also be eligible to apply. For IGCSE/O-level and IAL/GCE/A-level and any foreign degree holders, the equivalent grades will be calculated and thus the eligibility will be determined.
- In the admission test, the candidate must secure at least 60% marks of the total marks allocated for the Physics and Mathematics parts.

c. **Total class weeks in a Year/semester**: 15 weeks/semester including midterm exam; 2 semesters in a year

d. **Teaching hours of theory courses**: One theory course credit is defined as conducting one 60 minutes class delivery in a week, spanning 14 weeks in a semester excluding midterm examination. For a 3-credit course, two classes each of 90 minutes are held in a week, i.e., 42 hours of total contact hours per 3-credit course. Similarly, a 2-credit course has 28 hours of teaching, two classes of 60 minutes each week.

e. **Teaching hours of laboratory courses**: One laboratory course credit is defined as conducting hands-on work in the lab for 2 hours in a week, spanning 14 weeks in a semester. For a 1.5 credit laboratory course, one class of 3 hours is held in a week, i.e., 42 hours of total contact hours in 14 weeks. Similarly, a 0.75-credit lab course has one class of 3 hours in alternate weeks, and a 1.0-credit lab course has 28 hours of teaching, each class of 2 hours in 14 weeks.

f. **Mid and Final Examinations**: 1 week for midterm and 2 to 3 weeks for final examinations.

g. **Preparatory leave**: 9-10 days of preparatory leave will be allocated between the last class date of a semester and the starting date of the final examinations.

h. **Total minimum credit requirement to complete the degree program**: 150 Credits.

i. **Minimum CGPA requirements for graduation**: 2.00, and without 'F' grade in any subject.

j. **Maximum academic years of completion**: 6 (Six) Years from the date of admission at 1st year 1st semester.

k. **Course Code**

i. Every course has a unique course code. The letter prefix in any course code indicates the field or the discipline of the course, e.g., **CSE** stands for Computer Science and Engineering, **EEE** for Electrical and Electronic Engineering, **PHY** for Physics, **MATH** for Mathematics, **STAT** for Statistic, **HUM** for arts and humanities, **BUS** for business, and **MIS** for management of information system.

ii. The four digits in the course code have the following meaning:

- The first digit corresponds to the year in which the course is offered by the department.
- The second digit represents the semester in which the course is offered.
- The third and fourth digits are used to specify different theory and lab courses taught in a semester. The last digit is assigned an odd number for theoretical courses and even for laboratory courses.

l. **Category of Courses**:

i. General Education Courses: (Interdisciplinary courses, beyond the discipline/program, that provide a well-rounded learning experience to the students) For example Arts and Humanities, Social Sciences, Business, ICT, Basic Science/STEM, other engineering, etc. (as applicable for the disciplined academic program).

Sl	Course Code	Course Title	Credit
1	HUM 1109	History of Emergence of Bangladesh	2.0
2	HUM 4105	Professional Ethics and Environment	2.0
3	MIS 4203	IT Project Management	2.0
4	BUS 4205	ICT Business Entrepreneurship	2.0
5	PHY 1205	Physics	3.0
6	PHY 1206	Physics Lab	0.75
7	MATH 1107	Differential and Integral Calculus	3.0
8	MATH 1207	Linear Algebra	3.0
9	MATH 2107	Differential Equations, Laplace Transform and Fourier Analysis	3.0
10	STAT 2207	Probability and Statistics	3.0
11	STAT 3107	Random Processes	3.0
12	EEE 1105	Electrical Circuits	3.0
13	EEE 1106	Electrical Circuits Lab	0.75
14	EEE 1209	Electronic Devices and Circuits	3.0
15	EEE 1210	Electronic Devices and Circuits Lab	0.75
Total		**(12 Theory and 3 Lab courses)**	**34.25**

ii. Core courses (Courses that characterize the discipline):

Sl	Course Code	Course Title	Credit
16	CSE 1101	Discrete Mathematics	3.0
17	CSE 1103	Computational Problem Solving	3.0
18	CSE 1104	Computational Problem Solving Lab	1.5
19	CSE 1201	Structured Programming	3.0
20	CSE 1202	Structured Programming Lab	1.5
21	CSE 1203	Digital Logic Design	3.0
22	CSE 1204	Digital Logic Design Lab	0.75
23	CSE 2101	Data Structures and Algorithms	3.0
24	CSE 2102	Data Structures and Algorithms Lab	1.5
25	CSE 2103	Object Oriented Design and Programming	3.0
26	CSE 2104	Object Oriented Design and Programming Lab	1.5
27	CSE 2105	Computer Architecture and Microprocessor	3.0
28	CSE 2106	Microprocessor and Assembly Language Lab	1.5
29	CSE 2109	Data and Telecommunication	3.0
30	CSE 2201	Database Management System	3.0
31	CSE 2202	Database Management System Lab	1.5
32	CSE 2203	Design and Analysis of Algorithms	3.0
33	CSE 2204	Design and Analysis of Algorithms Lab	1.5
34	CSE 2205	Microcontroller and Embedded System	3.0
35	CSE 2206	Microcontroller and Embedded System Lab	1.5
36	CSE 2209	Numerical Methods	3.0
37	CSE 3101	Software Engineering	3.0
38	CSE 3102	Software Design and Development Project	1.5
39	CSE 3103	Web Engineering and Technology	3.0
40	CSE 3104	Web Engineering and Technology Lab	1.5
41	CSE 3105	Algorithm Engineering	3.0
42	CSE 3109	Operating System	3.0
43	CSE 3110	Operating System Lab	1.5
44	CSE 3201	Computer Network	3.0
45	CSE 3202	Computer Network Lab	1.5
46	CSE 3203	Artificial Intelligence	3.0
47	CSE 3204	Artificial Intelligence Lab	1.5
48	CSE 3205	Information Security	3.0
49	CSE 3206	Information Security Lab	1.5
50	CSE 3207	Theory of Computation	3.0
51	CSE 4101	Machine Learning	3.0
52	CSE 4102	Machine Learning Lab	1.5
53	CSE 4103	Internet of Things	3.0
54	CSE 4104	Internet of Things Lab	1.5
55	CSE 4201	Parallel and Distributed Systems	3.0
56	CSE 4202	Parallel and Distributed Systems Lab	1.5

Total	**(23 Theory and 18 Lab courses)**	**95.25**

iii. Elective Courses (Courses for specialization within the discipline):

ELECTIVE I courses with laboratories

Sl	Course Code	Course Title	Credit
1	CSE 3209	Digital Image Processing	3.0
2	CSE 3210	Digital Image Processing Lab	1.5
3	CSE 3211	Introduction to Data Science	3.0
4	CSE 3212	Introduction to Data Science Lab	1.5
5	CSE 3213	Bioinformatics	3.0
6	CSE 3214	Bioinformatics Lab	1.5
7	CSE 3215	Mobile Application Development	3.0
8	CSE 3216	Mobile Application Development Lab	1.5
9	CSE 3217	Simulation and Modeling	3.0
10	CSE 3218	Simulation and Modeling Lab	1.5
11	CSE 3219	Computer Graphics	3.0
12	CSE 3220	Computer Graphics Lab	1.5
13	CSE 3221	Wireless Networks	3.0
14	CSE 3222	Wireless Networks Lab	1.5
Total	**(One theory course and its lab will be chosen by a student)**		**4.5**

ELECTIVE II courses with laboratories

Sl	Course Code	Course Title	Credit
1	CSE 4211	Deep Neural Network	3.0
2	CSE 4212	Deep Neural Network Lab	1.0
3	CSE 4213	Natural Language Processing	3.0
4	CSE 4214	Natural Language Processing Lab	1.0
5	CSE 4215	Data Mining	3.0
6	CSE 4216	Data Mining Lab	1.0
7	CSE 4217	Digital Forensics	3.0
8	CSE 4218	Digital Forensics Lab	1.0
9	CSE 4219	Software Security	3.0
10	CSE 4220	Software Security Lab	1.0
11	CSE 4221	Compiler Design	3.0
12	CSE 4222	Compiler Design Lab	1.0
13	CSE 4223	Cloud Computing	3.0
14	CSE 4224	Cloud Computing Lab	1.0
Total	**(One theory course and its lab will be chosen by a student)**		**4.0**

ELECTIVE III courses without laboratory

Sl	Course Code	Course Title	Credit
1	CSE 4225	Big Data Analytics	3.0
2	CSE 4227	Information Retrieval	3.0
3	CSE 4229	Human Robot Interaction	3.0
4	CSE 4231	Computer Vision	3.0
5	CSE 4233	Software Testing and Quality Assurance	3.0
6	CSE 4235	VLSI Design and Formal Verification	3.0
7	CSE 4237	Parallel and Distributed Database Systems	3.0
8	CSE 4239	Applied Cryptography	3.0
9	CSE 4241	Wireless Network Security	3.0
10	CSE 4243	Graph Theory	3.0
11	CSE 4245	Operations Research	3.0
12	CSE 4247	Quantum Computing	3.0
13	CSE 4249	Game Theory	3.0
14	CSE 4251	Human Computer Interaction	3.0
Total	**(One theory course will be chosen by a student)**		**3.0**

iv. Final Year Design Project and Internship (as applicable for the discipline/academic program)

Sl	Course Code	Course Title	Credit
1	CSE 4100	Internship	3.0
2	CSE 4110	Final Year Project - Part A	2.0
3	CSE 4210	Final Year Project - Part B	4.0
Total			**9.0**

16 Year/Level/Semester/Term wise distribution of courses

The courses of the Bachelor of Science in Computer Science and Engineering are arranged and distributed among eight semesters based on the importance and hierarchical need of the courses. In the following, semester-wise courses are listed along with relevant information.

16.1 1^{st} Year, 1^{st} Semester

Sl	Course Code	Course Title	Credit	Prerequisite
1	CSE 1101	Discrete Mathematics	3.0	
2	CSE 1103	Computational Problem Solving	3.0	
3	CSE 1104	Computational Problem Solving Lab	1.5	
4	EEE 1105	Electrical Circuits	3.0	
5	EEE 1106	Electrical Circuits Lab	0.75	
6	MATH 1107	Differential and Integral Calculus	3.0	
7	HUM 1109	History of Emergence of Bangladesh	2.0	
	Total	(5 Theory and 2 lab courses)	16.25	

16.2 1^{st} Year, 2^{nd} Semester

Sl	Course Code	Course Title	Credit	Prerequisite
1	CSE 1201	Structured Programming	3.0	CSE 1103
2	CSE 1202	Structured Programming Lab	1.5	
3	CSE 1203	Digital Logic Design	3.0	
4	CSE 1204	Digital Logic Design Lab	0.75	
5	PHY 1205	Physics	3.0	
6	PHY 1206	Physics Lab	0.75	
7	MATH 1207	Linear Algebra	3.0	
8	EEE 1209	Electronic Devices and Circuits	3.0	
9	EEE 1210	Electronic Devices and Circuits Lab	0.75	
	Total	(5 Theory and 3 lab courses)	18.75	

16.3 2^{nd} Year, 1^{st} Semester

Sl	Course Code	Course Title	Credit	Prerequisite
1	CSE 2101	Data Structures and Algorithms	3.0	CSE 1201
2	CSE 2102	Data Structures and Algorithms Lab	1.5	
3	CSE 2103	Object Oriented Design and Programming	3.0	CSE 1201
4	CSE 2104	Object Oriented Design and Programming Lab	1.5	
5	CSE 2105	Computer Architecture and Microprocessor	3.0	
6	CSE 2106	Microprocessor and Assembly Language Lab	1.5	
7	MATH 2107	Differential Equations, Laplace Transform and Fourier Analysis	3.0	
8	CSE 2109	Data and Telecommunication	3.0	
	Total	(5 Theory and 3 lab courses)	19.5	

16.4 2^{nd} Year, 2^{nd} Semester

Sl	Course Code	Course Title	Credit	Prerequisite
1	CSE 2201	Database Management System	3.0	CSE 2101
2	CSE 2202	Database Management System Lab	1.5	
3	CSE 2203	Design and Analysis of Algorithms	3.0	CSE 2101
4	CSE 2204	Design and Analysis of Algorithms Lab	1.5	
5	CSEA 2205	Microcontroller and Embedded System	3.0	CSE 2105
6	CSE 2206	Microcontroller and Embedded System Lab	1.5	
7	STAT 2207	Probability and Statistics	3.0	
8	CSE 2209	Numerical Methods	3.0	
	Total	(5 Theory and 3 lab courses)	19.5	

16.5 3^{rd} Year, 1^{st} Semester

Sl	Course Code	Course Title	Credit	Prerequisite
1	CSE 3101	Software Engineering	3.0	CSE 2201
2	CSE 3102	Software Design and Development Project	1.5	
3	CSE 3103	Web Engineering and Technology	3.0	
4	CSE 3104	Web Engineering and Technology Lab	1.5	
5	CSE 3105	Algorithm Engineering	3.0	CSE 2203
6	STAT 3107	Random Processes	3.0	
7	CSE 3109	Operating System	3.0	
8	CSE 3110	Operating System Lab	1.5	
	Total	(5 Theory and 3 lab courses)	19.5	

16.6 3^{rd} Year, 2^{nd} Semester

Sl	Course Code	Course Title	Credit	Prerequisite
1	CSE 3201	Computer Network	3.0	CSE 2109
2	CSE 3202	Computer Network Lab	1.5	
3	CSE 3203	Artificial Intelligence	3.0	
4	CSE 3204	Artificial Intelligence Lab	1.5	
5	CSE 3205	Information Security	3.0	
6	CSE 3206	Information Security Lab	1.5	
7	CSE 3207	Theory of Computation	3.0	
8		Elective I[a]	3.0	
9		Elective I Lab	1.5	
	Total	(5 Thoery and 4 lab courses)	21.0	

[a]Two or more courses will be offered based on the availability of human and physical resources. A student chooses one of them within the first two weeks of the semester. The minimum number of registered students to run an undergraduate elective course is 12.

16.7 4^{th} Year, 1^{st} Semester

Sl	Course Code	Course Title	Credit	Prerequisite
1	CSE 4100	Internship [a]	3.0	
2	CSE 4101	Machine Learning	3.0	CSE 3203
3	CSE 4102	Machine Learning Lab	1.5	
4	CSE 4103	Internet of Things	3.0	CSE 3201
5	CSE 4104	Internet of Things Lab	1.5	
6	HUM 4105	Professional Ethics and Environment	2.0	
6	CSE 4110	Project - Part A [b]	2.0	
	Total	(1 internship, 3 Theory and 2 lab courses, and 1 project)	16.0	

[a] Internship is mandatory for all students and they will work in the relevant industry for 3 months as part-time or full-time. Students will start their internship just after completing their third year second semester final examinations. A detailed plan of implementation is available in the course outline.

[b] 2 students will make a group and submit a topic of interest to the committee either on a design/development project or a research project specifying two names of intended supervisors in order of preference. The expected outcomes of part A of the final year design project are a literature study, identifying limitations of the existing systems or application services, objectives of the work, problem statement or list of novel features of the system, research questions and methodology or list of steps and tools to be used for the design and development project, a Gantt chart for the project, and a list of apparatus to be used along with their costs. The supervisors will take the initiative to engage industry partners with the projects, wherever applicable.

16.8 4^{th} Year, 2^{nd} Semester

Sl	Course Code	Course Title	Credit	Prerequisite
1	CSE 4201	Parallel and Distributed Systems	3.0	
2	CSE 4202	Parallel and Distributed Systems Lab	1.5	
3	MIS 4203	IT Project Management	2.0	
4	BUS 4205	ICT Business Entrepreneurship	2.0	
5		Elective II	3.0	
6		Elective II Lab	1.0	
7		Elective III	3.0	
8	CSE 4210	Project - Part B[a]	4.0	
	Total	(5 Theory and 2 lab courses, and 1 project)	19.5	

[a] The expected outcomes of part B of the project are a usable software system or a comprehensive prototype of any application service comprising of hardware, software and network tools, or a publishable research article/conference paper with sufficient investigation, results and propositions. The students need to submit a complete project report, and a software/ prototype/ collected data/simulation or test-bed implementation codes/proof of work in an acceptable form. Finally, they will present and defend their system design, development, and results.

III ♦ Part C

17 Description of Courses

The *Course outlines* of each course of the Bachelor of Science in Computer Science and Engineering degree program are provided in the following subsections.

17.1 Core Courses

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 1101 Discrete Mathematics

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**1st year 1st semester 2024**
Course Code	CSE 1101
Course Title	*Discrete Mathematics*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	None

2 Syllabus

Logic: Propositional Logic, Composite Statements, Logical Connectives, Application of Propositional Logic, Limitation of Propositional Logic, Propositional Equivalences, Predicate Logic, Quantifiers and Nested Quantifiers, Rule of Inference, Introduction of proofs; **Basic Discrete Structure:** Basics of Set, Cardinality, Infinite Set, Power Set, Cartesian Product, Set Operation, Computer Representation of Set; **Function:** Representing a Function, Notation of Set, Injective Function, Surjective Function, Bijection Function, Inverse Function, Composition of Function, Sequences and Summations, Zero-One Matrices, Boolean Product; **Relation:** Binary Relation, Reflexive Relation, Symmetric Relation, Transitive Relation, Closure of a Relation, Composite Relation, Equivalence Relation; **Mathematical Induction:** Proof Technique, Mathematical Induction, Discrete Probability, Uniform Probability Measure, Probability of Complementary Event, Probability of a Union Event. **Counting:** Counting Rules, Inclusion, Pigeonhole principle, Permutation, Combination, Binomial Coefficients and Identifies, Generalized Permutations and Combinations, Caesar Cipher; **Recursion:** Applications of recurrence relations, Inclusion-Exclusion Principles; **Basic Number Theory:** Importance of Number Theory, Divisors, Prime Numbers, Fundamental Theorem of Arithmetic, GCD and Relatively Prime, Least Common Multiple, Mod Function. **Graph:** Terminology, Directed Graph, Undirected Graph, Complete Graph, Bipartite Graph, Subgraph, Representation of Graph in Computer System, Eurler and Hamilton Paths; **Tree:** Rooted Tree, M-ary, Binary Tree, Complete Binary Tree.

3 Text and Reference Materials

T Textbook:

- *Keneth H. Rosen*, **Discrete Mathematics and Its Applications**, 7th edition, AMC, 2020.

R References:

- *Goodaire, E.G., Paramenter, M.M* , **Discrete Mathematics with Graph Theory**, ?? Edition, Prentice hall PTR., 1997.

4 Course Outcomes

After completion of this course, the students are expected to -

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Apply the basic structures, characteristics and operations of logic, sets, functions, relations, graphs, and trees.	PO1	Cognitive (C2)	40%	Please refer to Section 5.
CO2	Analyze problems by applying concepts related to quantifiers, rule of inference, basic number theory, counting discrete objects, and proving the mathematical properties of a variety of discrete structures using principles of induction.	PO2	Cognitive (C4)	50%	
CO3	Translate a real-world computing problem collaboratively into a mathematical model using various concepts of discrete mathematics.	PO3	Cognitive (C4)	10%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	25%	35%		60%
Midterm Exam	10%	10%		20%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation			5%	5%
Class Participation			5%	5%
Total	40%	50%	10%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	Networking and Socialization, sharing course administration and guidelines. • **Logic:** Propositional Logic, Composite Statements, Logical Connectives, Application of Propositional Logic.	T	T
3-4	Limitation of Propositional Logic, Propositional Equivalences, • Predicate Logic, Quantifiers and Nested Quantifiers, • Rule of Inference, Introduction of proofs.	T	T
5-7	**Basic Discrete Structure:** Basics of Set, Set Cardinality • Infinite Set, Power Set, Cartesian Product, Set Operation, Computer Representation of Set.	T	T

8-9	**Function:** Representing a Function, Notation of Set, Injective Function, Surjective Function, Bijection Function • Inverse Function, Composition of Function, Sequences and Summations, Zero-One Matrices, Boolean Product.	T	T
10-11	**Relation:** Binary Relation, Reflexive Relation, Symmetric Relation, Transitive Relation, • Closure of a Relation, Composite Relation, Equivalence Relation;	T	T
12-14	**Mathematical Induction:** Proof Technique, Mathematical Induction, • Discrete Probability, Uniform Probability Measure, Probability of Complementary Event, Probability of a Union Event.	T	T
15-17	**Recursion:** Applications of recurrence relations, Inclusion-Exclusion Principles; • **Counting:** Counting Rules, Inclusion, Pigeonhole principle, • Permutation, Combination, Caesar Cipher.	T	R
18-22	**Basic Number Theory:** Importance of Number Theory, Divisors, Prime Numbers, • Fundamental Theorem of Arithmetic, GCD and Relatively Prime, Least Common Multiple, Mod Function.	T	T
23-27	**Graph:** Terminology, Directed Graph, Undirected Graph, • Complete Graph, Bipartite Graph, Subgraph, Representation of Graph in Computer System. • **Tree:** Rooted Tree, M-ary, Binary Tree, Complete Binary Tree;	T	T
28	Reviews, Practical applications of various techniques • Problem-solving practices, • Assignments/Presentations, etc.	T	R

For the definitions of T and R , Please refer to Section 3.

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Appendix A : Program Outcomes (POs)

POs	Category	Program Outcomes
PO1	Foundational Knowledge	Apply a profound understanding of basic science, mathematics, and core principles of computer, computing, and communications to tackle intricate challenges within the field effectively. Utilize theoretical insights and practical skills to devise innovative solutions.
PO2	Problem Analysis and Modeling	Identify, formulate, and rigorously analyze complex engineering problems in computer science and engineering domains. This involves extensive computing and scientific issues, literature review, and the application of mathematical, statistical, and computational algorithmic techniques to derive substantiated conclusions.
PO3	Design and Development	Design solutions for complex computer science and engineering problems and design systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. (K5)
PO4	Investigations	Conduct investigations of complex problems using research-based knowledge (K8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
PO5	Modern Tool Usage	Apply a cutting-edge array of computing, communication and artificial intelligence techniques to develop innovative software application models, network systems and other AI applications. Understand the use of prediction and modeling techniques for complex engineering activities and their limitations.
PO6	Engineers and Society	Apply reasoning informed by computer science and engineering knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems. (K7)
PO7	Environment and Sustainability	Understand and evaluate the sustainability and impact of professional engineering work in solving complex computer science and engineering problems in societal and environmental contexts. (K7)
PO8	Ethics	Apply ethical principles and commit to professional ethics, responsibilities, and the norms of engineering practice.
PO9	Individual and Teamwork	Function effectively as an individual and as a member or leader of diverse teams and in multidisciplinary settings.
PO10	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project Management and Finance	Demonstrate knowledge and understanding of the computation, software and network systems, and AI principles and apply these to one's own work as a member or a leader of a team to manage projects in multidisciplinary environments.
PO12	Life Long Learning	Recognize the need for and have the preparation and ability to engage in independent, life-long learning for adaptibility in the broadest context of technological change.

Appendix B : Domain and Level of Bloom's Taxonomy

Cognitive Domain		Psychomotor Domain		Affective Domain	
C1	Remembering	P1	Perception	A1	Receive
C2	Understanding	P2	Set	A2	Respond
C3	Applying	P3	Guided Response	A3	Value
C4	Analyzing	P4	Mechanism	A4	Organize
C5	Evaluating	P5	Complex Overt Response	A5	Internalize
C6	Creating/Designing	P6	Adaption		
		P7	Origination		

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Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
CSE 1103 Computational Problem Solving

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**1st year 1st semester 2024**
Course Code	CSE 1103
Course Title	*Computational Problem Solving*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	None

2 Course Rationale

The course "Computational Problem Solving" is designed to equip students with the foundational skills and mindset necessary to thrive in the digital age. In a world driven by technology and innovation, computational problem-solving has become an essential approach applicable across diverse fields. This course aims to cultivate this cognitive skill by teaching students control structures and how to break down complex problems into smaller, manageable components, identify patterns and algorithms, and develop systematic solutions. Through hands-on programming exercises, students will learn the basics of coding, honing their ability to translate abstract concepts into executable instructions. By gaining familiarity with programming languages and techniques, students will not only develop practical skills but also enhance their logical reasoning and creativity. This course serves as a stepping stone for students aspiring to delve into software development, data analysis, and other computational disciplines. Ultimately, by fostering computational problems and programming prowess, this course empowers students to approach challenges methodically, creating a mindset that is indispensable in our technology-driven world.

3 Syllabus

Introduction to Computational Thinking: Scopes, Evolution, and Laws of Modern Computing System. **Data Representation:** Data Types, Encoding, and Compression. **Logic Building:** Logical Thinking, Propositional Logic. **Problem Solving:** Defining a problem, logical reasoning, decomposition and abstraction. **Algorithmic Thinking:** Name binding, Selection, Repetition, Modularization. **Solution Modeling:** Abstraction, Modeling, Data Organization, Dealing with Errors, and Evaluation of a Solution. **Computational Limitations:** Process of capacity measurement in computer, Benchmarking, Practicality and Possibility of Solution.

4 Text and Reference Materials

T Textbook:

– *David D. Riley and Kenny A. Hunt*, **Computational thinking for the modern problem solver** , , CRC Press, .

R References:

– *Karl Beeche*, **COMPUTATIONAL THINKING A beginner's guide to problem solving and programming**, , BCS, .

5 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Explain the evolution and limitations of modern computing systems.	PO1	Cognitive (C2)	40%	Please refer to Section 6.
CO2	Implement logic and other programming facilities to solve various types of logical problems.	PO2	Cognitive (C3)	50%	
CO3	Demonstrate the scopes of a solution with limitations.	PO3	Cognitive (C5)	10%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

6 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	25%	35%		60%
Midterm Exam	10%	10%		20%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation			5%	5%
Class Participation			5%	5%
Total	40%	50%	10%	100%

7 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	**Introduction to Computational Thinking:** Scopes, Evolution, and Laws of Modern Computing System.	T	T
3-5	**Data Representation**: Data Types, Encoding, and Compression.	T	T
6-9	**Logic Building:** Logical Thinking, Propositional Logic.	T	T
10-12	**Problem Solving:** Defining a problem, logical reasoning, decomposition and abstraction.	T	T
13-18	**Algorithmic Thinking:** Name binding, Selection, Repetition, Modularization.	T	T

19-23	**Solution Modeling:** Abstraction, Modeling, Data Organization, Dealing with Errors, and Evaluation of a Solution.	T	T
24-26	**Computational Limitations:** Process of capacity measurement in computer, Benchmarking, Practicality and Possibility of Solution	T	T

For the definitions of T and R , Please refer to Section 4.

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Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
CSE 1104 Computational Problem Solving Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**1st year 1st semester 2024**
Course Code	CSE 1104
Course Title	*Computational Problem Solving Lab*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	None

2 Syllabus

The Computational Problem Solving Lab is designed to provide students with hands-on experience in coding, problem-solving, debugging, and application development using the C programming language. This laboratory-based course aims to complement the theoretical concepts covered in the corresponding theory lectures, enabling students to apply their knowledge in practical, real-world scenarios. By engaging in coding exercises, error handling, projects, and collaborative activities, students will develop fundamental programming skills and gain confidence in their ability to create functional and efficient programs. This course will mainly focus on the outline: Familiarity of the Evolution of Computing System: Basic Hardware and Software Components. Programming Language History and the hands-on implementation of simple programs. Data Representation: Data Types, Encoding, and Compression. Conditional Operations. Arrays. Algorithmic Thinking: Name binding, Selection, Repetition (Loops), Modularization (Basic Function Blocks), I/O Operations.

3 Text and Reference Materials

T Textbook:

- *B. W. Kernighan, & D. M. Ritchie*, **The C programming language**, Second Edition, Prentice Hall, 2006.

R References:

- *Herbert Schildt*, **Teach Yourself C Plus Plus**, Third Edition, Mcgraw-Hill Osborne Media Publications, 1994.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Apply the fundamental knowledge on logic, data types, variables, and various control structures in writing program codes for solving computing problems.	PO1	Cognitive (C2)	25%	Please refer to Section 5.
CO2	Write small-scale multi-functional application programs for solving real-life complex engineering problems in the fields of computer and information systems.	PO2	Cognitive (C3)	30%	
CO3	Defend modular design principles and development solutions of real-life foundational complex engineering problems both in written and oral forms.	PO10	Psychomotor (P5)	45%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Class Participation			10%	10%
Continuous Lab Performance	15%	10%	5%	30%
Lab Reports		5%	5%	10%
Lab Viva-Voce			20%	20%
Capstone Project or Demo/Presentation	10%	15%	5%	30%
Total	25%	30%	45%	100%

6 Lab Activity Outline

Week	Experiment Title	CO	Activities
1	Familiarize students with the Integrated Development Environment, Write and run basic programs in C programming language.	CO1	Coding and Report Writing
2	Solving problems with different data types, variables and constants.	CO1	Coding and Report Writing
3-4	Solving decision-making problems using conditional operators.	CO1	Coding and Report Writing
5-6	Solving problems using repetitive statements.	CO2	Coding and Report Writing
7-8	Solving various problems using decision-making and looping control structures.	CO1	Coding and Report Writing
9-10	Write different types of modular programs and handling diverse data types.	CO3	Coding, debugging, and Report Writing

11-12	Write programs using arrays to solve different problems.	CO2	Coding and Report Writing
13-14	Design, development, demonstration, and defending a small menu-driven capstone project, developed by the students in small groups.	CO3	Coding, debugging, and Report Writing

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University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 1201 Structured Programming

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**1st year 2nd semester 2024**
Course Code	CSE 1201
Course Title	*Structured Programming*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	CSE 1103 - Computational Problem Solving

2 Syllabus

Function: Functions with Return Type and Trivial Parameters, Local and Global Variables, Call by Value Function, Library Functions/Header Files Concept. Passing Arrays in a Function as Parameter, Call by Reference Function, Recursion, Scope Visibility and Lifetime of Variable. **Strings:** Basics, Difference between String and Character Array, I/O, Basic Operations without using Library Functions, Array of Strings. String Library - Basic String Operations, Length, Compare, Concatenate, Substring, Reverse. **Structures:** Basics, Necessity, Declaration, Accessing, Initialization, Array of Structures. **Pointers:** Basics, Uses, Pointer Operation, Call by Reference using Pointers, Pointer for 1D/2D/3D Array, Structure, Pointer Expression, Array of Pointers, Function Returning Pointers. **Dynamic Memory Allocation:** Basics, Uses, Malloc, Free, Calloc, Realloc. **File Operation:** Basics, Uses, File Opening, Closing, File I/O, Use of Redirect Operator to Write in File or Read from File. **Preprocessors and Macros:** Application and Implementation of preprocessors and macros to increase the reusability and simplicity of a program. **Linked List:** Introduction to Linked List, Contrasting with Arrays, Advantages and Disadvantages of Linked List, basic terminologies - nodes, pointers, head, tail, etc., Different types of linked list - Singly Linked List, Doubly Linked List, Circular Linked List, Linked List Operations - Insertion at different positions, Deletion from different positions, Traversing Linked List, Searching in Linked List, Update Operation in Linked List, Linked List reversal, Linked List Algorithms - Cycle Detection, Merging two linked lists, Splitting Linked List, etc. Application of Linked List in different Data Structures - Implementation of Stack, and Queue Data structures. **Sorting Algorithms:** Insertion Sort, Selection Sort, Bubble Sort, Counting Sort, Merge Sort and Quick Sort. **Object Oriented Concepts in Computer Programming:** Application of Object Oriented Ideas.

3 Text and Reference Materials

T Textbook:

- *Herbert Schildt*, **C++: The Complete Reference**, Recent Edition, Wiley Publications.

R References:

- *HARVEY M. DEITEL & PAUL DEITEL*, **C++ How to Program** , Recent Edition, Prentice Hall.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Apply the principles of Fundamental Concepts related to structured programming to solve various problems.	PO1	Cognitive (C3)	40%	Please refer to Section 5.
CO2	Analyze the properties of various Data Structures and underlying concepts, limitations, and bounds to design an algorithm to model various real-life scenarios	PO2	Cognitive (C4)	45%	
CO3	Apply Computational Mathematics and Optimization Techniques to translate various problems to solve them	PO6	Affective (A4)	15%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome* (Appendix: ??)
LoBT: *Level of Bloom's Taxonomy* (Appendix: ??)

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	25%	30%	5%	60%
Midterm Exam	10%	10%		20%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation			5%	5%
Class Participation			5%	5%
Total	40%	45%	15%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1-3	**Function:** Functions with Return Type and Trivial Parameters, Local and Global Variables, Call by Value Function, Library Functions/Header Files Concept. Passing Arrays in a Function as Parameter, Call by Reference Function, Recursion, Scope Visibility and Lifetime of Variable.	T	T
4-6	**Strings:** Basics, Difference between String and Character Array, I/O, Basic Operations without using Library Functions, Array of Strings. String Library - Basic String Operations, Length, Compare, Concatenate, Substring, Reverse.	T	T
7-8	**Structures:** Basics, Necessity, Declaration, Accessing, Initialization, Array of Structures.	T	T

9-12	**Pointers:** Basics, Uses, Pointer Operation, Call by Reference using Pointers, Pointer for 1D/2D/3D Array, Structure, Pointer Expression, Array of Pointers, Function Returning Pointers. **Dynamic Memory Allocation:** Basics, Uses, Malloc, Free, Calloc, Realloc.	T	T
13-14	**File Operation:** Basics, Uses, File Opening, Closing, File I/O, Use of Redirect Operator to Write in File or Read from File.	T	T
15	**Preprocessors and Macros:** Application and Implementation of preprocessors and macros to increase the reusability and simplicity of a program.	T	T
16-20	**Linked List:** Introduction to Linked List, Contrasting with Arrays, Advantages and Disadvantages of Linked List, basic terminologies - nodes, pointers, head, tail, etc., Different types of linked list - Singly Linked List, Doubly Linked List, Circular Linked List, Linked List Operations - Insertion at different positions, Deletion from different positions, Traversing Linked List, Searching in Linked List, Update Operation in Linked List, Linked List reversal, Linked List Algorithms - Cycle Detection, Merging two linked lists, Splitting Linked List, etc. Application of Linked List in different Data Structures - Implementation of Stack, and Queue Data structures.	T	T
21-23	**Sorting Algorithms:** Insertion Sort, Selection Sort, Bubble Sort, Counting Sort, Merge Sort and Quick Sort.	T	T
24-28	**Object Oriented Concepts in Computer Programming:** Application of Object Oriented Ideas.	T	T

For the definitions of **T** and **R** , Please refer to Section 3.

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April 24, 2024

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April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
CSE 1202 Structured Programming Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**1st year 2nd semester 2024**
Course Code	CSE 1202
Course Title	*Structured Programming Lab*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	CSE 1104 - Computational Problem Solving Lab

2 Syllabus

The Structured Programming Lab will focus on increasing the skill and knowledge of students over a structured programming language, preferably C. It will offer students practical exposure to coding, problem-solving, debugging, and application development using the C programming language. This hands-on lab course is designed to reinforce the theoretical principles taught in related lectures (CSE-1201: Structured Programming), empowering students to employ their understanding in practical contexts. Through coding tasks, error resolution, projects, and teamwork, students will cultivate core programming competencies and enhance their confidence in crafting effective and optimized programs.

3 Text and Reference Materials

T Textbook:

- *Herbert Schildt*, **C++: The Complete Reference**, Recent Edition, Wiley Publications.

R References:

- *HARVEY M. DEITEL & PAUL DEITEL*, **C++ How to Program** , Recent Edition, Prentice Hall.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Apply the principles of Fundamental Concepts related to structured programming to solve various problems.	PO1	Cognitive (C3)	30%	

CO2	Analyze the properties of various Data Structures and underlying concepts, limitations, and bounds to design an algorithm to model various real-life scenarios	PO2	Cognitive (C4)	50%	Please refer to Section 5.
CO3	Apply Computational Mathematics and Optimization Techniques to translate various problems to solve them	PO6	Affective (A4)	20%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome* (Appendix: ??)
LoBT: *Level of Bloom's Taxonomy* (Appendix: ??)

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Class Participation			10%	10%
Continuous Lab Performance	15%	10%	5%	30%
Lab Reports	5%	5%		10%
Lab Viva-Voce		20%		20%
Capstone Project or Demo/Presentation	10%	15%	5%	30%
Total	30%	50%	20%	100%

6 Topic Outline

Week	Experiment Title	CO	Activities
1	Solving coding problems: Related to the concept of Function, Loop, and Arrays	CO1	Coding and Report Writing
2	Solving coding problems: Related to the concept of Function, Recursion, Nested Loops, and Arrays	CO1	Coding and Report Writing
3	Solving coding problems: Related to the concept of String Manipulation	CO1	Coding and Report Writing
4-5	Solving coding problems: Related to the concept of Custom Data Type, Structure	CO1	Coding and Report Writing
6	Solving coding problems: Related to the concept of Pointers and Dynamic Memory Allocation	CO1	Coding and Report Writing
7	Solving coding problems: Related to the concept of File related I/O in C	CO1	Coding and Report Writing
8-9	Solving coding problems: Related to the concept of Linked List and associated algorithms	CO1	Coding and Report Writing
10	Solving coding problems: Related to the Stack and Queue with customized implementation	CO1	Coding and Report Writing

11	Solving coding problems: Related to the Sorting	CO1	Coding and Report Writing
12	Solving coding problems: Related to the concept of Number Theory	CO1	Coding and Report Writing
13-14	Design, development, demonstration, and defending a small menu-driven capstone project, developed by the students in small groups	CO2, CO3	Coding, Debugging, Demonstration and Report Writing

For the definitions of **T** and **R** , Please refer to Section 3.

Course Teacher, CSE 1202
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 1203 Digital Logic Design

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**1st year 2nd semester 2024**
Course Code	CSE 1203
Course Title	*Digital Logic Design*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	None

2 Syllabus

Introduction: Analog System, Digital System, differences between Analog and digital systems.;**Number Systems:**: Decimal, Binary, Octal and Hexadecimal, BCD, ASCII, and ERCDIC Codes.; **Combinational Logic Circuits:** Data Representation, Logic Gates and Boolean Algebra, Theorems, Combinational Circuits Design using NAND of NOR Gates only. Algebraic Simplification, Karnaugh Map.; Introduction to Decision Diagram, Minimization of Switching Functions. **Arithmetic Circuits:** Half-Adder Full Adder, Parallel Adders.; **Sequential Logic Circuits:** NAND and NOR Latches. Clocked SR. JK, D and T Flip-Flops. FF Timing Consideration, Master-Slave FF. **Complex Sequential logic Circuits:** Asynchronous Ripple Up and Down Counters, Counters with any MOD Numbers, Asynchronous IC Counters, Propagation Delay. ParaIIeI Up/Down Counters, 74193 Counter. Decoding a Counter. Cascading Counters. Shift Registers. **MSI Logic Circuits:** BCD - to - Decimal Decoders, BCD - to 7 Segment Decoder/Drivers. Encoders. Multiplexer and Demultiplexer. **. Integrated Circuits Logic Families:** TTL Logic Family Standard, TTL Series Characteristics, Digital MOSFET Circuits. **Memory Devices:** Semiconductor Memory Technologies ROM Architecture Timing and Type of ROM, EPROM, EEPROM, ROM Applications. RAM Architecture Static and Dynamic RAM, DRAM Structure Operation and Refreshing. Introduction to Verilog.

3 Text and Reference Materials

T Textbook:

- *Ronald J. Tocci Neal J. Widmer*, **Digital Systems Principals and Applications**, Eleventh Edition, Pearson, 2010.

R References:

- *Charles H. Roth Larry L. Kinney*, **Fundamentals of Logic Design**, Seventh Edition, Cengage Learning, 2013.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Describe number system and methods of conversion between different types of number systems. Identify the importance of established forms in the minimization or other optimization of Boolean formulas in combinational logic circuits. Analyze the design procedures of Arithmetic circuits.	PO1	Cognitive (C3)	40%	Please refer to Section 5.
CO2	Minimize functions using any type of minimizing algorithms (Boolean algebra, Karnaugh map or Tabulation method). Analyze the design procedures of Combinational and Sequential circuits. Describe the basic concepts of sequential logic circuits like flip-flops. Introduces complex sequential logic circuits like counters, registers etc.	PO2	Cognitive (C4)	50%	
CO3	Basic concepts of Integrated Circuits Logic Families. Analyze the design procedures of Memory Devices. Introduce decision diagrams and Verilog.	PO6	Affective (A4)	10%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome* (Appendix: ??)
LoBT: *Level of Bloom's Taxonomy* (Appendix: ??)

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	20%	40%		60%
Midterm Exam	10%	10%		20%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation			5%	5%
Class Participation			5%	5%
Total	35%	55%	10%	100%

Lecture	Selected Topic	Article	Problems
1-2	Networking and Socialization, sharing course administration and guidelines • Define Analog System, Digital System and their applications. Analog vs. digital.;	T	T
3-4	Introduction to different types of number systems: Binary, Octal, and Hexadecimal, BCD, ASCH, and ERCDIC Codes. Methods of conversion between different types of number systems.	T	T

5-7	Introduction to Combinatorial Logic circuits. Data Representation Logic Gates and Boolean Algebra, Theorems, Combinational Circuits Design using NAND of NOR Gates only. Algebraic Simplification, Karnaugh Map.	T	T
8-12	Arithmetic circuits: Half-Adder Full Adder, Parallel Adders.	T	T
13-14	Sequential Logic: NAND and NOR Latches. Clocked SR. JK, D and T Flip-Flops. FF Timing Consideration. Master- Slave FF.	T	T
15-17	Introduction to Complex sequential logic circuits. Asynchronous Ripple Up and Down Counters, Counters with Any MOD Numbers, Asynchronous IC Counters, Propagation Delay. ParaIIeI Up Down and Up/Down Counters, 74193 Counter. Decoding a Counter. Cascading Counters. Shift Registers.	T	T
18-21	MSI Logic Circuits: BCD - to - Decimal Decoders, BCD - to 7 Segment Decoder/Drivers. Encoders. Multiplexer and Demultiplexer.	T	R
22-24	Integrated Circuits Logic Families: TTL Logic Family Standard TTL Series Characteristics, Digital MOSFET Circuits.	T	T
25-26	Memory Devices: Semiconductor Memory Technologies ROM Architecture Timing and Type of ROM, EPROM, EEPROM, ROM Applications. RAM Architecture Static and Dynamic RAM, DRAM Structure Operation and Refreshing. Introduction to Sequential Circuits, formal Representation of Sequential Circuits. Decision Diagram.	T	T
27-28	Introduction to Decision Diagram, Minimization of Switching Functions. Introduction to Verilog.. Reviews, Future of IoT and its Challenges • Problem-solving practices, • Assignments/Presentations, etc.	T	R

For the definitions of T and R , Please refer to Section 3.

Course Teacher, CSE 1203
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
CSE 1204 Digital Logic Design Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**1st year 2nd semester 2024**
Course Code	CSE 1204
Course Title	*Digital Logic Design Lab*
Course Credit	0.75 units
Contact Hours Per Week	3 hours in alternate weeks
Course Status	Core Course
Prerequisite Course	None

2 Syllabus

Laboratory works based on CSE 1203 Digital Logic Design course - Verification of Basic Logic Gates, Implementing all individual gates with universal gates NAND & NOR, Design a circuit for the given canonical form, drawing the circuit diagram and verifying the De-Morgan laws, Design of a combinational logic circuit for 4X1 MUX and verify the truth table, Design a combinational logic circuit for 1X4 DeMUX and verify the truth table, Construct Half Adder and Full Adder using Half Adder and verify the truth table, Implementation of Encoder, Decoder, Priority Encoder and verify the truth table, Verification of truth tables of the basic Flip -Flops with synchronous and asynchronous modes, Implementation of Master-Slave Flip-Flop with J-K Flip-Flop and verify the truth table for Race Around condition, Design a Decade Counter and verify the truth table, Design the Mod 6 counter using D Flip-Flop.

3 Text and Reference Materials

T Textbook:

- *Ronald J. Tocci Neal J. Widmer*, **Digital Systems Principals and Applications**, Eleventh Edition, Pearson, 2010.

R References:

- *Charles H. Roth Larry L. Kinney*, **Fundamentals of Logic Design**, Seventh Edition, Cengage Learning, 2013.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Design and implement various basic combinatorial and sequential logic circuits, for example- implementing basic logic gates, multiplexers, demultiplexers, adders, encoders, decoders, counters and flip-flops.	PO3	Cognitive (C5)	50%	Please refer to Section 5.
CO2	Demonstrate appropriate digital logic design techniques and tools to convert descriptions of logical problems to efficient digital logic circuits.	PO5	Psychomotor (P4)	30%	
CO3	Design simple digital logic projects as a team member to solve real-life problems.	PO9	Psychomotor (P7)	20%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Class Participation	5%		5%	10%
Continuous Lab Performance	25%	10%	5%	40%
Lab Reports	5%	5%		10%
Capstone Project Presentation and Viva-voce	15%	15%	10%	40%
Total	50%	30%	20%	100%

6 Lab Activity Outline

Week	Experiment Title	CO	Activities
1	Laboratory works based on CSE 1203 Digital Logic Design course - Verification of Basic Logic Gates, Implementing all individual gates with universal gates NAND & NOR;	CO1	Experimentation and Report Writing
2	Design a circuit for the given canonical form and verifying the De-Morgan laws, Design of a combinational logic circuit for 4X1 MUX or 1X4 DeMUX.	CO1	Experimentation and Report Writing
3	Construct Half Adder and Full Adder, Encoder, Decoder, Priority Encoder and verify the truth table.	CO1	Experimentation and Report Writing
4	Verification of truth tables of the basic Flip -Flops with synchronous and asynchronous modes, Implementation of Master-Slave Flip-Flop with J-K Flip-Flop.	CO1	Experimentation and Report Writing
5	Design a Decade Counter and verify the truth table, Design the Mod 6 counter using D Flip-Flop.	CO2	Experimentation and Report Writing
6	Project design, experimentation, and testing.	CO2	Experimentation and Report Writing

7	Project demonstration and viva-voce.	CO3	Demonstration and viva-voce

Course Teacher, CSE 1204
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
CSE 2101 Data Structures and Algorithms

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**2nd year 1st semester 2024**
Course Code	CSE 2101
Course Title	*Data Structures and Algorithms*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	None

2 Syllabus

Complexity Analysis: Complexity Analysis, beyond experimental analysis, comparing growth rates, Best, Average, and Worst-case Analysis. **Searching:** Linear search, binary Search, application of Binary Search-finding elements in a sorted array, finding the n^{th} root of a real number, solving equations. **Recursion:** Basic idea of recursion (3 laws-base case, call itself, move towards the base case by state change), Tracing output of a recursive function, Applications- merge sort, permutation, combination, Memoization. **Sorting:** Insertion sort, selection sort, bubble sort, merge sort, quick sort (randomized quick sort), Distribution sort (counting sort, radix sort, bucket sort) lower bounds for sorting, external sort. **Linked List:** Singly/doubly/circular linked lists, Basic operations on linked list (insertion, deletion, and traverse), Dynamic array and its application. **Stack:** stack operations (push/pop/peek), Stack-class implementation using Array and linked list, in-fix to postfix expressions conversion and evaluation, Balancing parentheses using stack. **Queue:** Basic queue operations (Enqueue, dequeue), circular queue/ dequeue, Queue-class implementation using array and linked list, Application- Josephus problem, palindrome checker using stack and queue. **Binary Tree:** Binary tree representation using array and Pointer, Traversal of Binary Tree (in-order, pre-order and post-order). **Binary Search Tree:** BST representation, Basic operations on BST (creation, insertion, deletion, querying and traversing), Application- searching, sets. **Self-balancing Binary Search Tree:** AVL tree, Red Black Tree. **Heap:** Min-heap, max-heap, Binomial Heap, Fibonacci-heap, Applications-priority queue, Heap sort. **Disjoint Set:** MakeSet, Union, find Set, Path compression optimization techniques. **Huffman Coding:** method and application in lossless data compression.

3 Text and Reference Materials

T Textbook:

- *Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C.*, **Introduction to Algorithms**, 4th Edition, MIT Press, 2022.

4 Course Outcomes

CO	CO Description	PO	Domain	Weight	Assessment Methods
CO1	Understand and apply the principles of complexity analysis including best, average, and worst-case scenarios and different growth rates in terms of time complexity, space complexity, and big-O notation to compare different data structures and algorithms and make informed decisions based on their performance characteristics.	PO1	Cognitive (C3)	25%	Please refer to Section 5
CO2	Implement and analyze fundamental data structures such as arrays, linked lists, stacks, and queues, including their applications, operations, advantages, and limitations.	PO3	Cognitive (C3)	23%	
CO3	Develop efficient algorithms using sorting and searching techniques, understand recursion, and apply them to solve real-life problems .	PO4	Cognitive (C4)	25%	
CO4	Master advanced data structures such as binary trees, binary search trees, AVL trees, red-black trees, heaps, and disjoint sets, choose the right data structure, and apply them to relevant problems.	PO12	Cognitive (C5)	27%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	CO4	Total
Final Exam	15%	15%	15%	15%	60%
Midterm Exam	5%	5%	5%	5%	20%
Class Test/Quiz	5%	3%	2%	0%	10%
Assignment/Presentation	0%	0%	0%	5%	5%
Class Participation	0%	0%	3%	2%	5%
Total	25%	23%	25%	27%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	**Complexity Analysis**: Complexity Analysis, Beyond experimental analysis, comparing growth rates, Best, Average, and Worst case Analysis	T	T

3-4	**Searching**: Linear search, binary Search, application of Binary Search- finding elements in a sorted array, finding nth root of a real number, solving equations	T	T
5-6	**Recursion**: Basic idea of recursion (3 laws-base case, call itself, move towards base case by state change), Tracing output of a recursive function, Applications- merge sort, permutation, combination, Memoization	T	T
7-9	**Sorting**: Insertion sort, selection sort, bubble sort, merge sort, quick sort (randomized quick sort), Distribution sort (counting sort, radix sort, bucket sort), lower bounds for sorting, external sort	T	T
10-12	**Linked List**: Singly/doubly/circular linked lists, Basic operations on linked list (insertion, deletion, and traverse), Dynamic array and its application	T	T
13-14	**Stack**: Stack operations (push/pop/peek), Stack-class implementation using Array and linked list, in-fix to postfix expressions conversion and evaluation, Balancing parentheses using stack	T	T
15-16	**Queue**: Basic queue operations (Enqueue, dequeue), circular queue/ dequeue, Queue-class implementation using array and linked list, Application- Josephus problem, palindrome checker using stack and queue	T	T
17	**Binary Tree**: Binary tree representation using array and Pointer, Traversal of Binary Tree (in-order, pre-order and post-order)	T	T
18-19	**Binary Search Tree (BST)**: BST representation, Basic operations on BST (creation, insertion, deletion, querying and traversing), Application- searching, sets	T	T
20-21	**Self-balancing Binary Search Tree**: AVL tree, Red Black Tree	T	T
22-24	**Heap**: Min-heap, max-heap, Binomial Heap, Fibonacci-heap, Applications-priority queue, Heap sort	T	T
25-26	**Disjoint Set**: MakeSet, Union, find Set, Path compression optimization techniques	T	T
27	**Huffman Coding**: Method and application in lossless data compression	T	T

For the definitions of T and R , Please refer to Section 3.

Course Teacher, CSE 3207
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
CSE 2102 Data Structures and Algorithms Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**2nd year 1st semester 2024**
Course Code	CSE 2102
Course Title	*Data Structures and Algorithms Lab*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	Check the prerequisite for the related theory course

2 Syllabus

This laboratory course complements the theoretical knowledge gained in the Data Structures and Algorithms course by providing hands-on experience in practical implementation and applications of data structures and algorithms to real-life problems. Students will analyze real-world problems, and then pick and utilize the correct data structures and algorithms to solve them. The lab projects are designed to be innovative, and practical, preparing students for future technological challenges in the industry.

3 Text and Reference Materials

T Textbook:

- *Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C.,* **Introduction to Algorithms**, 4th Edition, MIT Press, 2022.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Implement and apply fundamental data structures such as arrays, linked lists, stacks, and queues to solve complex computational problems.	PO1	Cognitive (C2)	25%	Please refer to Section 5.
CO2	Develop efficient algorithms using sorting and searching techniques, understand recursion, and apply them to solve real-life problems	PO2	Cognitive (C3)	30%	
CO3	Master advanced data structures such as binary trees, binary search trees, AVL trees, red-black trees, heaps, and disjoint sets, choose the right data structure through critical analysis, and apply them to relevant problems.	PO10	Psychomotor (P5)	45%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Class Participation			10%	10%
Continuous Lab Performance	15%	10%	5%	30%
Lab Reports		5%	5%	10%
Lab Viva-Voce			20%	20%
Capstone Project or Demo/Presentation	10%	15%	5%	30%
Total	25%	30%	45%	100%

6 Lab Activity Outline

Week	Experiment Title	CO	Activities
1	Introduction to Complexity Analysis: Understanding complexity analysis beyond experimental analysis, Comparing growth rates: Best, Average, and Worst-case analysis.	CO1	Coding and Report Writing
2	Implementing linear search and binary search algorithms, Application of Binary Search: Finding elements in a sorted array, Finding the nth root of a real number using binary search, Solving equations using binary search	CO1	Coding and Report Writing
3	Understanding the basic idea of recursion and its three laws, Tracing output of a recursive function Implementing recursion in merge sort, permutation, combination, and memorization.	CO1	Coding and Report Writing

4	Implementing Insertion sort, selection sort, bubble sort, merge sort, and quick sort, Introduction to distribution sort algorithms: Counting sort, radix sort, and bucket sort, Lower bounds for sorting and understanding external sort techniques.	CO2	Coding and Report Writing
5	Implementing singly/doubly/circular linked lists, Performing basic operations on linked lists: Insertion, deletion, and traversal, Understanding dynamic array and its application.	CO2	Coding and Report Writing
6	Implementing stack operations using arrays and linked lists, In-fix to postfix expressions conversion and evaluation using stacks, and Balancing parentheses using the stack data structure.	CO2	Coding and Report Writing
7	Implementing basic queue operations: Enqueue, dequeue, Implementing circular queue/dequeue, Application of queues: Solving Josephus problem, palindrome checker using stack and queue.	CO1	Coding and Report Writing
8	Representing binary trees using arrays and pointers, Traversal of Binary Tree: in-order, pre-order, and post-order traversal.	CO3	Coding, and Report Writing
9	Implementing Binary Search Tree operations: Creation, insertion, deletion, querying, and traversing, Application of BST: Searching, sets.	CO3	Coding, and Report Writing
10	Understanding AVL trees and Red-Black trees, Implementing operations on self-balancing BSTs.	CO2	Coding and Report Writing
11	Implementing Min-heap and max-heap data structures, Introduction to Binomial Heap and Fibonacci Heap, Application of heaps: Priority queue and Heap sort.	CO2	Coding and Report Writing
12	Implementing Disjoint Set data structure operations: MakeSet, Union, FindSet, Optimizing Disjoint Set operations using path compression techniques.	CO3	Coding, and Report Writing
13	Understanding Huffman Coding method, Application of Huffman Coding in lossless data compression.	CO3	Coding, and Report Writing
14	Reviewing concepts covered throughout the course, Integrating different data structures and algorithms to solve complex problems.	CO3	Coding, and Report Writing

Mr. Md. Tanvir Alam
Course Teacher, CSE 2102
April 24, 2024

Prof. Dr. Md. Abdur Razzaque
Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
CSE 2103 Object Oriented Design and Programming

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**2nd year 1st semester 2024**
Course Code	CSE 2103
Course Title	*Object Oriented Design and Programming*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	CSE 1201 - Structured Programming

2 Syllabus

Introduction: Object Orient Programming (OOP). Object-oriented concepts: modeling problems using object-oriented concepts, namespace, inheritance, encapsulation, polymorphism, Object-oriented design methodologies, and OOP memory models. Object-oriented design patterns in OOP and class diagrams. Use case, activity, and interaction diagram. **Creational design patterns:** UML class diagram and creation of an object in OOP using a singleton, factory, abstract factory, builder, and prototype design pattern. **Structural Design Pattern:** UML class diagram and object composition or extend in OOP using an adapter, flyweight, composite, proxy, facade (or interface), bridge, and decorator. **Behavioral Design Pattern:** UML class diagram and change the behavior or access scope in OOP-object using template, chain, mediator, observer, strategy, command, interpreter, visitor, memento, and state design pattern. **Exception handling:** exception types, chained exceptions using chain design pattern. **OOP I/O:** Stream and files using decorator and factory design pattern. Java GUI event, Event Container, and Components.

3 Text and Reference Materials

T Textbook:

- *Olaf Musch*, **Design Patterns with Java: An Introduction**, Springer Vieweg Wiesbaden, First Edition, 2023
- *Eric Freeman (Author)*, *Elisabeth Robson*, **Head First Design Patterns: Building Extensible and Maintainable Object-Oriented Software**, O'Reilly Media, 2nd Edition, Jan 2021
- *Herbert Schildt*, **Java: The Complete Reference**, 10th Ed..

R References:

- *Erich Gamma*, *Richard Helm*, *Ralph Johnson*, *John Vlissides*, **Design Patterns: Elements of Reusable Object-Oriented Software**, Addison-Wesley Professiona, 1st Edition, October 1994
- *Robert Sebesta*, **Concepts of Programming Language** 11th Ed.
- *Deitel & Deitel* **Java: How to Program** 11th Ed.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Understand the evolution of programming, the rationale behind OOP, basic concepts of OOP such as objects and classes, class diagram, java class design using design pattern	PO1	Cognitive (C3)	40%	Please refer to Section 5.
CO2	Analysis of design methodologies, UML, interaction class diagram using design pattern in Java developing enterprise application.	PO2	Cognitive (C4)	50%	
CO3	Understand and apply design patterns in OOP to solve real-life complex problems, demonstrate OOP design skills.	PO6	Affective (A4)	10%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	25%	35%		60%
Midterm Exam	10%	10%		20%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation			5%	5%
Class Participation			5%	5%
Total	40%	50%	10%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	Introduction to Object Oriented Programming • Object-oriented concepts, modeling problems using object-oriented concepts	T	T
3-6	Object-oriented programming: • namespace, • inheritance, • encapsulation, • polymorphism, • Object-oriented design • methodologies, • OOP memory models	T	T
7-9	Object-oriented design patterns: • OOP and class diagrams. • Use case, activity, and interaction diagram	T	T
10-13	Creational design patterns: • UML class diagram, class definition, and creation of an object in OOP using a singleton, factory, abstract factory, builder, and prototype design pattern.	T	R
14-17	Structural Design Pattern: • UML class diagram, class definition, and object composition or extend in OOP using an adapter, flyweight, composite, proxy, facade (or interface), bridge, and decorator.	T	R

17-19	Behavioral Design Pattern:• UML class diagram, class structure and change the behavior or access scope in OOP-object using template, chain, mediator, observer, strategy, command, interpreter, visitor, memento, and state design pattern	T	R
20-22	Exception handling:• exception types, chained exceptions using chain design pattern.	T	T
23-24	Exception handling: motivation, basic constructs, exception class hierarchy, exception types, multiple catch clauses, creating own exceptions.	T	T
25-26	Java I/O: Stream and files using decorator and factory design pattern.	T	T
27-28	GUI Containers and Components: • GUI packages/library, GUI Event component classes, GUI Accumulator, and design pattern.	T	T

For the definitions of T and R , Please refer to Section 3.

Course Teacher, CSE2103
April 24, 2024

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April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 2104
Object Oriented Design and Programming Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**2nd year 1st semester 2024**
Course Code	CSE 2104
Course Title	*Object Oriented Design and Programming Lab*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	None

2 Syllabus

Laboratory works based on CSE 2103 Objected Oriented Design and Programming course - Introduction: evolution of programming languages, from procedural programming to Object Orient Programming (OOP). Object oriented concepts: modeling problems using object oriented concepts. OOP overview: encapsulation, inheritance and polymorphism. Objects and classes: attributes, functions or methods, constructors and destructors, overloading and overriding methods, access control, special considerations in different languages. Inheritance: inheriting classes: subclass and superclass, inheritance hierarchy, overloading, overriding, dynamic binding, abstract class, inner classes, multiple inheritance, interface. Packages or namespaces. Exception handling: exception types, chained exception, creating own exception subclasses. I/O: Stream and files. Multithreading. Generics and templates. Introduction to UML diagram. Common object-oriented design principles and design patterns with case studies. Introduction to event handling in GUI environment.

3 Text and Reference Materials

T Textbook:

- *Herbert Schildt*, **Java: The Complete Reference**, 10th Ed..

R References:

- *Deitel & Deitel* **Java: How to Program** 11th Ed.
- *Cay Horstmann* **Object Oriented Design and Patterns** 2nd Ed. Wiley 2005

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Understand evolution of programming, rationale behind OOP, basic concepts of OOP such as objects and classes.	PO3	Cognitive (C5)	50%	Please refer to Section 5.
CO2	Interpret and apply core OOP concepts, namely encapsulation, inheritance, and polymorphism.	PO5	Psychomotor (P4)	30%	
CO3	Understand and apply advanced OOP features like multithreading, exception handling, generics, I/O, and namespace, use object oriented design principles and design patterns to solve real life complex problems, demonstrate OOP skills and write report on OOP concepts.	PO9	Psychomotor (P7)	20%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Class Participation	5%		5%	10%
Continuous Lab Performance	25%	10%	5%	40%
Lab Reports	5%	5%		10%
Capstone Project Presentation and Viva-voce	15%	15%	10%	40%
Total	50%	30%	20%	100%

6 Lab Activity Outline

Week	Experiment Title	CO	Activities
1	Getting familiar with an IDE and command line, and the very basics of Java. Translating some problems from C to Java.		
2	Class. Constructors. Static block and methods. Passing objects to and returning objects from methods. Built-in methods of Object and String class.	CO1	Experimentation and Report Writing
3	finalize method, array of objects, static keyword (block, variable, method), nested class.	CO1	Experimentation and Report Writing
4	File I/O. Inheritance.	CO2	Experimentation and Report Writing
5	Interface.	CO2	Experimentation and Report Writing
6	Exception handling.	CO2	Experimentation and Report Writing

7	Multithreading.	CO2	Experimentation and Report Writing
8	Java's Collection framework.	CO2	Experimentation and Report Writing
9	OOP design principles.	CO2	Experimentation and Report Writing
10	Project progress evaluation.	CO3	Demonstration
11	Project progress evaluation.	CO3	Demonstration
12	Project demonstration and viva-voce.	CO3	Demonstration and viva-voce

Course Teacher, CSE 2104
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 2105
Computer Architecture and Microprocessor

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**2nd year 1st semester 2024**
Course Code	CSE 2105
Course Title	*Computer Architecture and Microprocessor*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	None

2 Syllabus

Introduction: Classes of Computers, classes of Processor, trending in technology, the evolution of microprocessors, scalar, superscalar, defining computer architecture, features of ARM Architecture- ARMv7; **Instruction Set Architecture (ISA):** ARM Cortex M4 - features, operating states, operation modes, architecture, bus matrix, register sets, instruction sets, addressing modes; **Cortex M4 Memory System:** memory map, endianness, alignment, bit-band, connecting processor- AMBA; **Arithmetic operations:** Multiplication- sequential version, Booth's algorithm, array implementation for Booth Multiplier, Division- restoring and non-restoring division; **Cortex M4 Exceptions and Interrupts:** interrupt management, priority, vector table, ISR, NVIC, SCB, PRIMASK, FAULTMASK, BASEPRI, exception handler, interrupt latency and exception handling optimization- tail chaining, Fault handling- MemManage fault, Bus fault, Usage fault, HardFault, fault status registers, faults related exception handling - stacking, unstacking, vector fetches, invalid return; memory protection unit; **Floating point:** IEEE 754, single precision, half-precision, double -precision floating point numbers, arithmetic operation- addition, subtraction, multiplication, division, Cortex M4 FPU - registers, lazy stack; **Arithmetic Logic Unit (ALU):** Spatial and temporal expansion, 1 bit-ALU, 32-bit ALU for Cortex M4; **Pipelining:** Cortex M4 pipelining, hazard - data, control, branch hazard, handling hazards in single cycle, Pipelined single-cycle processor's datapath design, control signal propagation in pipelined processor, pipelined dependency, pipelined datapath with hazard handling circuits ; **Cortex M4 Instruction Set and Assembler Directives:** Instruction set of Cortex M4, Machine language instruction formats, Assembler directives and operators; Programming with ARM Assembly Language: Instruction to machine code conversion, C to Assembly code conversion and vice-verse. **Systolic Array: matrix multiplication**.

3 Text and Reference Materials

T Textbook:

- *David A. Patterson, John L. Hennessy*, **Computer Organization and Design ARM Edition: The Hardware Software Interface**, First Edition, Morgan Kaufmann, 2016.

- *Joseph Yiu*, **The definitive guide to the ARM Cortex-M3 and Cortex-M4 Processors**, Third Edition, Newnes, 2013.

R References:

- *Robert Plantz*, **Introduction to Computer Organization: ARM** , First Edition, No Starch Press, 2024.
- *David A. Patterson, John L. Hennessy*, **Computer Organization and Design RISC-V Edition: The Hardware Software Interface**, First Edition, Morgan Kaufmann, 2017.
- *Daniel Kusswurm* , **Modern Arm Assembly Language Programming: Covers Armv8-A 32-bit, 64-bit, and SIMD**, First Edition, 2020.
- *Larry D Pyeatt*, **Modern Assembly Language Programming with the ARM**, First Edition, Newnes, 2016.
- **STM32F446xx advanced Arm ® -based 32-bit MCUs**.
- **Data Sheet : STM32F446xC/E**.
- **Cortex-M4 Devices Generic User Guide**
- **Cortex-M4 Technical Reference Manual**
- **ARM 7 Technical Reference Manual**

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Demonstrate a comprehensive understanding of microprocessor architecture, including its components, instruction set, addressing modes, and operation principles.	PO1	Cognitive (C3)	40%	Please refer to Section ??.
CO2	Analyze the performance and behavior of microprocessor-based systems, including understanding concepts such as pipelining, caching, and memory hierarchy.	PO2	Cognitive (C4)	30%	
CO3	Apply the knowledge to effectively program microprocessors using assembly language, including writing, debugging, and optimizing code for various applications.	PO5	Affective (A4)	30%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	Networking and Socialization, sharing course administration and guidelines • Classes of Computers, classes of Processor, trending in technology, the evolution of microprocessors, scalar, superscalar, defining computer architecture, features of ARM Architecture- ARMv7;;	T	T

3-5	Instruction Set Architecture (ISA) • ARM Cortex M4 - features, operating states, operation modes, architecture, bus matrix, register sets, instruction sets, addressing modes;	T	T
6	Cortex M4 Memory System • memory map, endianness, alignment, bit-band, connecting processor- AMBA;	T	T
7-8	Arithmetic operations • Multiplication- sequential version, Booth's algorithm, array implementation for Booth Multiplier, Division- restoring and non-restoring division;	T	T
9-12	Cortex M4 Exceptions and Interrupts • interrupt management, priority, vector table, ISR, NVIC, SCB, PRIMASK, FAULTMASK, BASEPRI, exception handler, interrupt latency and exception handling optimization- tail chaining, Fault handling- MemManage fault, Bus fault, Usage fault, HardFault, fault status registers, faults related exception handling - stacking, unstacking, vector fetches, invalid return; memory protection unit	T	T
13-14	Floating point • IEEE 754, single precision, half-precision, double -precision floating point numbers, arithmetic operation- addition, subtraction, multiplication, division, Cortex M4 FPU - registers, lazy stack	T	T
15	Arithmetic Logic Unit (ALU) • Spatial and temporal expansion, 1 bit-ALU, 32-bit ALU for Cortex M4;	T	T
16-19	Pipelining • Cortex M4 pipelining, hazard - data, control, branch hazard, handling hazards in a single cycle, Pipelined single-cycle processor's datapath design, control signal propagation in pipelined processor, pipelined dependency, pipelined datapath with hazard handling circuits ;	T	T
20-23	Cortex M4 Instruction Set and Assembler Directives • The instruction set of Cortex M4, Machine language instruction formats, Assembler directives, and operators;	T	T
24-26	Programming with ARM Assembly Language • Instruction to machine code conversion, C to Assembly code conversion, and vice-versa;	T	R
27	Systolic Array: matrix multiplication;	T	T
28	Reviews;	T	R

For the definitions of T and R , Please refer to Section 3.

Course Teacher, CSE 2105
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 2106
Microprocessor and Assembly Language Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**2nd year 1st semester 2024**
Course Code	CSE 2106
Course Title	*Microprocessor and Assembly Language Lab*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	None

2 Syllabus

The lab course aims to provide hands-on knowledge of Assembly language programming for ARM architecture using an ARM instruction set. Learn good practices in structuring a microprocessor control program. Apply the programming principles, including top-down programming, bottom-up programming, and functional programming to define an accurate programming problem statement. Recognize that good problem definition assists the program design process. Describe differences between the various approaches to solving a programming problem using assembly/C language. Select one specific approach. Using ARM Assembly programming to design and implement interrupts and exceptions. It will be used to handle different interfacing techniques. The lab will cover design and Simulation of Data Path and Control of CPUs.

3 Text and Reference Materials

T Textbook:

- *David A. Patterson, John L. Hennessy*, **Computer Organization and Design ARM Edition: The Hardware Software Interface**, First Edition, Morgan Kaufmann, 2016.
- *Joseph Yiu*, **The definitive guide to the ARM Cortex-M3 and Cortex-M4 Processors**, Third Edition, Newnes, 2013.

R References:

- *Robert Plantz*, **Introduction to Computer Organization: ARM** , First Edition, No Starch Press, 2024.
- *David A. Patterson, John L. Hennessy*, **Computer Organization and Design RISC-V Edition: The Hardware Software Interface**, First Edition, Morgan Kaufmann, 2017.
- *Daniel Kusswurm* , **Modern Arm Assembly Language Programming: Covers Armv8-A 32-bit, 64-bit, and SIMD**, First Edition, 2020.

- *Larry D Pyeatt*, **Modern Assembly Language Programming with the ARM**, First Edition, Newnes, 2016.
- **STM32F446xx advanced Arm ® -based 32-bit MCUs**.
- **Data Sheet : STM32F446xC/E**.
- **Cortex-M4 Devices Generic User Guide**
- **Cortex-M4 Technical Reference Manual**
- **ARM 7 Technical Reference Manual**

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	The lab reinforces theoretical concepts learned in the Microprocessor theory course, providing students with practical experience in microprocessor architecture and assembly language programming for solving computing problems.	PO1	Cognitive (C2)	25%	Please refer to Section 5.
CO2	Lab activities will involve conducting experiments to observe the behavior of microprocessor systems, analyzing experimental results, and interpreting data to gain insights into system performance and functionality.	PO2	Cognitive (C3)	30%	
CO3	Students will work collaboratively for a project, which will require students to work effectively in teams, demonstrating communication, leadership, and problem-solving skills. Students will learn to distribute tasks, coordinate efforts, and integrate individual contributions to achieve common objectives through this task.	PO5	Psychomotor (P5)	45%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Class Participation			10%	10%
Continuous Lab Performance	15%	10%	5%	30%
Lab Reports		5%	5%	10%
Lab Viva-Voce			20%	20%
Capstone Project or Demo/Presentation	10%	15%	5%	30%
Total	25%	30%	45%	100%

Course Teacher, CSE 2106
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
CSE 2109 Data and Telecommunication

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**2nd year 1st semester 2024**
Course Code	CSE 2109
Course Title	*Data and Telecommunication*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	None

2 Syllabus

Introduction: Communication model, data communication tasks, data communication network standards and organizations. Protocol architecture, communications between layers, peer to peer communication between remote layers, service access points, service primitives and communication between adjacent layers, encapsulation of PDUs, addition of headers on transmission; removal on reception, segmentation & reassembly by protocol layers. **Physical Layer:** Analog and digital data transmission, spectrum and bandwidth, transmission impairments, data rate and channel capacity. **Wireless Transmission:** Characteristics and applications of wireless transmission-terrestrial and satellite microwave, radio waves, propagation mechanism, free space propagation, land propagation, path loss, slow fading, fast fading, delay spread, inter symbol interference. **Digital transmission:** Line coding techniques- NRZ, RZ, Manchester, and differential Manchester encoding, AMI, Block coding, analog to digital conversion based on PCM, delta modulation, etc. **Analog transmission:** ASK, FSK, PSK, QPSK, QAM encodings, AM, PM, FM, etc. **Data Transmission:** Synchronous and asynchronous data transmission techniques. **Multiplexing:** FDM, international FDM carrier standards, synchronous TDM, international TDM carrier standards, statistical time division multiplexing. **Spread Spectrum:** Frequency hopping spread spectrum, direct sequence spread spectrum, code division multiple access. **Error Detection and Correction:** parity check, CRC, forward error correction technique, linear block code, hamming code, etc. **Data Link Control:** Line configurations, flow control and error control techniques- sliding window, stop and wait ARQ, selective reject ARQ protocols.

3 Text and Reference Materials

T Textbook:

- *B. Forouzan*, ***Data Communications and Networking*** , Fifth Edition, McGraw-Hill , 2012.

R References:

- *W. Stallings*, **Data and Computer Communications** , 10th Edition, Prentice Hall, 2013.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Understand the fundamental concepts, elements, network structures, criteria, and bandwidth utilization techniques of data communication systems.	PO1	Cognitive (C2)	50%	Please refer to Section 5.
CO2	Explain Analog and Digital signals, transmission impairments, capacity, and performance of a communication system. Analyze Digital-Digital, Analog-Digital, Analog-Analog conversion approaches.	PO2	Cognitive (C3)	40%	
CO3	Familiarizing with the fundamentals of Error Detection and Correction techniques.	PO1	Cognitive (C3)	10%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	25%	25%	10%	60%
Midterm Exam	15%	5%		20%
Class Test/Quiz		5%		5%
Assignment/Presentation	5%	5%		10%
Class Participation		5%		5%
Total	45%	45%	10%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	Introduction to data communication systems and its components. Network performance criteria. Organization of the Internet.	T	T
3	Network Models: Layered architecture (OSI and TCP)	T	T
4-6	Data and Signal: Periodic analog signals, composite signals, Fourier series. Bit rate, bit length.	T , R	T , R
7	Transmission Impairments: Attenuation, distortion, noise. Signal to noise ratio.	T	T
8	Data Rate Limits: Nyquist bit rate, Shannon's channel capacity.	T , R	T , R
9	Performance Criteria: Bandwidth, throughput, latency, bandwidth-delay product.	T	T

10-11	Digital-to-Digital Conversion: Data and signal elements. Criteria for good signalling element (baseline wandering, DC component, self-synchronization, error detection, complexity)	T , R	T , R
12-13	Line Encoding Schemes: Unipolar, Polar (NRZ, RZ), Biphase (Manchester, differential Manchester), Bipolar (AMI, Psedoternary), Multilevel	T	T , R
14	Block Coding and Scrambling techniques	T	T
15-16	Analog-to-Digital: Pulse Code Modulation (Sampling, Quantization, Bit rate, BW), PCM decoder, Delta Modulation, Delta PCM.	T , R	T , R
17-18	Digital-to-Analog: Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying, Constellation diagram. Quadrature Amplitude Modulation	T , R	T , R
19-20	Analog-to-Analog: Amplitude, Frequency, and Phase Modulation.	T	T , R
21-22	Bandwidth Utilization: Multiplexing (frequency-division, wavelength-division, time-division), Data rate management	T , R	T
23-24	Spreading: Frequency Hopping Spread Spectrum (FHSS), Direct Sequence Spread Spectrum (DSSS).	T , R	T , R
25-26	Error Detection and Correction: Types of errors, redundancy, detection and correction, forward error correction, Hamming distance.	T , R	T , R
27-28	Linear Block Codes: Cyclic codes, checksum.	T , R	T , R

For the definitions of T and R , Please refer to Section 3.

TBA
Course Teacher, CSE 2109
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka
Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
CSE 2201 Database Management System

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**2nd Year 2nd Semester 2024**
Course Code	CSE 2201
Course Title	*Database Management System*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	None

2 Syllabus

Introduction to Database System Concepts: Purpose and Applications of Database Systems, View of Data, Database Language, Database Engine, Database and Application Architecture, Database Users and Administrators. **Database Design using Relational and ER Models:** Structure of Relational Databases, Database Schema and Instance, Constraints and Keys: Super, Candidate, Primary, Foreign, Unique; Schema Diagram, The Entity-Relationship Model: Entity and Relationship Sets, Attribute Types; Constraints: Mapping Cardinalities, Participation; Strong and Weak Entity Sets, Entity-Relationship (ER) Diagram, Reducing E-R Diagram to Relational Schemas, Extended E-R Features: Specialization, Generalization, Aggregation; E-R Model Design Issues. **Structured Query Language:** Overview, Data Types, SQL Data Definition Language (DDL), SQL Data Manipulation Language (DML): Basic Structure of SQL Queries, Set Operations, Null Values, Grouping and Aggregate Functions, String and Other Functions, Nested Sub-queries, Database Modification: Insert, Update, Delete; Join Types and Conditions: Inner Joins: Cartesian, Natural; Outer Joins: Left, Right and Full, View and Materialized View, Integrity Constraints, Authorization, Role, Embedded and Dynamic SQL, Trigger. **Relational Algebra:** Fundamental Operations: Select, Project, Rename, Cartesian-Product, Set, Assignment Operations. **Relational Database Design:** Functional Dependency Theory: Keys and FDs, Closure set of FDs, Attribute Closure, Canonical Cover, Normal Forms: 1NF, 2NF, BCNF, 3NF; Decomposition Algorithms, Features of Good Relational Designs: Lossless Join, Dependency Preservation, Concept of Multivalued Dependency: 4NF, 5NF. **Data Storage Structure:** RAID: Importance, RAID Levels; File Organization: Fixed and Variable Length Records; Heap, Sequential, Multitable, B+-Tree File Organizations, Data Dictionary Storage. **Indexing:** Basic Concepts, Ordered Indices: Dense, Sparse, Secondary, Multilevel; B+-Tree Index: Insert, Update, Delete; Hash Indices: Static Hashing, Extendible Hashing, Comparison of Ordered Indexing and Hashing. **Query Processing:** Measures of Query Cost: Selection, Sort and Join Operations Algorithms, Other Operations: Duplicate Elimination, Projection, Set Operations, Outer Joins, Aggregation, Evaluation of Expressions: Materialization and Pipelining. **Query Optimization:** Transformation of Relational Expression: Equivalence Rules, Join Ordering; Cost Based and Heuristics Optimization, Materialized View and Maintenance. **Transactions:** Transaction Concept and ACID Properties, Transaction States, Schedule, Recoverability and Serializability. **Concurrency Control:** Lock-Based Protocols, Graph-Based Protocols, Deadlock Handling, Multiple Granularity, Timestamp-Based Protocols, Validation-Based Protocols. **Advanced Topics:** XML, NoSQL.

3 Text and Reference Materials

T Textbook:

- *Abraham Silberschatz, Henry F. Korth, and S. Sudarshan*, **Database System Concepts**, 7th Edition, McGraw Hill Publications, 2020.

R References:

- *P Raja Sekhar Reddy & A Mallikarjuna Reddy*, **Foundations of Database Management Systems**, Fifth Edition, Lambert Academic Publishing, 2020.
- *Ramez Elmasri & Shakant B. Navathe*, **Fundamentals of Database System**, 7th Edition, Pearson Publications, 2016.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Understand the basics of the database and conceptualize a database system using E-R and relational model.	PO1	Cognitive (C3)	25%	Please refer to Section 5.
CO2	Analyze and construct queries using relational algebra and Structured Query Language (SQL).	PO2	Cognitive (C3)	20%	
CO3	Understand the functional dependencies and apply systematic dataset design approaches using normal forms.	PO3	Cognitive (C4)	15%	
CO4	Understand basic database storage structures and identify suitable index and hashing mechanism for effective storage and retrieval of data; Learn effective techniques for query processing and optimization; Understand the needs of transaction processing and learn techniques for controlling the concurrent data access.	PO1	Cognitive (C2)	40%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	CO4	Total
Final Exam	10%	10%	10%	30%	60%
Midterm Exam	10%	5%	5%		20%
Class Test/Quiz		5%	5%		10%
Assignment/Presentation				5%	5%
Class Participation				5%	5%
Total	20%	20%	20%	40%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	• Purpose and Applications of Database Systems, View of Data, Database Language, Database Engine, Database and Application Architecture, Database Users and Administrators	T	T
3-5	• Structure of Relational Databases • Database Schema and Instance, • Constraints and Keys: Super, Candidate, Primary, Foreign, Unique • Schema Diagram • The Entity-Relationship Model: Entity and Relationship Sets, Attribute Types • Constraints: Mapping Cardinalities, Participation; • Strong and Weak Entity Sets, • Entity-Relationship (ER) Diagram • Reducing E-R Diagram to Relational Schemas • Extended E-R Features: Specialization, Generalization, Aggregation • E-R Model Design Issues	T	R
6-10	• SQL: Overview, Data Types • SQL Data Definition Language (DDL) • SQL Data Manipulation Language (DML): Basic Structure of SQL Queries, Set Operations, Null Values, Grouping and Aggregate Functions, String and Other Functions, Nested Sub-queries, • Database Modification: Insert, Update, Delete • Join Types and Conditions: Inner Joins: Cartesian, Natural; Outer Joins: Left, Right and Full, View and Materialized View, • Integrity Constraints • Authorization, Role • Embedded and Dynamic SQL • Trigger • The Relational Algebra: Fundamental Operations: Select, Project, Rename, Cartesian-Product, Set, Assignment Operations	T	R
11-14	• Functional Dependency Theory: Keys and FDs, Closure set of FDs, Attribute Closure, Canonical Cover • Normal Forms: 1NF, 2NF, BCNF, 3NF • Decomposition Algorithms, Features of Good Relational Designs: Lossless Join, Dependency Preservation, • Concept of Multivalued Dependency: 4NF, 5NF	T	R
15-17	• RAID: Importance, RAID Levels • File Organization: Fixed and Variable Length Records; Heap, Sequential, Multitable, B+-Tree File Organizations • Data Dictionary Storage	T	T
18-20	• Basic Concept of Indexing, Ordered Indices: Dense, Sparse, Secondary, Multilevel; • B+-Tree Index: Insert, Update, Delete • Hash Indices: Static Hashing, Extendible Hashing • Comparison of Ordered Indexing and Hashing	T	T
21-22	• Measures of Query Cost: Selection, Sort and Join Operations Algorithms, • Other Operations: Duplicate Elimination, Projection, Set Operations, Outer Joins, Aggregation, • Evaluation of Expressions: Materialization and Pipelining	T	T
23-24	• Transformation of Relational Expression: Equivalence Rules • Join Ordering • Cost Based and Heuristics Optimization • Materialized View and Maintenance	T	T
25-27	• Transaction Concept and ACID Properties • Transaction States • Schedule: Recoverability and Serializability • Lock-Based Protocols, Graph-Based Protocols, Deadlock Handling, Multiple Granularity, Timestamp-Based Protocols, Validation-Based Protocols	T	T
28	• XML, NoSQL	T	R

For the definitions of T and R , Please refer to Section 3.

Course Teacher, CSE 2201
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
CSE 2202 Database Management System Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**2nd Year 2nd Semester 2024**
Course Code	CSE 2202
Course Title	*Database Management System Lab*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	None

2 Syllabus

Task: Implementation of 'Bank' and 'University' databases of the text book *T* or any other sample database using Oracle Express Edition or any other DBMS software. **Database Language:** SQL(Structured Query Language) –**DDL:** Creating Users and Assigning Roles and Authorities; Creating, Modifying and Deleting Objects: Table, Index, View; Creating Integrity Constraints: Data Types and Lengths, Keys (Primary key, Unique key, Foreign key/Referential Integrity Constraint), Check, Null and Not Null etc. –**DML:** Insert (direct, text or excel file upload, using query); Basic structure of SQL queries: select, from, where, order by, group by, having; rename, string and set operations; Aggregate functions: sum, min, max, avg, count; Nested sub-queries; Complex queries; Views; Modification of the database: update, delete. **Lab Examination 1:** Based on DDL and DML of SQL **Introduction to PL/SQL:** PL/SQL features, PL/SQL Control Structures and Procedures, Functions and Packages. **Lab Examination 2:** Based on PL/SQL. **Project:** A database project is to be done mainly focusing on database design (form E-R model to Relational model with normalization), implementation and querying information based on the scenario chosen by the students with prescribed criteria.

3 Text and Reference Materials

T Textbook:

- *Abraham Silberschatz, Henry F. Korth, and S. Sudarshan*, **Database System Concepts**, 7th Edition, McGraw Hill Publications, 2020.

R References:

- *P Raja Sekhar Reddy & A Mallikarjuna Reddy*, **Foundations of Database Management Systems**, Fifth Edition, Lambert Academic Publishing, 2020.
- *Ramez Elmasri & Shakant B. Navathe*, **Fundamentals of Database System**, 7th Edition, Pearson Publications, 2016.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Create, modify and delete database object structures and implement different constraints on schema and instance and populate data into the sample database using any modern database management system.	PO2	Cognitive (C3)	25%	Please refer to Section 5.
CO2	Construct and apply DML commands to access data form the sample database.	PO2	Cognitive (C3)	25%	
CO3	Model a new database of students' choice, identify the various entities, appropriate data types, relationships, constraints, etc.; design, normalize and achieve goodness of the relational database schemas; write the SQL commands to create and populate the database and also write SQL, PL/SQL to access the data from the database.	PO9	Cognitive (C6)	50%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Continuous Lab Performance	20%	20%		40%
Project Presentation and Viva-Voce			40%	40%
Project Report			10%	10%
Class Participation	5%	5%		10%
Total	25%	25%	50%	100%

Course Teacher, CSE 2202
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
CSE 2203 Design and Analysis of Algorithms

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**2nd year 2nd semester 2024**
Course Code	CSE 2203
Course Title	*Design and Analysis of Algorithms*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	CSE2101: Data Structures and Algorithms

2 Syllabus

Graph Traversal: Graph representation using Adjacency list and Adjacency matrix, Breadth-first search (BFS), Depth first search (DFS), Topological Sort, Strongly Connected Components, Euler Path, Articulation Point, Bridge, Bi-connected Components. **Shortest Path Algorithms:** Dijkstra's Shortest Path Algorithm, Bellman-Ford algorithm, and negative cycle detection, Shortest path in Directed Acyclic Graph, Floyd-Warshall all pair shortest path algorithm, Johnson's Algorithm. **Greedy Algorithms:** Elements and properties of Greedy algorithms, Fractional knapsack, job scheduling with deadline, Minimum spanning tree: Prim's and Kruskal's algorithms. **Complexity Analysis and Recurrence Relation:** Review of asymptotic notations, growth of a function, Amortized analysis, Aggregate analysis, The accounting method, The potential methods, Methods to solve recurrence relation, Substitution method, Recursion tree method, Master method. **Dynamic Programming:** Basic idea, properties and comparison with Divide & Conquer and Greedy Algorithms, Rod Cutting algorithm, General form of Dynamic Programming and Memorization, Coin related problems, Longest Increasing subsequence (LIS), Longest Common Subsequence (LCS), 0/1 Knapsack, Matrix Chain Multiplication, Rock Climbing, Applications of Dynamic programming. **Divide & Conquer:** Counting Inversion using merge sort, Closest pair of points, Finding Ak mod M using DC method, Finding median (in general k-th smallest element) in a set using DC in expected linear time. **Network Flow:** Flow Networks, Max-Flow Min-cut theorem, Ford Fulkerson method and its limitation, Edmonds Karp algorithm, Maximum bipartite matching, Minimum path cover, edge cover, The Hopcroft-Karp algorithm, The stable marriage problem. **Hashing:** Linear Probing, Quadratic probing, Double Hashing, Random Hashing, Cuckoo Hashing, Consistent Hashing.

3 Text and Reference Materials

T Textbook:

- *Cormen, T. H., Leiserson, C. E., Rivest, R. L., Stein, C.*, **Introduction to Algorithms**, 4th Edition, MIT Press, 2022.

4 Course Outcomes

CO	CO Description	PO	Domain	Weight	Assessment Methods
CO1	Understand and apply various graph traversal techniques including BFS, DFS, and algorithms for finding shortest paths, articulation points, and strongly connected components.	PO1	Cognitive (C3)	25%	Please refer to Section 5
CO2	Analyze and implement Greedy algorithms and Dynamic Programming techniques for solving optimization problems, and distinguish between these strategies and other methods like Divide and Conquer.	PO3	Cognitive (C4)	23%	
CO3	Design and analyze algorithms for network flow problems, including understanding the Max-Flow Min-Cut theorem and implementing flow algorithms like Ford-Fulkerson and Edmonds-Karp.	PO4	Cognitive (C3)	25%	
CO4	Master complex data structures for efficient algorithm implementation, including various hashing techniques, and analyze their impact on algorithm performance.	PO12	Cognitive (C3)	27%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	CO4	Total
Final Exam	15%	15%	15%	15%	60%
Midterm Exam	5%	5%	5%	5%	20%
Class Test/Quiz	5%	3%	2%	0%	10%
Assignment/Presentation	0%	0%	0%	5%	5%
Class Participation	0%	0%	3%	2%	5%
Total	25%	23%	25%	27%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems

1-4	**Graph Traversal**: Graph representation using Adjacency list and Adjacency matrix, Breadth first search (BFS), Depth first search (DFS), Topological Sort, Strongly Connected Components, Euler Path, Articulation Point, Bridge, Bi-connected Components	T	T
5-8	**Shortest Path Algorithms**: Dijkstra's Shortest Path Algorithm, Bellman-Ford algorithm and negative cycle detection, Shortest path in Directed Acyclic Graph, Floyd-Warshall all pair shortest path algorithm, Johnson's Algorithm	T	T
9-10	**Greedy Algorithms**: Elements and properties of Greedy algorithms, Fractional knapsack, job scheduling with deadline, Minimum spanning tree: Prim's algorithm and Kruskal's algorithm	T	T
11-13	**Complexity Analysis and Recurrence Relation**: Review of asymptotic notations, growth of a function, Amortized analysis, Aggregate analysis, The accounting method, The potential methods, Methods to solve recurrence relation including Substitution method, Recursion tree method, Master method	T	T
14-17	**Dynamic Programming**: Basic idea, properties and comparison with Divide & Conquer and Greedy Algorithms, Rod Cutting algorithm, General form of Dynamic Programming and Memorization, Coin related problems, Longest Increasing subsequence (LIS), Longest Common Subsequence (LCS), 0/1 Knapsack, Matrix Chain Multiplication, Rock Climbing, Applications of Dynamic programming	T	T
18-20	**Divide & Conquer (DC)**: Counting Inversion using merge sort, Closest pair of points, Finding Ak mod M using DC method, Finding median (in general k-th smallest element) in a set using DC in expected linear time	T	T
21-24	**Network Flow**: Flow Networks, Max-Flow Min-cut theorem, Ford Fulkerson method and its limitation, Edmonds Karp algorithm, Maximum bipartite matching, Minimum path cover, edge cover, The Hopcroft-Karp algorithm, The stable marriage problem	T	T
25-26	**Hashing**: Linear Probing, Quadratic probing, Double Hashing, Random Hashing, Cuckoo Hashing, Consistent Hashing	T	T

For the definitions of T and R , Please refer to Section 3.

Course Teacher, CSE 2203
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 2204
Design and Analysis of Algorithms Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**2nd year 2nd semester 2024**
Course Code	CSE 2204
Course Title	*Design and Analysis of Algorithms Lab*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	Check the prerequisite for the related theory course

2 Syllabus

This laboratory course is designed to provide practical experience in implementing, analyzing, and optimizing various algorithms as covered in the Design and Analysis of Algorithms course. Students will develop and test algorithmic solutions using real-world data and simulations, focusing on essential topics such as graph traversal, shortest path algorithms, greedy techniques, complexity analysis, dynamic programming, divide and conquer strategies, network flows, and advanced hashing techniques. The course aims to deepen students' understanding of theoretical concepts through hands-on application, enabling them to effectively tackle complex computational problems and enhance their ability to devise algorithms that are both efficient and scalable.

Prospective Lab Tasks Description

1. **Graph Traversal:**
   - Implementing and visualizing graph traversal algorithms: BFS and DFS.
   - Applications and implementation of Topological Sort and algorithms for finding Strongly Connected Components.
   - Implementing algorithms to find Euler paths, Articulation Points, Bridges, and Bi-connected Components.
2. **Shortest Path Algorithms:**
   - Implementing Dijkstra's algorithm and visualizing step-by-step path finding.
   - Implementing and comparing the Bellman-Ford algorithm and Floyd-Warshall algorithm.
   - Applying Johnson's Algorithm to sparse graph scenarios.
3. **Greedy Algorithms:**

- Implementing the Fractional Knapsack and job scheduling problems.
- Constructing Minimum Spanning Trees using Prim's and Kruskal's algorithms.

4. **Complexity Analysis and Recurrence Relation:**
   - Analyzing the growth of functions using different asymptotic notations.
   - Practicing the substitution, recursion tree, and Master methods to solve recurrence relations.
5. **Dynamic Programming:**
   - Implementing and analyzing the efficiency of the Rod Cutting algorithm and the Coin Change problem.
   - Solving the Longest Increasing Subsequence, Longest Common Subsequence, and 0/1 Knapsack problems.
   - Implementing the Matrix Chain Multiplication and exploring applications of Dynamic Programming in solving complex problems.
6. **Divide & Conquer:**
   - Implementing and analyzing the Counting Inversions using merge sort and finding the median using the DC method.
   - Exploring Closest pair of points problem and its implementation.
7. **Network Flow:**
   - Implementing the Ford Fulkerson method and Edmonds Karp algorithm for solving flow network problems.
   - Analyzing algorithms for maximum bipartite matching and studying the application of the Hopcroft-Karp algorithm.
8. **Hashing:**
   - Implementing various hashing techniques such as Linear Probing, Quadratic Probing, and Double Hashing.
   - Exploring advanced hashing strategies like Cuckoo Hashing and Consistent Hashing, analyzing their performance and use-cases.

3 Text and Reference Materials

Check the textbook and reference list for the corresponding theory course

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Implement and apply various graph traversal techniques including BFS, DFS, and algorithms for finding shortest paths, articulation points, and strongly connected components.	PO1	Cognitive (C2)	25%	

CO2	Implement and apply Greedy algorithms and Dynamic Programming techniques for solving optimization problems, and distinguish between these strategies and other methods like Divide and Conquer.	PO2	Cognitive (C3)	30%	Please refer to Section 5.
CO3	Design, implement, analyze, and apply algorithms for network flow problems, including understanding the Max-Flow Min-Cut theorem and implementing flow algorithms like Ford-Fulkerson and Edmonds-Karp.	PO10	Psychomotor (P5)	45%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Class Participation			10%	10%
Continuous Lab Performance	15%	10%	5%	30%
Lab Reports		5%	5%	10%
Lab Viva-Voce			20%	20%
Capstone Project or Demo/Presentation	10%	15%	5%	30%
Total	25%	30%	45%	100%

Course Teacher, CSE 2204
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka
Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 2205
Microcontroller and Embedded System

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**2nd year 2nd semester 2024**
Course Code	CSE 2205
Course Title	*Microcontroller and Embedded System*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	CSE2101 Data Structures and Algorithms, CSE 2105 Computer Architecture and Microprocessor

2 Syllabus

Introduction to Microcontroller (MCU) and Embedded system: Functional components of the microcontroller, Types of microcontroller, application of microcontroller: robotics, control system, IoT, drones, autonomous vehicle and the building block of the intelligent industry, software and firmware; **ARM Microcontroller architecture**: Bus matrix (AHBx, APBx), peripherals, GPIO port/pin, Timers, FPU, MPU, DSP, and Voltage regulator, clock generator, ADC, DAC, audio and video interface, communication ports, **System Configuration and Control**; **GPIO and GPIO port**: GPIO concepts, grouping, communication data rate, EXT interrupt and GPIO modes, Pull-up, pull-down, set and reset GPIO output, Speed, alternate use of GPIO. **GNU Debugger**: C/C++ debugger for MCU, memory, and peripheral register content verification and finding faults or logical errors. **MCU System Reset and Clock Control – RCC**: ARM Cortex-M4/7 internal clock, MCU external and internal clock generator, RCC and real-time (RTC) clock architecture and functional procedure, clock distribution and power management, Peripheral bus registers for supplying clock to peripheral; **Flash memory and SRAM:** MCU flash memory and SRAM architecture address data rate, interface to the microprocessor, external memory, and functions of MPU. Address mapping for memory and I/O, **Internal and External Interrupt:** Microcontroller interrupt vector and service routine, customization; **Timers:** Timer and use of timer, timer pre-scaler, auto-reload register, counter, input capture, CCR registers, PWM generation, delay generation, pattern generation, duty cycle, and power delivery, **Synchronous and asynchronous communication**: Asynchronous communication such as UART, GPIO; serial synchronous communication such as USART, SPI, I2C (I2S), CAN (fdCAN,bxCAN) protocol architecture, packet and frame format, data communication, error checking, use of interrupt and DMA for data transfer, configuration and status verification, troubleshooting; **MCU communication network**: R232, RS485, ethernet, and CANBus; **Transaction of information:** Polling, Interrupt I/O, DMA, No-buffer, single buffer, and double buffer data transaction. **ADC and DAC:** Analog and digital peripherals, resolution, quantization, sampling and use of DMA channel; **DSP, floating point and Vector processing**: Signal pattern analysis, signal processing, review of FFT and DFT; **Diplay Peripherals and GPU**: LCD TFT, LVDS, RGB protocol, color matrix, MIPI, IPS and HDMI display interfaces. Touch screen, multi-touch, and input management.

3 Text and Reference Materials

T Textbook:

- *STMicroelectronics*, **STM32F446xx of M7 advanced Arm®-based 32-bit MCUs - Reference manual**, RM0390 Rev 6 (M4), STMicroelectronics Online, March 2021.
- *STMicroelctronics*, Datasheet - STM32F446xC/E - Arm® Cortex®-M4/7 32-bit micocontroller, DS10693 Rev 10, Jan, 2021
- *ARM Limited*, Cortex-M4 Revision r0p0 Technical Reference Manual Revision r0p0, 2009/10

R References:

- *Joseph Yiu*, **The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors**,3rd Edition, November 2013.
- *ARM Limited*, Cortex-M4 Revision r0p0 Technical Reference Manual Revision r0p0, 2009/10

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Apply the knowledge of sciences and engineering fundamentals to interpret the elementary concepts of the architectures of the microcontroller and its components, including design goal and various features.	PO1	Cognitive (C3)	35%	Please refer to Section 5.
CO2	Analyze operational details of the microcontroller components and apply knowledge to develop various complex control systems, firmware for automation, and intelligent machines.	PO2	Cognitive (C4)	45%	
CO3	Apply the knowledge obtained to comprehend the role of modern embedded systems architecture, including design and its link with the innovation of new machines, to comprehend the country's SDG.	PO6	Affective (A4)	20%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	20%	30%	10%	60%
Midterm Exam	10%	10%		20%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation			5%	5%
Class Participation			5%	5%
Total	35%	45%	20%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	Introduction to microcontroller and embedded system • Functional components, Type of microcontrollers, • the role of the microcontroller, and embedded system in automation and control system. • Architecture, bus matrix, and components features	T	T
3-4	Overview of C/C++ programming and development environment • Embedded C/C++ programming, microcontroller programming, and debugging.	T	T
5-6	Microcontroller Core components and Clock Signal • Embebbed microprocessor: an overview of the features of the embedded microprocessor. • clock generation and distribution, PLL clock generation, • External and internal clock, Prescaller, and clock configuration.	T	T
5-6	General purpose input and output (GPIO): • GPIO, characteristics, types of input-output systems, push-pull, pullup and pulldown methods, analog, digital, serial input-output. GPIO modes, speed, alternate functions, purpose, and role. GPIO interrupt and Interrupt routines. Interrupt I/O.	T	T
7-8	Internal flash memory, SRAM, and External Memory • MCU flash memory model, architecture, power management, access control, memory, and I/O address mapping. MPU and external memory.	T	T
9-10	Synchronous and Asynchronous communication • Concepts of synchronous and asynchronous communication, MCU components for synchronous and asynchronous communication, Signaling, Clock sharing, synchronous and asynchronous communication protocol overview, and low-level signaling techniques.	T	T
11-13	Universal synchronous/Asynchronous Receiver and Transmitter (USART) • USART clock, GPIO Alternate function, Baud rate calculation and configuration, transmission and receiving functional diagram, signaling, input and output buffer, interrupt and overrun, and noise error handling. Frame format, parity, payload. RS485 communication. Application of UART and USART.	T	T
14-16	Timer and Pulse Width Modulation • MCU timer functions, Basic Timer, General Purpose timer, Advance Timer, Role of timer. Delay generation. • Concept of PWM, algorithms: naive, Space Vector Modulation. PWM duty cycle, power delivery, dead time, Complement output, and input capture. One plus generation. Full bridge and half-bridge concept. • Pattern generation and PWM applications • Drone-based data collection strategies;	T	R
17-18	DMA and I/O • Direct memory access, Application of DMA memory to memory, memory to I/O, and I/O to I/O. Role of DMA in Serial Communication and PWM. DMA channel, stream, priority. DMA flow control, DMA error handling. DMA circular and double buffer modes	T	T

19-21	SPI and I2S • SPI protocols, frame format, simplex and duplex communication, a clock signal, master-slave communication, multi-master and multi-slave communication, and slave selection. SPI addressing and configuration of target devices. Clock phase and polarity, CRC, interrupts, and DMA control. Low power SPI communication.	T	T
22-23	I2C peripherals and protocols • Communication protocol, frame format, data, and control frame, I2C reset, and error handling. • Communication mode: master transmitter, master receiver, slave transmitter, slave receiver, I2C DMA, and Interrupt handling. SPI ACK and NACK.	T	T
24-25	bxCAN and fdCAN – Controller Area Network • CAN protocol, Types of CAN, Data and control frame format, Mailbox, CAN filter, CAN bus architecture, Sleep mode, initialization mode, and Normal mode. CAN DMA and error handling. CAN application	T	T
24-25	ADC and DAC • Analog to digital (ADC/DAC) conversion, sampling rate, quantization, ADC channel selection. Signal conversion mode, continuous conversation mode. Timing diagram. Data Alignment. ADC/DAC input output handling.	T	R
26-28	Display peripherals and GPU • floating point and Vector processing: Signal pattern analysis, signal processing, review of FFT and DFT; Display Peripherals and GPU: LCD TFT, LVDS, RGB protocol, color matrix, MIPI, IPS, and HDMI display interfaces. Touch screen, multi-touch, and input management.	T	R

For the definitions of **T** and **R** , Please refer to Section 3.

TBA
Course Teacher, CSE 2205
April 24, 2024

Prof. Dr. Md. Abdur Razzaque
Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka
Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 2206
Microcontroller and Embedded System Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**2nd year 2nd semester 2024**
Course Code	CSE 2206
Course Title	*Microcontroller and Embedded System Lab*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	CSE 2205 Microcontroller and Embedded System (co-requisite)

2 Syllabus

This lab course aims to provide hands-on knowledge of building modern control, IoT, and robotics systems based on theory and techniques learned in CSE2205: microcontrollers and embedded systems. The students are given innovative, practical, commercially viable, industry-friendly projects to enhance their knowledge and expertise and target future technology industry establishments in Bangladesh. The project must be demonstrated and presented in four or five phases, with a final showcase of the developed system. However, the project must have some compulsory components like clock and RTC configuration, UART communication, Graphical display design, and one of the following communication for transferring information between machines/devices such as HTTP(s), TCP, UDP, XMLRPC, MQTT, and Matter protocols. The students do not need to design the protocols but use them; otherwise, they propose a new viable protocol. Students must develop a backed server process and UI interface on the mobile/web platform to be visible to authorized users from throughout the globe. However, students can propose any project connected to the industry that may have commercial value or be commercially viable.

3 Text and Reference Materials

T Textbook:

- *STMicroelectronics*, **STM32F446xx of M7 advanced Arm®-based 32-bit MCUs - Reference manual**, RM0390 Rev 6 (M4), STMicroelectronics Online, March 2021.
- *STMicroelctronics*, Datasheet - STM32F446xC/E - Arm® Cortex®-M4/7 32-bit micocontroller, DS10693 Rev 10, Jan, 2021
- *ARM Limited*, Cortex-M4 Revision r0p0 Technical Reference Manual Revision r0p0, 2009/10

R References:

- *Joseph Yiu*, **The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors**,3rd Edition, November 2013.
- *ARM Limited*, Cortex-M4 Revision r0p0 Technical Reference Manual Revision r0p0, 2009/10

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Analyze understand the values of the commercial/industry standard project and selection of suitable algorithms and techniques to develop the targeted control/IoT/Robotic system	PO1	Cognitive (C2)	25%	Please refer to Section 5.
CO2	Design and solve the target embedded system project bare-metal hardware using (μ vision keil or any other IDE environment) register-based programming. Demonstrate and present the project and submission the final report and web/mobile-based application/product.	PO2	Cognitive (C3)	60%	
CO3	Continuous presences in the lab, evaluate the progress of the given project	PO10	Psychomotor (P5)	15%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Class Participation			10%	10%
Continuous Lab Performance	15%	10%	5%	30%
Lab Reports		10%		10%
Lab Viva-Voce		20%		20%
Capstone Project or Demo/Presentation	10%	20%		30%
Total	25%	60%	15%	100%

Course Teacher, CSE 2206
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 2209 Numerical Methods

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**2nd year 2nd semester 2024**
Course Code	CSE 2209
Course Title	*Numerical Methods*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	None

2 Syllabus

ERROR ANALYSIS: Approximations and Round-Off Errors: Accuracy and Precision, Error Definitions, Round-Off Errors. Truncation Errors and the Taylor Series: The Taylor Series, Error Propagation, Total Numerical Error, Blunders, Formulation Errors and Data Uncertainty. **ROOTS OF EQUATIONS:** Bracketing Methods: Graphical Methods, Bisection Method, False-Position Method. Open Methods: Simple Fixed-Point Iteration, Newton-Raphson Method, Secant Method. **LINEAR ALGEBRAIC EQUATIONS:** Gauss Elimination: Naive Gauss Elimination, Pitfalls of Elimination Methods, Complex Systems. Nonlinear Systems of Equations, Gauss-Jordan, LU Decomposition and Matrix Inversion, Special Matrices and Gauss-Seidel. **CURVE FITTING:** Least-Squares Regression: Linear Regression, Polynomial Regression, General Linear Least Squares. Interpolation: Newton's Divided-Difference Interpolating Polynomials, Lagrange Interpolating Polynomials, Inverse Interpolation **Spline Interpolation:** Quadratic and Cubic Spline. **NUMERICAL DIFFERENTIATION AND INTEGRATION:** Newton-Cotes Integration Formulas: Trapezoidal Rule, Simpson's Rules. Integration of Equations: Newton-Cotes Algorithms for Equations, Gauss Quadrature. Numerical Differentiation: High-Accuracy Differentiation Formulas, Derivatives of Unequally Spaced Data, Partial Derivatives.

3 Text and Reference Materials

T Textbook:

- *Steven C. Chapra and Raymond P. Canale*, **Numerical Methods for Engineers**, 7th Edition, McGraw-Hill Education, 2015.

R References:

- *Online Available Resources*,

4 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	**ERROR ANALYSIS:** Approximations and Round-Off Errors: Accuracy and Precision, Error Definitions, Round-Off Errors.	T	T
3-4	Truncation Errors and the Taylor Series: The Taylor Series, Error Propagation, Total Numerical Error, Blunders, Formulation Errors and Data Uncertainty.	T	T
5-7	**ROOTS OF EQUATIONS:** Bracketing Methods: Graphical Methods, Bisection Method, False-Position Method.	T	T
8-9	Open Methods: Simple Fixed-Point Iteration, Newton-Raphson Method, Secant Method.	T	T
10-12	**LINEAR ALGEBRAIC EQUATIONS:** Gauss Elimination: Naive Gauss Elimination, Pitfalls of Elimination Methods, Complex Systems. Nonlinear Systems of Equations, Gauss-Jordan,	T	T
13-15	LU Decomposition and Matrix Inversion, Special Matrices and Gauss-Seidel.	T	T
16-18	**CURVE FITTING:** Least-Squares Regression: Linear Regression, Polynomial Regression, General Linear Least Squares. Interpolation: Newton's Divided-Difference Interpolating Polynomials, Lagrange Interpolating Polynomials,	T	R
19-22	Inverse Interpolation, **Spline Interpolation:** Quadratic and Cubic Spline.	T	T
23-25	**NUMERICAL DIFFERENTIATION AND INTEGRATION:** Newton-Cotes Integration Formulas: Trapezoidal Rule, Simpson's Rules. Integration of Equations: Newton-Cotes Algorithms for Equations, Gauss Quadrature	T	T
27-28	Numerical Differentiation: High-Accuracy Differentiation Formulas, Derivatives of Unequally Spaced Data, Partial Derivatives.	T	R

For the definitions of T and R , Please refer to Section 3.

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April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 3101 Software Engineering

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**CSE 3101: Third Year First Semester 2024**
Course Code	CSE 3101
Course Title	*Software Engineering*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	CSE 3103 Object Oriented Design and Programming (co-requisite)

2 Syllabus

Introduction: Software engineering techniques, software process structure, process model **Software development practices:** agile software development methods such as Extreme Programming (XP) and XP framework, Agile Modeling (AM), Scrum and Scrum workflow, Adaptive Software development (ASD), Dynamic Systems Development Method (DSDM), Crystal, feature-driven development (FDD), Incremental Funding Method (IFM), DevOps, and Site Reliability Engineering (SRE). **No-agile approaches** Rational Unified Process (RUP), Open Process Framework (OPF). **Process improvement initiatives:** Capability Maturity Model (CMM) and Personal Software Process (PSP) **Software Requirement Analysis:** Requirement engineering, Eliciting Requirements, Developing Use Cases, requirement analysis, scenario-based use-case modeling, UML modeling, class-based method, requirement modeling for web and mobile app **Software Design:** design concept, architectural design, pattern-based architectural design, component-based design, user interface design, pattern-based design, Webapp and mobile app design. **Quality management:** concepts, software quality, review techniques, software quality assurance, **Software testing strategies:** Unit testing, integral testing, Test Strategies for Object-Oriented Software, testing Web and mobile App, white box and black box testing **Security Engineering:** Security Engineering Analysis, Security Assurance, Security Risk Analysis. **Formal Modeling and verification:** Functional specification, clean room design, Cleanroom Testing. **Software Project Management:** concepts, process and project metric, estimation, scheduling, and risk management.

3 Course Rationale

To provide a comprehensive introduction to software engineering leading to the ability to understand contemporary terminology, progress, issues, and trends. A thorough introduction to software engineering techniques, focusing on software process models, agile development. Principle that guides practice, understanding requirements, requirements modeling: scenarios, information and analysis classes, Requirements modeling: Flow, behavior, patterns and web apps, Design concept, pattern-based design, quality management, software quality assurance, software testing strategies.

4 Text and Reference Materials

T Textbook:

- *Roger S. Pressman and Bruce Maxim*, **Software Engineering: A Practitioner's Approach**, 8th Edition, McGraw Hill, January, 2014,

R References:

- *Ian Sommerville*, **Software Engineering**, 10th Edition Pearson, March 2015)
- *Gene Kin, Patrick Debois, John Willis, Jez Humble, and John Allspaw*, **The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations**, IT Revolution Press, October 2016
- *Niall Murphy, Betsy Beyer, Chris Jones, and Jennifer Petoff*, **Site Reliability Engineering**, 1st edition, O'Reilly Media, May 2016

5 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Apply knowledge to software development life cycle, engineering techniques, and software process modeling and development tools.	PO1	Cognitive (C2)	20%	
CO2	Analysis and use of agile software requirements model, design techniques, testing methodologies, use case, class, interaction diagram in software development life cycle.	PO2	Cognitive (C3)	35%	
CO3	Review and design software testing and verification tools including software security, risk assessment, cost estimation, software project scheduling, and management.	PO4	cognitive (C4)	30%	
CO4	Compare and contrast different analyses and design methodologies and develop design solutions for complex enterprise software engineering projects.	P10	Affective (A4)	15%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

6 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	CO4	Total
Final Exam	10%	20%	20%	10%	60%
Midterm Exam	10%	5%	5%		20%
Class Test/Quiz		5%			5%
Assignment/Presentation		5%		5%	10%
Class Participation			5%		5%
Total	20%	35%	30%	15%	100%

7 Topic Outline

Lecture	Selected Topic	Reading	Exercise
1-2	Introduction to Software Engineering • Process structure, process model, • classical process model, agile model	T	T
3-6	Agile software development methods • Extreme framework and programming, • Scrum workflow • Adaptive Software development, • Dynamic system development process, • Crystal, feature-driven development (FDD), • Incremental Funding Method (IFM), DevOps and Site Reliability • Rational unified process, open process framework	T	T
7-8	Human Aspects of Software Engineering • Characteristics of software engineer • psychology of software engineering, • software team, team structure • Agile team, XP team • Software engineering using cloud, collaboration tools • Process improvement initiative, personal software process	T	T
8-11	Software requirement analysis • Requirement engineering, Specification, • Eliciting Requirements, • Developing Use Cases, requirement analysis, scenario-based use-case modeling, • UML modeling and Activity diagram, class diagram, • requirement modeling for web and mobile apps, requirement validation	T	R
12-17	Software Design • design concept, pattern-based architectural design, • data-centric architecture, data-flow architecture, • layered architecture, Architectural context diagram, • component-based design, user interface design, Swimlane diagram, pattern-based design, error handling • Webapp, and mobile app design.	T	R
18-21	Quality management •concepts, software quality, McCall's software quality factors, review techniques, Defect amplification model, Analyzing Metrics, software quality assurance, Software quality goals, attributes, and metrics	T	T
22-24	Software testing strategies: • Unit testing, integral testing, Test Strategies for Object-Oriented Software, • testing Web and mobile App, white box and black box testing	T	R
25-26	Formal Modeling and verification: •Functional specification, • clean room design,cleanroom Testing	T	T
27-28	Software Project Management: concepts, process, • project metric, • estimation, scheduling, and risk management	T	T

Course Teacher, CSE 3101
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University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 3102
Software Design and Development Project

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 1st semester 2024**
Course Code	CSE 3102
Course Title	*Software Design and Development Project*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	None

2 Syllabus

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.

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

3 Text and Reference Materials

T Textbook:

- *Roger Pressman*, **Software engineering a practitioner's approach**, 7th Edition, McGraw Hill Higher Education, 2010.
- *Ian Sommerville*, **Software engineering**, 9th Edition, Pearson, 2011.

R References:

- *Soren Lauesen*, **Software requirements styles and techniques**, First Edition, Addison-Wesley, 2002.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Apply Engineering Principle to software development and use UML notation to represent project model.	PO1	Cognitive (C2)	30%	Please refer to Section 5.
CO2	Analyze a problem for feasibility study, get the business requirement, design, implement and test for checking that the business requirements are met.	PO2	Cognitive (C3)	30%	
CO3	Write reports for requirement, design and testing of the proposed solution following the given formats and demonstrate the solution	PO10	Psychomotor (P3)	30%	
CO4	Exhibit the leadership skills to work in a group and as an individual member through the project	PO9	Psychomotor (P6)	10%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	CO4	Total
Class Participation	10%				10%
Continuous Lab Performance	10%	10%			20%
Lab Reports		5%	5%		10%
Lab Viva-Voce			20%		20%
Capstone Project or Demo/Presentation	10%	15%	5%	10%	40%
Total	30%	30%	30%	10%	100%

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Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 3103
Web Engineering and Technology

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 1st semester 2024**
Course Code	CSE 3103
Course Title	*Web Engineering and Technology*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	CSE 1201 Structured Programming

2 Syllabus

Introduction to Web Engineering: Functional components of the Internet and World Wide Web architecture, backend, User Interface (UI), RESTfull web architecture: Uniform Interface, Stateless, Cacheable, Client-Server **Overview of internet protocol**: HTTP, HTTPS, FTP, SMTP, POP, IMAP, SOAP, **HTML/XML Standard**: W3C XML/HTML document format, logical architecture, physical architecture, Header, body and footer, data handling, Validity; **Architecture/Framework:** Presentation layer, business layer, database presentation layer, database/ persistent storage; **Example Architecture:** Hexagonal Architecture, life cycle, UI, input and output port, REST adapter, use case and application business logic, domain/business logic, entity database adapter, database/persistence storage. Overview of clear and onion architecture; **UI Design examples:** React model, Typescript, javascript, AngularJs, CSS; **Mobile Application Model:** overview of MVVM Model and Hexagonal architecture, Model, View, View Model, Data binding; **Mobile Application development plateform:** Swift, Cotlin, and Flutter; **Case study web platform:** Apache, nginx, NodeJs, Django; **Web application Security:** TLS, PCI data security, Firewall, MITM, DoS, DDoS attack, poisoning attack.

3 Text and Reference Materials

T Textbook:

- *Davi Vieira*, **Designing Hexagonal Architecture with Java: An architect's guide to building maintainable and change-tolerant applications with Java and Quarkus**, 8st Edition, Packt Publishing, January 7, 2022.
- *Leslie Sikos*, **Web Standards: Mastering HTML5, CSS3, and XML**, 2nd Edition, Apress;,December, 2014
- *Mike Amundsen*, **RESTful Web API Patterns and Practices Cookbook: Connecting and Orchestrating Microservices and Distributed Data**, O'Reilly Media, 1st Edition, November, 2022

– *Jeff McWherter & Scott Gowell*, **Professional Mobile Application Development**, 1st Edition, Wrox publisher, August, 2012

R References:

– *Doguhan Uluca*, **Angular for Enterprise Applications - Third Edition: Build scalable Angular apps using the minimalist Router-first architecture** , 3rd ed. Edition, Packt Publishing, January, 2024.

– *John A Estrella & Rossetta Sornabala*,**Agile Project Management for Mobile Application Development**, Agilitek Corporation, February 28, 2017

– *Andrew Hoffman*, **Web Application Security: Exploitation and Countermeasures for Modern Web Applications**, 1st Edition, O'Reilly Media, April, 2020

– *Carl Rippon*,**Learn React with TypeScript - A beginner's guide to reactive web development with React 18 and TypeScript**, Packt Publishing, Second Edition, March 2023

– Christos Karayiannis & Andrew Swartzbaugh, **Linux Web Server Development: A Step-by-Step Guide for Ubuntu, Fedora, and other Linux Distributions**, CreateSpace Independent Publishing Platform, June, 2015

– *Dušan Stojanović*,**Modern Web Development with Go: Build real-world, fast, efficient and scalable web server apps using Go programming language**, Orange Education Pvt Ltd, March, 2023

– *Kevin Hoffman*, **Programming WebAssembly with Rust: Unified Development for Web, Mobile, and Embedded Applications**, 1st Edition, Pragmatic Bookshelf, March, 2019 by

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Apply the knowledge of sciences and engineering fundamentals to interpret the elementary concepts of various architectures, applications, protocols, and backend application models for Web application design-related problems.	PO1	Cognitive (C3)	35%	Please refer to Section 5.
CO2	Analyze operational details of various Web Architecture, UI Design, Business logic, Domain Model, Persistence Storage, Use case, REST Adapter, and Interaction between layers to apply the specialist engineering knowledge to solve the complex web engineering infrastructure development problem.	PO2	Cognitive (C4)	45%	
CO3	Establish a reliable protocol while planning and designing web and mobile application infrastructure to address web engineering-related problems and issues that ensure user acceptance, testing, and quality assurance.	PO6	Affective (A4)	20%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	20%	30%	10%	60%
Midterm Exam	10%	10%		20%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation			5%	5%
Class Participation			5%	5%
Total	35%	45%	20%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	Introduction to Web Engineering • Functional Component, Internet and World Wide Web architecture, protocols, back-end, RESTful web architecture, Uniform Interface, Cacheable, and Client-Server architecture	T	T
3-4	Overview of Web and Internet Protocols • TCP, UDP, HTTP, HTTPS, FTP, SMTP, SOAP	T	T
5-6	Overview Web Framework Architecture: • Layered approach • Presentation, business, data presentation, and database persistence layer.	T	T
8-14	Hexagonal Architecture and Web development life cycle • UI design and concepts, Input and output port, REST adapter, use case, application business logic, domain business logic, database application logic, database and persistence storage.	T	T
15-16	Overview Clear and Onion Architecture • Components, layer model, domain services, application services, infrastructure, and observability services.	T	R
17-20	UI design and UI models • React Model, Typescript, javascript, Angularjs, CCS	T	R
21-23	MVVM and mobile application design • Understanding MVVM and hexagonal model, View, View Model, Data Binding	T	R
23-24	Mobile Application Development Platform • Swift, Cotlin, and Flutter	T	T
25-26	Web application Server Platform • Apache, nginx, NodeJs, Django and so on, log management	T	R
27-28	Web Application Security • TLS, Certified Authority, PCI data security, firewall, MITM, Fishing attack, Web poisoning, DoS, DDoS attack.	T	T

For the definitions of T and R , Please refer to Section 3.

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University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 3105 Algorithm Engineering

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 1st semester 2024**
Course Code	CSE 3105
Course Title	*Algorithm Engineering*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	CSE 2203 Design and Analysis of Algorithms

2 Syllabus

NP Completeness: Detailed exploration of P, NP, NP-hard, NP-complete, Co-NP, and PSPACE, with focus on polynomial time verification, NP-completeness and Reducibility, proving NP-completeness, examples of NP-complete problems, the Satisfiability Problem and Cook's Theorem. **Exact Exponential Algorithms and Approximation or Non-Exact Algorithms:** Coverage includes Dynamic Programming for the Traveling Salesman Problem (TSP), a branching algorithm for the Independent Set Problem, parameterized algorithms for the Vertex Cover Problem, and discussions on undecidability and the Halting problem. Also included are a 2-approximation algorithm for vertex cover, PTAS and FPTAS for the knapsack problem, and a look at various problems such as the vertex-cover problem, the traveling salesman problem, the Hamiltonian Cycle problem, the set-covering problem, Maximum Cut, Steiner Tree Problem, and Job shop scheduling. **Heuristic and Metaheuristic:** This segment offers an overview of Heuristics and Metaheuristics, fundamentals of Simulated Annealing, temperature schedule and cooling strategies, acceptance probabilities in Simulated Annealing, applications of Simulated Annealing, and discusses the performance and limitations of Metaheuristics, including trade-offs and case studies. **Computational Geometry:** Focuses on basics and applications, Convex Hull, Graham Scan Algorithm, Quick Hull Algorithm, parallelized versions of Convex Hull algorithm, Voronoi Diagram, and Fortune's Algorithm (Sweep Line Algorithm). **String Matching:** This part of the course covers the naive string matching algorithm, the Rabin-Karp algorithm, string matching with finite automata, Knuth-Morris-Pratt algorithm, and Suffix Arrays. **Backtracking:** Topics include basics and applications, Graph coloring, n-Queen, understanding the concept of branch and bound in backtracking, and the impact of pruning techniques on improving the performance of backtracking. **Online Algorithms:** Basics and applications, Ski-Rental Problem, K-Server Problem, Linear-List Search Problem, Waiting for an Elevator, Online Caching, distinguishing online and anytime algorithms, and ways of proving anytime property of an algorithm. **Linear Programming:** Basics and applications, formulating problems as linear programs, and duality.

3 Text and Reference Materials

T Textbook:

- *Cormen, T. H., Leiserson, C. E., Rivest, R. L., Stein, C.*, **Introduction to Algorithms**, 4th Edition, MIT Press, 2022.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Compare the time and space complexities of computational problems.	PO1,P02	Cognitive (C4), Affective(A1, A2)	25%	Please refer to Section 5
CO2	Design feasible and useful algorithms (such as fast, exact algorithms, approximation algorithms, randomized algorithms, heuristics, and metaheuristics) for computationally hard optimization problems.	PO3	Cognitive (C6), Affective(A1, A2)	50%	
CO3	Analyze performance parameters and their trade-off.	PO4	Affective (c4), Affective(A1, A2)	25%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome* (Appendix: ??)
LoBT: *Level of Bloom's Taxonomy* (Appendix: ??)

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	15%	30%	15%	60%
Midterm Exam	5%	10%	5%	20%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation		5%		5%
Class Participation			5%	5%
Total	25%	50%	25%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1-3	**NP Completeness**: Detailed exploration of P, NP, NP-hard, NP-complete, Co-NP, and PSPACE, Polynomial time verification, NP-completeness and Reducibility, Proving NP-completeness, Examples of NP-complete problems, Satisfiability Problem and Cook's Theorem	T	T

4-8	**Exact Exponential Algorithms and Approximation/Non-Exact Algorithms**: Dynamic Programming for Traveling Salesman Problem (TSP), Branching algorithm for Independent Set Problem, Parameterized Algorithms for Vertex Cover Problem, Undecidability and the Halting problem, 2-approximation algorithm for vertex cover, PTAS and FPTAS for knapsack, Independent set problems in planar graphs, The vertex-cover problem, The traveling salesman problem, The Hamiltonian Cycle problem, The set-covering problem, Maximum Cut, Steiner Tree Problem, Job shop scheduling	T	T
9-12	**Heuristic and Metaheuristic**: Overview of Heuristics and Metaheuristics, Fundamentals of Simulated Annealing, Temperature Schedule and Cooling Strategies, Acceptance Probabilities in Simulated Annealing, Applications of Simulated Annealing, Performance and Limitations of Metaheuristics, Trade-offs and Case Studies	T	T
13-15	**Computational Geometry**: Basics and Applications, Convex Hull - Graham Scan Algorithm, Quick Hull Algorithm, Parallelized versions of Convex Hull algorithm, Voronoi Diagram - Fortune's Algorithm (Sweep Line Algorithm), Divide and Conquer	T	T
16-18	**String Matching**: The naive string matching algorithm, The Rabin-Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm, Suffix Arrays	T	T
19-20	**Backtracking**: Basics and applications, Graph coloring, n-Queen, Understanding the concept of branch and bound in backtracking, Impact of pruning techniques on improving the performance of backtracking	T	T
21-24	**Online Algorithms**: Basics and applications, Ski-Rental Problem, K-Server Problem, Linear-List Search Problem, Waiting for an Elevator, Online Caching, Distinguishing Online and Anytime Algorithms, Ways of Proving Anytime Property of an Algorithm	T	T
25-26	**Linear Programming**: Basics and applications, Formulating problems as linear programs, Duality	T	T

For the definitions of **T** and **R** , Please refer to Section 3.

TBA
Course Teacher, CSE 3105
April 24, 2024

Chairman, Dept. of CSE, DU
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University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 3109 Operating System

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 1st semester 2024**
Course Code	CSE 3109
Course Title	*Operating System*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	CSE 2205: Microcontroller and Embedded System

2 Syllabus

Introduction: Operating system overview, types of operating system, computer system structure, structure and components of an operating system, and introduction to RTOS: DUOS. **System calls**: class of system calls and description, ARM system call (SVC). **Process and threads**: process and thread model, process and thread creation (TCB) and termination, user and kernel level thread, scheduling, scheduling algorithms, dispatcher, context switch, real-time scheduling, ARM SysTick, PendSV, Process Stack. **Concurrency and synchronization**: IPC and inter-thread communication, critical region, critical section problems and solutions, ARM semaphore, and Exclusive Access. **Resource management**: introduction to deadlock, ostrich algorithm, deadlock detection and recovery, deadlock avoidance, deadlock prevention, starvation. **Memory management**: basic memory management, fixed and dynamic partition, virtual memory, segmentation, paging and swapping, MMU, ARM MPU. **Virtual memory management**: paging, page table structure, page replacement, TLB, exception vector, demand paging, segmentation, thrashing, and performance. **File management**: File Naming and structure, file access and attributes, system calls, file organization: OS and user perspective view of the file, memory mapped file, file directories organization. **File System Implementation**: implementing file, allocation strategy, allocation method, directory implementation, UNIX inode, block management, quota, and example and case study file system. **I/O management**: I/O Devices, I/O Bus architecture, controller, interrupts, DMA, programmed I/O, ARM Interrupt and DMA. **Disk I/O management**: structure, performance, low-level disk formatting, Disk-Arm scheduling algorithm, error handling, SSD, and stable storage. **Operating System Security**: Concept of Computer Virus, Malware, Trojan Horse, DoS, Access control: Authentication and Authorization. Case study: Linux variant, windows, embedded and HPC OS

3 Text and Reference Materials

T Textbook:

- *Andrew S. Tanenbaum*, **Modern Operating System**, Pearson, Fourth Edition, March, 2014.
- *Joseph Yiu*, **The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors**,3rd Edition, November 2013.

R References:

- *Silberschatz and P.B. Galvin*, **Operating System Concepts**, Addison Wesley.
- *William Stallings*, **Operating Systems: Internals and Design Principles**, Pearson, 8th edition (February 2, 2014).
- *A. Tannenbaum, A. Woodhull*, **Operating Systems – Design and Implementation**, Pearson, 3rd edition, Jan 2006.
- *John O'Gorman*, **Operating Systems**, MacMillan.
- *Uresh Vahalla*, **UNIX Internals: The New Frontiers**, Prentice Hall, 1996.
- *McKusick et al.*, **The Design and Implementation of the 4.4 BSD Operating System**, Addison Wesley, 1996.
- Lectures in various social media.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Apply knowledge to visualization, understand design trade-offs and decisions and their dependence on the target environment, esteem the distinction between mechanisms and policies, be exposed to low-level system code, and understand current operating systems research and development trends.	PO1	Cognitive (C3)	35%	Please refer to Section 5.
CO2	Analyzing design methodologies of operating kernel systems calls the links between hardware and kernel and interaction between process, threads, and process scheduling, including handling concurrency control and deadlock. Investigating techniques for physical and virtual memory management, online file systems, storage management, and methodologies	PO2	Cognitive (C4)	45%	
CO3	Apply the knowledge obtained to comprehend the role of modern operating systems architecture on embedded systems, desktops, and server systems, including the design and role of the OS system ingredients from the cybersecurity facet.	PO6	Affective (A4)	20%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	20%	30%	10%	60%
Midterm Exam	10%	10%		20%
Class Test/Quiz	5%	5%		10%

Assignment/Presentation			5%	5%
Class Participation			5%	5%
Total	35%	45%	20%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	Introduction to Operating Systems and Computer Hardware • types of the operating system, architecture, components, computer basic resources, and memory. Operating system examples.	T	T
3-5	ARM Cortex-4/7 processor architecture review and System call • ARM Cortex processor available facilities to design operation system kernel system call, algorithm for invoking system call and returns.	T	T
6-7	Process and Thread • Process and thread architecture • process and thread creation, termination and process control block • variable and code memory mapping	T	T
8-9	Process and thread scheduling • Design of process scheduling algorithm and examples and performance evaluation, • Role of SysTick (system timer) and PendSV (pending exception) services for process scheduling, • process stackframe • realtime scheduling.	T	T
10-11	Concurrency and Synchronization • System resources and inter-process communication • concurrent and synchronization algorithms their correctness, • review interrupt, test-and-set, semaphore, mutex, lock of ARM processor.	T	T
12-13	Resource management – Deadlock handling, • Cause of deadlock, • deadlock prevention prevention, avoidance and detection algorithms • Recovery from deadlock, • process starvation and best effort solution	T	T
14-16	Memory management, • fixed, dynamic partition memory allocation • paging and swapping, • virtual memory management: TLB, demand paging, demand segmentation, trashing and performance. • page replacement algorithms • Aceess violation and considering ARM MPU, • Demand paging design considerations	T	T
17-18	File system management • File naming, data structure, access and attributes • OS file system call • directory and file organization, memory mapped file	T	T
19-20	File system implementation • File allocation methods, • Unix inode concepts, block mana gement, • file access, quotas, • journaling ext4, xfs file system case study.	T	T
21-22	I/O management • Types of I/O devices, I/O bus controller, • interrupt, poling and DMA for I/O data communication. • Review ARM interrupt and DMA Problem-solving practices,	T	T
23-24	Disk I/O management • Disk structure, format and disk arm scheduling, • error handling • SSD and state disk management • Stable storage: RAIDx	T	T

25-26	Operating system Security: • Concept and taxonomy of computer Virus, malware, trojan horse, DoS attack. • Access control: authentication and authorization	T	T
27-28	Case study • Linux variant, Microsoft Windows, MacOS, IOS, Android OS, RTOS and embedded system OS	R	R

For the definitions of **T** and **R** , Please refer to Section 3.

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Chairman, Dept. of CSE, DU
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University of Dhaka

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University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 3110 Operating System Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 1st semester 2024**
Course Code	CSE 3110
Course Title	*Operating System Lab*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	Assembly language, C Programming, Data Structure, Microcontroller

2 Syllabus

The Operating System lab intends to provide students hands-on experience developing operating system components on a bare metal hardware platform under DUOS (developed by CSE, DU). The students must demonstrate sufficient knowledge of GNU C/C++, GCC Makefile, Linkers, ARM assembly language, data structure, and algorithms, as demonstrated in the operating system theory courses. The lab intended to design and implement the various components and concepts acquired in the CSE3109 operating system theory courses. The students will given five to six complex lab assignments on the OS system call (using SVC exception) design and implementation on ARM Cortex-4/7 processors, process creation and execution, process scheduling (process single/multilevel queue), synchronization, and concurrency control using ARM Test-And-Set, semaphore, and lock, assignment on deadlock algorithm implementation, process stackframe handling. Next, students will develop dynamic memory allocation from the heap and free heap memory, device driver, and double/Single buffer I/O management (character, block I/O, wifi, sensors, GPS, GSM, etc.). Next, the students will implement a file system on microSD memory and graphical I/O assignment using a multi-touch TFT LCD Touchscreen display with multi-touch, including neoGPU.

3 Text and Reference Materials

T Textbook:

- *ARM Limited*, Cortex-M4 Revision r0p0 Technical Reference Manual Revision r0p0, 2009/10
- *Joseph Yiu*, **The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors**,3rd Edition
- *STMicroelectronics*, PM0214 Programming manual, Rev. Doc ID 022708 Rev 3, Sept, 2013

R References:

- *Andrew S. Tanenbaum*, **Modern Operating System**, Pearson, Fourth Edition, March, 2014.
- *STMicroelectronics*, **STM32F446xx of M7 advanced Arm®-based 32-bit MCUs - Reference manual**, RM0390 Rev 6 (M4), STMicroelectronics Online, March 2021.
- *STMicroelctronics*, Datasheet - STM32F446xC/E - Arm® Cortex®-M4/7 32-bit micocontroller, DS10693 Rev 10, Jan, 2021

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Analyze understand the assignment problem and selection of suitable algorithms and techniques to solve the given problem	PO2	Cognitive (C2)	25%	Please refer to Section 5.
CO2	Design and solve the given operation system assignment problem on bare-metal hardware with minimal DUOS implementation. Demonstrate and present the solution.	PO3	Cognitive (C3)	60%	
CO3	Continuous presences in the lab, evaluate the progress of the given assignment	PO9	Psychomotor (P5)	15%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Class Participation			10%	10%
Continuous Lab Performance	10%	5%	5%	20%
Viva, Lab Presentation and Demonstration	10%	50%		60%
Lab Reports	5%	5%		10%
Total	25%	60%	15%	100%

6 Lab Activity Outline

Assignment No	Experiment Title	CO	Activities
1	*Design and implement DUOS, Makefile, Linker, boot process and basic I/O driver	CO1	Coding and Demonstration
2	*Design and Implementation of System call (ARM SVCall) mechanism and separation kernel and userspace	CO2	Coding and presentation and demonstration
3	*Process and Thread creation (fork, exec services, etc.), cloning, stack memory assignment, and heap memory allocation and management implementation.	CO2	Coding, presentation and demonstration
4	*Design and deployment of Scheduling Queue (Single and multi-level), scheduling algorithms: time sharing, FCFS, and priority and their performance comparison.	CO2	Coding, presentation, demonstration, and Report Writing
5	Process synchronization and concurrency control	CO2	Coding and demonstration
6	Deadlock creation and implementation of deadlock detection/avoidance and recovery algorithms	CO2	Coding, presentation and demonstration

7	Implement demand paging and page replacement algorithm	CO2	Coding, presentation and demonstration
8	Designing inode and simple file system implementation	CO2	Coding, presentation and demonstration
9	*Designing and implementing various device drivers and I/O buffer	CO2	Coding, presentation and demonstration
10	Security IDS signature management and scanning for finding affected resources.	CO2	Coding, presentation and demonstration
11	Final Report, including selected lab assignments from the above list (compulsory).	CO3	Online report submission

* Compulsory

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April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka
Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
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University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 3201 Computer Network

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 2nd semester 2023**
Course Code	CSE 3201
Course Title	*Computer Network*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	CSE 2109 - Data and Telecommunication

2 Syllabus

Introduction to Computer Networks: Functional components of the Internet, Protocol layers, Protocol standards, Network Performance metrics (delay, loss, throughput, jitter, etc.), Packet switching principles. **Application Layer: Network application architecture, Client-server, and peer-to-peer models,** Design details of HTTP protocol versions 1.1 through 3.0, FTP, SMTP, IMAP, DNS; Proxy and Web caching, P2P file distribution, HTTP stream and DASH protocols, Content Delivery Networks (CDNs). **Transport Layer:** Protocol overview of UDP and TCP, Multiplexing and Demultiplexing, Internet Checksum; Reliable Data Transfer, Flow Control, Congestion Control - AIMD, Slowstart, Congestion Avoidance, Fast Retransmission and Fast Recovery techniques; TCP Tahoe, TCP Reno, TCP New Reno, TCP CUBIC; Throughput and Fairness performances of TCP protocol versions. **Network Layer:** Forwarding and Routing functions at the Data plane and Control plane, Functional components of a router; Overview of IPv4 and IPv6, IP Addressing, subnetting and supernetting, NAT, DHCP, Generalized forwarding in Software Defined Networking (SDN), and Middleboxes; Link State (LS) and Distance Vector (DV) Routing Algorithms, Autonomous Systems, and their categories, OSPF, IGRP, and EIGRP, and BGP; Software Defined Networking - OpenFlow Protocol and SDN controller functionalities - ODL and ONOS controller designs. **Wireless Networks** Introduction to wireless networks, Types of wireless networks, Medium Access Control in Wireless Networks, Routing in Wireless Networks, Mobility and Mobile IPv6.

3 Text and Reference Materials

T Textbook:

- *J. F. Kurose and K. W. Ross*, **Computer Networking: A Top Down Approach**, 8th Edition, Pearson Publications, 2020.

R References:

- *Andrew Tanenbaum & David Wetherall*, **Computer Networks**, Fifth Edition, Pearson, 2010.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Apply the knowledge of sciences and engineering fundamentals to interpret the elementary concepts of various architectures, applications, protocols, and background processes dealing with networking architecture and protocol design related problems.	PO1	Cognitive (C3)	40%	Please refer to Section 5.
CO2	Analyze operational details of various protocols, related to application, transport, and routing layers to apply the specialist engineering knowledge to solve the complex networking infrastructure development problem.	PO2	Cognitive (C4)	50%	
CO3	Establish a reliable protocol while planning and designing network services infrastructure, to address networking-related problems and issues that ensure user Quality of Service (QoS) and Quality of Experience (QoE).	PO6	Affective (A4)	10%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	25%	35%		60%
Midterm Exam	10%	10%		20%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation			5%	5%
Class Participation			5%	5%
Total	40%	50%	10%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	Networking and Socialization, sharing course administration and guidelines • What's the Internet? What's a protocol? Network edge, network core; Access net, physical media;	T	T
3-4	Internet/ISP structure; • Performance: traffic intensity, loss, delay ; Protocol layers, service models • network modeling and fundamentals of network security	T	T

5-7	Principles of network applications: app architectures and app requirements; • Client-Server and Peer-to-Peer Applications, Socket • Web and HTTP Protocols - version 1.1, 2.1, 2.2, 3.0, • Web Caching, Cookies • File Transfer Protocol (FTP) and Electronic Mail: SMTP, POP3, IMAP	T	T
8-10	Domain Name System (DNS): Architecture, database, operational records and DNS caches • P2P file sharing protocols, Socket programming with TCP and UDP, Content Distribution Networks (CDNs), and HTTP streaming and DASH Protocols	T	T
11-14	Transport layer services • Multiplexing and demultiplexing; • Connectionless transport: UDP, and Principles of reliable data transfer, Connection oriented transport TCP): segment structure, Principles of UDP Communications, UDP Checksum and Internet Checksum	T	T
15-17	Principles of flow control, connection management Principles of congestion control • TCP congestion control Algorithms: TCP Tahoe, TCP Reno, TCP New Reno, TCP CUBIC • Evolution of Transport layer functionality Problem solving on practical problems related to Application and Transport layer protocols	T	T
18-21	Introduction to Network Data plane functionalities: Forwarding, Connection setup; Virtual circuit and datagram networks; What's inside a router? Organization and functionalities of a router. • IP: Internet Protocol Datagram format, IPv4 addressing CIDR, sub and super netting • DHCP, NAT, and ICMP protocols •IPv6 header format, changes compared to IPv4, Transition from IPv4 to IPv6, Tunneling, Security, etc	T	R
22-25	Network Control Plane Functionalities: Routing algorithms - Link state Routing, Distance Vector Routing and Hierarchical routing Algorithms • Routing in the Internet Autonomous Systems, OSPF, and BGP fundamentals: iBGP and eBGP • Generalized Forwarding and Software Defined Networking, SDN Control plane, Open Flow Protocol, Interaction between data and control planes of SDN - ODL and ONOS controllers.	T	T
26-27	Introduction to Wireless and Mobile Networks • Elements of a wireless network; Wireless Link standards and their characteristics; CDMA; Noise, interference and hidden terminal problems • IEEE 802.11a/b/g systems; IEEE 802.11 MAC Protocol CSMA/CA; CSMA/CA with RTS/CTS; Cellular network architecture 4G, 5G, and beyond systems.	T	T
28	Reviews, Future Internet and its Challenges • Problem solving practices, • Assignments/Presentations, etc.	T	R

For the definitions of T and R , Please refer to Section 3.

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April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
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University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 3202 Computer Network Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 2nd semester 2024**
Course Code	CSE 3202
Course Title	*Computer Network Lab*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	None

2 Syllabus

The Computer Network lab is designed to provide students with hands-on experience in the design and development of various network application architectures and operational insights of network protocols at different layers. The students will analyze the performances of HTTP, DNS, SMTP. P2P, TCP Tahoe, TCP Reno, TCP CUBIC, and DASH protocols in terms of network throughput, fairness, delay, jitter, loss, and user quality of experience metrics for a given network scenario. Through implementation and deeper analysis of data traffic, the students will be able to identify suitable network design components and communication protocols applicable for meeting user service demands.

3 Text and Reference Materials

T Textbook:

- *J. F. Kurose and K. W. Ross*, **Computer Networking: A Top Down Approach**, 8th Edition, Pearson Publications, 2020.

R References:

- *Andrew Tanenbaum & David Wetherall*, **Computer Networks**, Fifth Edition, Pearson, 2010.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Analyze performances of the application layer and transport layer protocols in terms of throughput, delay, jitter, loss, and user quality of experience of a given network.	PO2	Cognitive (C2)	25%	Please refer to Section 5.
CO2	Evaluate the effectiveness of a network design topology using a given routing protocol and data protection algorithm.	PO3	Cognitive (C3)	30%	
CO3	Communicate effectively the data-analysis-driven choice of an application framework, network protocol, and a security algorithm for addressing real-life complex network engineering problems both in written and oral forms.	PO10	Psychomotor (P5)	45%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Class Participation			10%	10%
Continuous Lab Performance	5%	5%	5%	15%
Lab Reports		5%	5%	10%
Lab Presentation and Demonstration			30%	20%
Capstone Project or Demo/Presentation	10%	15%	5%	30%
Total	25%	30%	45%	100%

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April 24, 2024

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April 24, 2024

University of Dhaka

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Course Outline - CSE 3203 Artificial Intelligence

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 2nd semester 2024**
Course Code	CSE 3203
Course Title	*Artificial Intelligence*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	CSE 2203: Design and Analysis of Algorithms

2 Syllabus

Basics of Artificial Intelligence: Foundation and Brief history of Artificial Intelligence (AI), Turing test, Total Turing test, Applications of AI. **Intelligent Agents:** Agents and its variants, concept of rationality, Performance measure, task environment, Agent program types, Representation of agent programs and their impact. **Problem solving in AI through searching:** Problem formulation, Uninformed search strategies: BFS, DFS, UCS, DLS, IDS, Bidirectional search, applicability and performance measure, Informed search strategies: Greedy Best First Search, A* search, Weighted A*, Heuristic information, Heuristic function and admissibility. **Population-based Nature inspired Optimization Algorithms:** Genetic Algorithms, Swarm intelligence: Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO), Simulated Annealing **Adversarial Search:** Search in a competitive environment, Basics of Game theory and Mechanism design, Dominant strategy, Equilibrium, Nash Equilibrium, Optimal decision in games, Mini-Max Algorithm, Alpha-Beta Pruning, Monte Carlo Tree Search (MCTS). **Constraint Satisfaction Problem:** Constraint graph, constraint optimization problems, Inference in CSP, Enforcing consistency, Backtracking search and its extensions for solving CSP, Local search for CSPs: Min-conflict heuristic. **Knowledge-based agents and Logic in AI:** History of Logic within the context of AI, Propositional logic, First order predicate logic, Normal Forms – Disjunction and Conjunction Normal Forms, Logical inference: Resolution, Higher order logic. **Expert Systems:** Basics and variants of expert systems, Rule-based expert systems, inference techniques, Fuzzy expert systems, Degree of Membership and Fuzzy inference. **Utility based Agents and Decision Theory:** Decision theoretic agent, utility theory, Bayesian Reasoning, Bayesian Network, Influence/Decision diagram, Markov property, Markov Decision Process, Bellman Equation, MDPs impact on model-free and Model-based settings, Value iteration algorithm, Policy iteration algorithm and Q-learning algorithm, Hidden Markov Model: Evaluation problem, Decoding problem, learning problem and their solution methods (forward algorithm, Viterbi algorithm, The Baum-Welch Algorithm, etc.) **Artificial Neural Networks:** Perceptron, Hebbian Learning, Linear and non-linear separability, Multi-layer perceptron, Forward Propagation, Backpropagation and its variations. **Ethics in AI:** Bias and Fairness, Privacy and Security, Explainability, Transparency, etc.

3 Text and Reference Materials

T Textbook:

– *S. Russell and P. Norvig* , **Artificial Intelligence: A Modern Approach**, 4th Edition, Prentice Hall, 2020.

4 Course Outcomes

CO	CO Description	PO	Domain	Weight	Assessment Methods
CO1	Understand and describe foundational concepts and history of Artificial Intelligence, including Turing tests and various AI applications.	PO1	Cognitive (C2)	25%	Please refer to Section 5
CO2	Apply problem-solving techniques in AI using search strategies and understand the design and analysis of intelligent agents.	PO3	Cognitive (C3)	23%	
CO3	Learn, implement, and analyze various optimization techniques, expert systems, decision-making algorithms such as Markov Decision Processes, and learning algorithms including Neural Networks.	PO4	Cognitive (C4)	25%	
CO4	Evaluate the ethical implications in AI practices, focusing on bias, fairness, and transparency, and explore advanced topics like neural networks and decision-making processes in AI.	PO12	Cognitive (C5)	27%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome* **(Appendix: ??)**
LoBT: *Level of Bloom's Taxonomy* **(Appendix: ??)**

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	CO4	Total
Final Exam	15%	15%	15%	15%	60%
Midterm Exam	5%	5%	5%	5%	20%
Class Test/Quiz	5%	3%	2%	0%	10%
Assignment/Presentation	0%	0%	0%	5%	5%
Class Participation	0%	0%	3%	2%	5%
Total	25%	23%	25%	27%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1	**Basics of Artificial Intelligence**: Foundation and Brief history of Artificial Intelligence (AI), Turing test, Total Turing test, Applications of AI	T	T

2-3	**Intelligent Agents**: Agents, concept of rationality, Performance measure, Environment, Actuators and Sensors, Properties of task environment: observability, determinism, episodic vs sequential, static vs dynamic, discrete vs continuous, cooperative vs competitive, single agent vs multi-agent, Agent program types: Simple reflex agents, Model-based reflex agents, Goal-based agents, Utility-based agents, Learning agents, Representation of agent programs and their impact: Atomic, Factored, Structured	T	T
4-6	**Problem Solving in AI through Searching**: Problem formulation, level of abstraction, Uninformed search strategies: BFS, DFS, UCS, DLS, IDS, Bidirectional search, applicability and performance measure, Informed search strategies: Greedy Best First Search, A* search, Weighted A*, Heuristic information, Heuristic function and admissibility	T	T
7-9	**Population-based Nature Inspired Optimization Algorithms**: Genetic Algorithms, Swarm intelligence: Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO), Simulated Annealing	T	T
10-11	**Adversarial Search**: Search in a competitive environment, Basics of Game theory and Mechanism design, Dominant strategy, Equilibrium, Nash Equilibrium, Optimal decision in games - problem formulation, MiniMax Algorithm, Alpha-Beta Pruning, Monte Carlo Tree Search (MCTS)	T	T
11-13	**Constraint Satisfaction Problem**: Problem formulation, Constraint graph, Real world applications, Discrete and continuous domain, Varieties of constraints: Unary, Binary, Higher order, Global constraints, Impact of hard and soft constraints, constraint optimization problems, Constraint Propagation: inference in CSP, Enforcing consistency: Node, Arc, path and k-consistency, AC-3 algorithm, Backtracking search and its extensions for solving CSP, Local search for CSPs: Min-conflict heuristic	T	T
14-15	**Knowledge-based Agents and Logic in AI**: History of Logic within the context of AI, Propositional logic, First order predicate logic, Normal Forms – Disjunction and Conjunction Normal Forms, Conversion to Conjunctive Normal Forms, Logical inference: Resolution, Higher order logic	T	T
16-17	**Expert Systems**: Basics and variants of expert systems, Rule-based expert systems, forward chaining and backward chaining inference techniques, Fuzzy expert systems, Degree of Membership and Fuzzy inference	T	T
18-24	**Utility based Agents and Decision Theory**: Decision theoretic agent, utility theory - marginal utility, expected utility, value of information, maximum expected utility, Bayesian Reasoning, Bayesian Network, Influence/Decision diagram, Markov property, Markov Decision Process, Bellman Equation, Basics of Reinforcement Learning, MDPs impact on model-free and Model-based Reinforcement Learning, Value iteration algorithm, Policy iteration algorithm, Q-learning algorithm, Hidden Markov Model: Evaluation problem, Decoding problem, learning problem, Viterbi algorithm, Online belief update, forward algorithm	T	T
25-27	**Artificial Neural Networks**: Perceptron, Hebbian Learning, Linear and non-linear separability, Multi-layer perceptron, Forward Propagation, Backpropagation and its variations	T	T

28	**Ethics in AI**: Bias and Fairness, Privacy and Security, Explainability and Transparency	T	T

For the definitions of T and R , Please refer to Section 3.

Course Teacher, CSE 3203
April 24, 2024

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April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
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Second Science Complex, Mokarram Bhaban Area
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Course Outline - CSE 3204 Artificial Intelligence Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 2nd semester 2024**
Course Code	CSE 3204
Course Title	*Artificial Intelligence Lab*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	Check the prerequisite for the related theory course

2 Syllabus

This laboratory course is designed to provide practical experience in implementing and optimizing various artificial intelligence algorithms covered in the Artificial Intelligence course. Students will develop and test AI models using real-world data, focusing on search algorithms, optimization techniques, adversarial search, constraint satisfaction problems, decision theory, and artificial neural networks.

Prospective Lab Tasks Description

1. **Search Algorithms:**
   - Implementing and comparing uninformed and informed search strategies.
   - Developing heuristic functions and analyzing their effectiveness in search strategies.
2. **Nature-Inspired Optimization Algorithms:**
   - Implementing genetic algorithms and population-based optimization algorithms.
   - Analyzing the performance of these algorithms in solving optimization problems.
3. **Adversarial Search and Game Theory:**
   - Developing game-playing AI using the MiniMax algorithm and Alpha-Beta pruning.
   - Implementing Monte Carlo Tree Search to handle more complex game environments.
4. **Constraint Satisfaction Problems:**
   - Implementing and solving CSPs using backtracking, local search, and the AC-3 algorithm.
   - Applying these techniques to real-world scenarios like scheduling and planning.
5. **Decision Theory:**
   - Implementing decision-theoretic agents and exploring concepts like Markov Decision Processes and Q-learning.

- Creating models that simulate decision-making processes and optimize outcomes based on learned experiences.

6. **Artificial Neural Networks:**
   - Building and training neural networks, including perceptrons and multi-layer networks.
   - Exploring backpropagation and its variations in network training processes.

3 Text and Reference Materials

Check the textbook and reference list for the corresponding theory course.

4 Course Outcomes

CO	Description	PO	Domain Level	Assessment Methods
CO1	Implement and analyze various AI techniques including search algorithms, optimization methods, and machine learning models to solve practical problems.	PO1	Cognitive (C3)	Please refer to Section 5
CO2	Apply advanced AI strategies such as adversarial search, constraint satisfaction, and learning algorithms to develop intelligent systems that perform optimally in dynamic environments.	PO3	Cognitive (C4)	
CO3	Demonstrate proficiency in using modern AI tools and platforms for simulation, testing, and deploying AI solutions with a focus on ethical considerations and real-world applications.	PO4	Cognitive (C5)	
CO4	Effectively communicate and defend project methodologies and outcomes through structured presentations, demonstrating the ability to engage an audience and respond to real-time feedback.	PO6	Psychomotor (P3)	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	CO4	Total
Class Participation			10%		10%

Continuous Lab Performance	7%	8%	5%	10%	30%
Lab Reports		5%	5%		10%
Lab Viva-Voce			10%	10%	20%
Capstone Project or Demo/Presentation	5%	10%	5%	10%	30%
Total	25%	30%	45%		100%

Course Teacher, CSE 3204
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 3205 Information Security

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 2nd semester 2024**
Course Code	CSE 3205
Course Title	*Information Security*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	None

2 Syllabus

Security basics: Confidentiality, integrity and availability (CIA Triad), threats, vulnerabilities, attacks, and attack agents, and common security threats. **Cryptographic primitives**: Classical encryption schemes, symmetric cipher, stream cipher, RC4, block cipher and data encryption standard, advanced encryption standard, key distributions, random number generation, public key cryptography, certificates, digital signature, hash functions, message authentication code. **Internet protocols**: PGP, IPSec, SSL/TLS, HTTPS, Tor protocols, DNSSec, DNS cache poisoning attacks, email security. **Access control**: discretionary access control, mandatory access control, role-based access control (RBAC) and attribute-based access control (ABAC). **User Authentication**: password-based mechanism–dictionary and rainbow table attacks, token-based authentication, biometric-based authentication, remote authentication. **Denial of service attacks**: TCP vulnerabilities, denial of service attacks, Flooding attacks, DDOS attacks, reflector and amplifier attacks, defense against DOS, Botnets. **Web security**: PHP exploits, SQL injection, cross-site scripting, browser side exploits. **Malicious softwares**: types of Malware, infected content, vulnerability exploits, social engineering, system corruption, bots, zombie, key loggers, phasing, spyware, backdoors, counter measures. Buffer overflow exploits and defenses, Intrusion detection and prevention, defense in depth, firewalls-packet filtering and proxy-server based firewall.

3 Text and Reference Materials

T Textbook:

- *William Stallings*, **Cryptography and Network Security, Principles and Practice**, Eighth Edition, Pearson Publications.

R References:

- *William Stallings & Lawrie Brown*, **Computer Security Principles and Practices**, Fifth Edition, Pearson Publications.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Describe fundamental theories, models and practices of information security.	PO1	Cognitive (C3)	30%	Please refer to Section 5.
CO2	Analyze existing theory, models and methods in the field of information security.	PO2	Cognitive (C4)	40%	
CO3	Apply knowledge to both modeling the potential problems and the solutions at organization level and be able to communicate this problems and solutions using basic theoretical skills.	PO6	Affective (A4)	30%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	20%	25%	15%	60%
Midterm Exam	5%	10%	5%	20%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation			5%	5%
Class Participation			5%	5%
Total	30%	40%	30%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1	Networking and Socialization, sharing course administration and guidelines • Orientation and Basics of security: Security basics: Confidentiality, integrity and availability (CIA Triad), threats, vulnerabilities, attacks, and attack agents, and common security threats.	T	T
2-10	Cryptographic primitives: Classical encryption schemes, symmetric cipher, stream cipher, RC4, block cipher and data encryption standard, advanced encryption standard, key distributions, random number generation, public key cryptography, certificates, digital signature, hash functions, message authentication code.;	T	T
11-14	Internet protocols: PGP, IPSec, SSL/TLS, HTTPS, Tor protocols, DNSSec, DNS cache poisoning attacks, email security.	T	T

15	Access control: discretionary access control, mandatory access control, role-based access control (RBAC) and attribute-based access control (ABAC).	R	R
16-17	User Authentication: password-based mechanism–dictionary and rainbow table attacks, token-based authentication, biometric-based authentication.	R	R
18	Denial of service attacks: TCP vulnerabilities, denial of service attacks, Flooding attacks, DDOS attacks, reflector and amplifier attacks, defense against DOS Botnets.	R	R
19-20	Web security: PHP exploits, SQL injection, cross-site scripting, browser side exploits	R	R
21-22	Malwares: types of Malware, infected content, vulnerability exploits, social engineering, system corruption, bots, zombie, key loggers, phasing, spyware, backdoors, counter measures.	R	R
23	Buffer overflow exploits and defenses.	R	R
24-25	Intrusion detection and prevention, denfense in depth.	R	R
26-28	firewall-packet filtering and proxy based firewall.	R	R

For the definitions of T and R , Please refer to Section 3.

Course Teacher, CSE 3205
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
CSE 3206 Information Security Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 2nd semester 2024**
Course Code	CSE 3206
Course Title	*Information Security Lab*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	None

2 Syllabus

The Information Security Lab is designed to provide students with hands-on experience in detecting different types of security attack scenarios and devising solutions to handle those attacks. This laboratory-based course aims to complement the theoretical concepts covered in the corresponding theory lectures, enabling students to apply their knowledge in practical, real-world scenarios. This lab is divided into three parts: 1) solving different security problems related to cryptography using the Python programming language, and learning different cryptographic tools ,2) Simulation of security attacks using open source security tools, and 3) Experiments on system vulnerability testing tools.

3 Text and Reference Materials

T Textbook:

- *William Stallings*, **Cryptography and Network Security, Principles and Practice**, Eighth Edition, Pearson Publications.

R References:

- *William Stallings & Lawrie Brown*, **Computer Security Principles and Practices**, Fifth Edition, Pearson Publications.
- *Online available resources.*

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Understand the core features of cryptography and basic properties of different security attacks. Apply the relevant cryptographic features and knowledge of security.	PO1	Psychomotor (P4)	20%	Please refer to Section 5.
CO2	Analyze different security problems and devise solutions using Python programming language and open-source security tools.	PO5	Cognitive (C2)	30%	
CO3	Design a security model for a given scenario, incorporate different security features using programming language and available security tools, and implement a reliable system.	PO9	Cognitive (C6)	50%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Class Participation			10%	10%
Continuous Lab Performance	15%	10%	5%	30%
Lab Examination		10%	10%	20%
Capstone Project or Demo/Presentation	5%	10%	25%	40%
Total	20%	30%	50%	100%

Course Teacher, CSE 3206
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 3207 Theory of Computation

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 2nd semester 2024**
Course Code	CSE 3207
Course Title	*Thoery of Computation*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	CSE 1101 Discrete Mathematics

2 Syllabus

Fundamentals: Strings and their properties, Basics of automata, Transition systems. **Formal Languages and the Chomsky Hierarchy:** Regular, Context-Free, Context-Sensitive, Recursively Enumerable. **Finite Automata:** Basics of DFA & NFA, Constructions of DFA, Extended transition function for DFA and NFA, Subset construction, DFA minimization, Equivalence test, Finite Automata with outputs: Mealy and Moore Machines - construction and conversions. **Regular Languages, Regular Expressions, and their relationship:** Constructions of Regular Expressions. **Properties of Regular Languages:** Closure Properties, Arden's Theorem, Pumping Lemma for Regular Languages. **Context-Free Languages and Grammars:** Context-free grammar (CFG) basics and construction, Derivation trees, Ambiguous grammar, Construction of reduced grammar, Elimination of null and unit productions, Normal forms for CFG (CNF & GNF), Pumping Lemma for Context-Free Languages, CYK Algorithm. **Pushdown Automata:** Push down automata (PDA) basics and construction, PDA acceptance by final state and empty stack, PDA transformations, Relationship between Context-Free Languages and PDAs. **Context-Sensitive Languages and Linear Bounded Automata:** Context-sensitive languages (CSL) and construction, Context-sensitive grammars (CSG), Linear bounded automata (LBA), Relationship between CSLs and LBAs. **Turing Machines:** Basics of Turing machines and construction, Decidability and Undecidability, The Halting Problem.

3 Text and Reference Materials

T Textbook:

- *John E. Hopcroft, Rajeev Motwani and Jefrey D. Ullman*, **Introduction to Automata Theory, Languages and Computation**, 3rd Edition, Pearson, 2006.

R References:

- *K.L.P. Mishra and N.Chandrasekaran*, **Theory of Computer Science: Automata, Languages and Computation**, 3rd Edition, Prentice Hall, 2006.
- *John C. Martin*, **Introduction to Languages and the Theory of Computation**, 4th Edition, McGraw-Hill, 2010.

4 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	**Fundamentals**: Strings and their properties, Basics of automata, Transition systems, Formal Languages and the Chomsky Hierarchy (Regular, Context-Free, Context-Sensitive, Recursively Enumerable)	T	T
3-8	**Finite Automata**: Basics of DFA & NFA, Constructions of DFA, Extended transition function for DFA and NFA, Subset construction, DFA minimization, Equivalence test, Finite Automata with outputs: Mealy and Moore Machines - construction and conversions	T	T
9-11	**Regular Languages, Regular Expressions, and their relationship**: Constructions of Regular Expressions, Closure Properties, Arden's Theorem, Pumping Lemma for Regular Languages	T	T
12-16	**Context-Free Languages and Grammars**: Context-free grammar (CFG) basics and construction, Derivation trees, Ambiguous grammar, Construction of reduced grammar, Elimination of null and unit productions, Normal forms for CFG (CNF & GNF), Pumping Lemma for Context-Free Languages, CYK Algorithm	T	T
17-19	**Pushdown Automata**: Push down automata (PDA) basics and construction, PDA acceptance by final state and empty stack, PDA transformations, Relationship between Context-Free Languages and PDAs	T	T
20-23	**Context-Sensitive Languages and Linear Bounded Automata**: Context-sensitive languages (CSL) and construction, Context-sensitive grammars (CSG), Linear bounded automata (LBA), Relationship between CSLs and LBAs	T	T
24-27	**Turing Machines and Undecidability**: Basics of Turing machines and construction, Decidability and Undecidability, The Halting Problem	T	T

For the definitions of T and R , Please refer to Section 3.

Course Teacher, CSE 3207
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4101 Machine Learning

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 1st semester 2024**
Course Code	CSE 4101
Course Title	*Machine Learning*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	CSE 3203 Artificial Intelligence

2 Syllabus

Introduction to Machine Learning: History and evolution of machine learning; Key types of machine learning: Supervised, Semi-Supervised, Unsupervised, Reinforcement; Real world applications of machine learning; Basic concepts: Features, Labels, Training data, Test data, Concept of model validation. **Supervised Learning: Classification**- Decision Trees: Attribute Selection Measures (Information Gain, Gain Ratio, Gini Index), Tree Pruning, Scalability; Bayesian Classifier: Naïve Bayesian and Bayesian Belief Network; K-Nearest Neighbors (KNN); Logistic Regression; Rule-Based Classification; Support Vector Machines (SVM). Artificial Neural Networks - Perceptron, Multi-Layer Perceptrons and Deep Learning; Activation Functions (ReLU, Leaky ReLU, tanh, softmax, etc.), Cost functions, Loss functions, Optimizers-Gradient Descent and beyond – SGD with Momentum, Adam, etc. **Regression**- Simple and Multiple Linear Regression; Polynomial Regression; Bias-Variance Trade-off; Overfitting and Underfitting; Regularization. **Model Evaluation & Fine Tuning:** Metrics: Confusion matrix, Accuracy, Precision, Recall, F and F_β measures, ROC-AUC; Error Metrics: Mean Absolute Error (MAE); Mean Squared Error (MSE); Preparing Training and Test Datasets: Holdout method, Random subsampling, Cross-validation techniques, Bootstrap; Model Selection using Statistical Tests of Significance, Feature Engineering, Learning Theory. **Aggregating Multiple Models to Improve Classification Performance:** Introducing Ensemble Methods, Bagging, Boosting, Random Forests. **Learning with Insufficient Training Data:** Semi-Supervised Learning, Transfer Learning, Active Learning. **Unsupervised Learning: Clustering**- Partitioning Methods: k-Means, k-Medoids; Hierarchical Methods; Density-Based Methods; Probabilistic Model-Based Clustering; Clustering High-Dimensional Data; Evaluation of Clustering; Outlier Detection Methods. **Reinforcement Learning:** Brief review of MDPs, Q-learning and limitations of tabular Q-learning with large state/action spaces. Function Approximation - The need to represent Q-values with neural networks. Deep Q-Networks (DQNs), Policy Gradients.

3 Text and Reference Materials

T Textbooks:

- *Tom M. Mitchel*, **Machine Learning**, First Edition, McGraw-Hill Education.

– *Peter Flach*, **Machine Learning: The Art and Science of Algorithms that Make Sense of Data**, First Edition, Cambridge University Press.

R References:

– *Jiawei Han, Jian Pei, H. Tong*, **Data Mining: Concepts and Techniques**, 4th Edition, Morgan Kaufmann Publishers, Elsevier.

– *Dirk P. Kroese, Zdravko I. Botev, Thomas Taimre, Radislav Vaisman*, **Data Science and Machine Learning: Mathematical and Statistical Methods**, 4th Edition, CRC Press, Taylor and Francis.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Learn the basics of ML algorithms and based on that guidance solve real-life ML problems in response.	PO3	Psychomotor (P3-Guided Response)	40%	Please refer to Section 5.
CO2	Evaluate the performance of an ML solution with analysis and investigation.	PO4	Cognitive (C5-Evaluating)	40%	
CO3	Designing optimized ML models gradually based on the feedback from the previous learning and deploying new cutting-edge techniques wherever needed.	PO5	Cognitive (C6- Creating/Designing)	20%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	25%	20%	15%	60%
Midterm Exam	10%	10%		20%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation		2%	3%	5%
Class Participation		3%	2%	5%
Total	40%	40%	20%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	**Introduction to Machine Learning:** History and evolution of machine learning; Key types of machine learning: Supervised, Semi-Supervised, Unsupervised, Reinforcement; Real world applications of machine learning; Basic concepts: Features, Labels, Training data, Test data, Concept of model validation to emphasize the importance of evaluating model performance on unseen data.	T	T
3-9	**Supervised Learning: Classification**- Decision Trees: Attribute Selection Measures (Information Gain, Gain Ratio, Gini Index), Tree Pruning, Scalability; Bayesian Classifier: Naïve Bayesian and Bayesian Belief Network; K-Nearest Neighbors (KNN); Logistic Regression; Rule-Based Classification; Support Vector Machines (SVM). Artificial Neural Networks - Perceptron, Multi-Layer Perceptrons and Deep Learning Activation Functions: ReLU, Leaky ReLU, tanh, softmax, etc., Loss functions Optimizers: Beyond Gradient Descent – SGD with Momentum, Adam, etc.	T	T
10-12	**Supervised Learning: Regression**- Introduction to Cost Functions and Gradient Descent; Simple and Multiple Linear Regression; Polynomial Regression; Bias-Variance Trade-off; Overfitting and Underfitting; Regularization.	T	T
13-15	**Model Evaluation & Fine Tuning:** Metrics: Confusion matrix, Accuracy, Precision, Recall, F and $F\beta$ measures, ROC-AUC; Error Metrics: Mean Absolute Error (MAE); Mean Squared Error (MSE); Preparing Training and Test Datasets: Holdout method, Random subsampling, Cross-validation techniques, Bootstrap; Model Selection using Statistical Tests of Significance, Feature Engineering, Learning Theory.	T	T
16-17	**Aggregating Multiple Models to Improve Classification Performance:** Introducing Ensemble Methods, Bagging, Boosting, Random Forests.	T	T
18-19	**Learning with Insufficient Training Data:** Semi-Supervised Learning, Transfer Learning, Active Learning.	T	T
20-24	**Unsupervised Learning: Clustering**- Partitioning Methods: k-Means, k-Medoids; Hierarchical Methods: Agglomerative, Divisive, BIRCH; Density-Based Methods: DBSCAN, OPTICS; Probabilistic Model-Based Clustering: Expectation-Maximization Algorithm; Clustering High-Dimensional Data; Evaluation of Clustering; Outlier Detection Methods.	T	T
25-28	**Reinforcement Learning:** Brief review of MDPs, Q-learning and limitations of tabular Q-learning with large state/action spaces. Function Approximation: The need to represent Q-values with neural networks. Deep Q-Networks (DQNs): (i) Architecture: How a neural network approximates the Q-function. (ii) Experience Replay: Stabilizing learning with past experiences. (iii) Target Networks: Improving convergence. Policy Gradients: Introduce the concept of directly learning policies.	T	T

TBA
Course Teacher, CSE 4101
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4102 Machine Learning Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 1st semester 2024**
Course Code	CSE 4102
Course Title	*Machine Learning Lab*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	Check the prerequisite for the related theory course

2 Syllabus

This laboratory course is designed to provide practical experience in implementing and optimizing various machine learning algorithms covered in the Machine Learning course. Students will develop and test ML models using real-world data, focusing on supervised, semi-supervised, unsupervised, and reinforcement learning.

Prospective Lab Tasks Description

1. **Supervised Learning:**
   - Implementing classification algorithms such as Decision Trees, Naïve Bayes, K-Nearest Neighbors, Logistic Regression, and SVM.
   - Training and evaluating performance using real-world datasets.
   - Exploring regularization techniques to combat overfitting.
2. **Regression Techniques:**
   - Implementing regression models like Linear Regression and Polynomial Regression.
   - Studying the bias-variance trade-off through experiments.
   - Using regularization methods like Ridge and Lasso.
3. **Neural Networks and Deep Learning:**
   - Building and training Perceptrons and Multi-Layer Perceptrons.
   - Implementing convolutional neural networks and exploring different activation functions.
   - Applying optimizers such as SGD, Momentum, and Adam.
4. **Ensemble Methods:**
   - Creating and analyzing the performance of ensemble methods like Bagging, Boosting, and Random Forests.

- Conducting experiments to compare single models versus ensemble models.

5. **Unsupervised Learning:**
   - Implementing clustering algorithms such as k-Means, Hierarchical, and DBSCAN.
   - Evaluating clustering quality and exploring techniques for determining the number of clusters.
6. **Reinforcement Learning:**
   - Implementing basic reinforcement learning algorithms like Q-learning and Policy Gradients.
   - Using environments from OpenAI Gym to test and improve RL models.

3 Text and Reference Materials

Check the textbook and reference list for the corresponding theory course.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Develop proficiency in utilizing machine learning libraries and frameworks to implement supervised and unsupervised learning models, addressing complex engineering problems in real-world applications.	PO1	Cognitive (C2)	25%	Please refer to Section 5.
CO2	Design, build, and optimize machine learning models using techniques such as ensemble methods, neural networks, and reinforcement learning to solve intricate engineering challenges in computational systems.	PO2	Cognitive (C3)	30%	
CO3	Effectively communicate the design principles, optimizations, and outcomes of machine learning models through structured documentation, presentations, and teamwork.	PO10	Psychomotor (P5)	45%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Class Participation			10%	10%
Continuous Lab Performance	15%	10%	5%	30%
Lab Reports		5%	5%	10%
Lab Viva-Voce			20%	20%
Capstone Project or Demo/Presentation	10%	15%	5%	30%
Total	25%	30%	45%	100%

Course Teacher, CSE 4102
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4103 Internet of Things

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 1st semester 2024**
Course Code	CSE 4103
Course Title	*Internet of Things*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	CSE 3201 - Computer Network

2 Syllabus

Orientation and Introduction to IoT: Inter-networking of tiny devices, Key features of Internet of Things and its diverse applications in practical fields including transportation, smart building, healthcare, agriculture, underwater health monitoring, etc. **IoT Devices**: IoT Device Architecture, Functional components of an IoT device - Sensing, computing, communication, and power units of an IoT mote, Types of IoT motes, Automotive IoT - Actuators, dynamic resource management and autonomic control units; **IoT Platforms:** Definition and architecture of IoT platform, ThingsBoard - an open source IoT platform, APIs for IoT platform, most popular IoT platforms provider include Amazon Web Services (AWS), Microsoft Azure, Oracle, Google Cloud, and Cisco IoT Cloud Connect; **Wireless IoT Network Infrastructure:** Architecture and functional details of Consumer IoT (CIoT), Industrial IoT (IIoT), and Underwater IoT, **IoT Access Protocols:** Radio Frequency Modulation, Media Access Control, RFID, Sigfox, LoRaWAN, BLE/NFC, Zigbee, WiFi, Cellular (3G/4G/5G), NBIoT and Mesh protocols; **IoT Routing Protocols:** Neighborhood Discovery, Principles of AODV and DSR protocols, Routing based on geographic location information, Types of routing based on route creation time - proactive, reactive, and hybrid; Challenges of Routing in IoT, Multipath routing, Mutliconstrained routing, drone-based data collection strategies; **Congestion Control in IoT Networks:** congestion detection, alleviation, and control strategies for IoT networks including CoAP, MQTT, and RPL. **AI and ML for IoT Security:** AI and ML for mitigating emerging threats in cyber-physical systems including device anomaly and network intrusion, malware infection, DoS, DDoS, etc. while balancing data protection and energy consumption.

3 Text and Reference Materials

T Textbook:

- *F. John Dian*, **Fundamentals of Internet of Things: For Students and Professionals**, First Edition, Wiley Publications, 2022.

R References:

- *Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, & David Boyle*, **Internet of Things Technologies and Applications for a New Age of Intelligence**, Second Edition, Academic Press, 2019.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Describe foundational concepts, architectural components, and principles that underpin the Internet of Things (IoT) ecosystem.	PO1	Cognitive (C3)	40%	Please refer to Section 5.
CO2	Explain operational details of data collection protocols at various layers that are energy-efficient while ensuring application Quality of Service (QoS).	PO2	Cognitive (C4)	50%	
CO3	Design impactful IoT applications by integrating sensors, actuators, communication protocols, and cloud services, addressing real-world challenges across diverse domains.	PO6	Affective (A4)	10%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	25%	35%		60%
Midterm Exam	10%	10%		20%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation			5%	5%
Class Participation			5%	5%
Total	40%	50%	10%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	Networking and Socialization, sharing course administration and guidelines • Orientation and Introduction to IoT: Internetworking of tiny devices, Key features of Internet of Things and its diverse applications in practical fields including transportation, smart building, healthcare, agriculture, civil infrastructure monitoring, underwater health monitoring, Logistic tracking, etc.;	T	T
3-4	IoT Devices: IoT Device Architecture, Functional components of an IoT device • Sensing, computing, communication, and power units of an IoT mote, • Types of IoT motes, Automotive IoT - Actuators, dynamic resource management and autonomic control units;	T	T

5-7	IoT Platforms: Definition and architecture of IoT platform, ThingsBoard - an open source IoT platform, • APIs for IoT platform, most popular IoT platforms provider: Amazon Web Services (AWS), Microsoft Azure, Oracle, Google Cloud, and Cisco Cloud Connect;	T	T
8-12	Wireless IoT Network Infrastructure: Architecture and functional details of Consumer IoT (CIoT), Industrial IoT (IIoT), and Underwater IoT, • IoT Access Protocols: the IEEE 802.15.4 standard for low-power medium access control (MAC), Radio Frequency Modulation, Media Access Control - TMAC, BMAC, SMAC, DCC-MAC, dynamic hybrid MAC (HyMAC);	T	T
13-14	RFID, Sigfox, LoRaWAN, BLE/NFC, Zigbee, WiFi, Cellular (3G/4G/5G), NBIoT and Mesh protocols;	T	T
15-17	IoT Routing Protocols: Neighborhood Discovery, Principles of AODV and DSR protocols, • Routing based on geographic location information, • Types of routing based on route creation time - proactive, reactive, and hybrid;	T	T
18-21	Emerging Challenges of Routing in IoT, • Multipath routing, Secured routing, • Mutliconstrained routing, • Drone-based data collection strategies;	T	R
22-24	Congestion Control in IoT Networks: congestion detection, alleviation, and control strategies for IoT networks including CoAP, MQTT, and RPL.	T	T
25-26	AI and ML for IoT Security: AI and ML for mitigating emerging threats in cyber-physical systems including device anomaly and network intrusion, malware infection, DoS, DDoS, etc. while balancing data protection and energy consumption.	T	T
27-28	Reviews, Future of IoT and its Challenges • Problem-solving practices, • Assignments/Presentations, etc.	T	R

For the definitions of T and R , Please refer to Section 3.

Course Teacher, CSE 4103
April 23, 2024

Chairman, Dept. of CSE, DU
April 23, 2024

University of Dhaka
Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4104 Internet of Things Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 1st semester 2024**
Course Code	CSE 4104
Course Title	*Internet of Things Lab*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	CSE 3201 Computer Network

2 Syllabus

Working with Microcontroller Board Understand the concept of Internet of Things Devices, Working with sensors and connecting various sensors with Arduino devices, working with various protocols for transferring data among multiple IoT devices; **Raspberi Pi Fundamentals:** Understand fundamental functions of Raspberri Pi, Collecting sensing data, Filtering data, and communicating to a cloud server; **Working with mbed environment:** mbed is an IDE (and also an operating system) tailored for IoT applications based on 32 bit ARM micro-controllers. There are several commercially available boards out there as a result it allows simple and rapid prototyping. One of its main advantages compared to other IDEs that it can handle multiple types of micro-controllers so that the code written can be reused in multiple environments. Furthermore it has an intuitive UI and also supports on-line workflows with team integration and version control.; **Creating a virtual sensor mote:** Adding features and services to a microcontroller to function as an independent sensor mote; **MQTT Communication and Configuring IoT Gateway** Creating an IoT network using studied protocols and configuring an IoT Gateway.

3 Text and Reference Materials

T Textbook:

- *F. John Dian*, **Fundamentals of Internet of Things: For Students and Professionals**, First Edition, Wiley Publications, 2022.

R References:

- *Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, & David Boyle*, **Internet of Things Technologies and Applications for a New Age of Intelligence**, Second Edition, Academic Press, 2019.

Course Teacher, CSE 4104
April 23, 2024

Chairman, Dept. of CSE, DU
April 23, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
CSE 4201 Parallel and Distributed Systems

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4201
Course Title	*Parallel and Distributed Systems*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	CSE 3201: Computer Network

2 Syllabus

Parallel Computing Overview: Overview of parallel processing landscape: why and how, types of parallelism, Flynn's taxonomy, and a brief overview of parallel architectures, Parallel Random Access Machine (PRAM) model; **Parallel Computer Architecture:** Shared memory, distributed memory, hybrid memory. **Parallel Programming Models:** Shared memory model, Message passing model, Data Parallel model, Hybrid Model, SPMD and MNMP; **Parallel Program Metrics:** Speedup, Efficiency, Iso-efficiency, Overhead, Strong and Weak scaling (Amdahl's law, Gustafson's law; **Multi-core parallel programming:** Data and task parallelism, Shared memory parallelism, OpenMP, CUDA, OpenACC; **Distributed Memory programming:** Message Passing Interface (MPI); **Clustering for Massive Parallelism:** Cluster Design Issues, Cluster System Interconnects, Hardware, Software, and Middleware Support, GPU Clusters for Massive Parallelism, Cluster Job Scheduling Methods, Load Sharing Facility (LSF) for Cluster Computing, MOSIX, Top 500; **Distributed System Overview:** Fundamental principles, Key features, Major design issues, Process, Middleware; **Distributed System Architectures:** Layered architectures, Object-based architectures, Data-centered architectures, Event-based architectures; **Distributed System Communication Model:** Sockets, RPC, RMI, publish-subscribe; **Naming:** Namespace, Distributed hash tables (DHT), Name resolution, Chord; **Migration:** Process migration, Code migration; **Time, Clock and Event:** Logical clocks, Lamport vector clocks, Ordering of events, Clock synchronization, NTP, Synchronization based on Co-ordination (with Election Algorithms), Distributed Mutual Exclusion, Distributed Transactions, Locking, Global State, Distributed Snapshot; **Consistency and Replication Model:** linearizability, eventual, causal, sequential, server-initiated replica, client-initiated replica, Epidemic protocol, Quorum-based protocol; **Consensus protocols:** 2PC, 3PC, Paxos; **Fault, Failure and Recovery:** Byzantine Failure, Triple Modular Redundancy, Agreement, Multicasting, Snapshotting, Checkpointing, Message Logging; **Virtualization:** Levels of Virtualization Implementation, VMM Design Requirements, Middleware Support for Virtualization, Virtualization of Clusters and Data Centers, Server Consolidation in Data Centers; **Peer to peer Computing:** P2P Computing Systems, Overlay networks, P2P fault tolerance, P2P trust and security management, P2P file sharing; **Overview:** Distributed Machine Learning, Edge Computing, Blockchain, Distributed Resource Allocation.

3 Text and Reference Materials

T Textbook:

- *Marteen van Steen, Andrew S. Tanenbaum*, **Distributed Systems: Principles and Paradigms**, Fourth Edition, Pearson Prentice Hall, 2023.
- *Ananth Grama, Vipin Kumar*, **Introduction to Parallel Computing**, Addison-Wesley, 2003.

R References:

- *George Coulouris, Jean Dollimore, Tim Kindbera, Gordon Blair*, **Distributed Systems**, Pearson, 2011.
- *Kai Hwang, Jack Dongarra & Geoffrey C. Fox*, **Distributed and Cloud Computing: Clusters, Grids, Clouds, and the Future Internet (DCC)**, Morgan Kaufmann, 2012.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	The course provides a comprehensive understanding of parallel and distributed systems, covering principles, theories, and practical applications. Students will learn about different architectures, algorithms, and programming models.	PO1	Cognitive (C3)	40%	Please refer to Section 5.
CO2	The course will assist in demonstrating analytical ability by applying knowledge from various domains to address real-world complex problems in parallel and distributed computing, identify requirements, and develop effective solutions.	PO2	Cognitive (C4)	50%	
CO3	Design and implement real-world complex parallel and distributed applications by integrating appropriate programming models, communication protocols, and fault tolerance mechanisms. They will demonstrate proficiency in developing efficient and scalable solutions.	PO6	Affective (A4)	10%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	25%	35%		60%
Midterm Exam	10%	10%		20%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation			5%	5%
Class Participation			5%	5%

Total	40%	50%	10%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1	Networking and Socialization, sharing course administration and guidelines • Parallel Computing Overview: Overview of parallel processing landscape: types of parallelism, Flynn's taxonomy, Parallel Random Access Machine (PRAM) model; Parallel Computer Memory Architecture: Shared memory, distributed memory, hybrid memory	T 2	T 2
2-3	Parallel Programming Models: Shared memory model, Message passing model, Data Parallel model, Hybrid Model, SPMD and MNMP • Parallel Program Metrics: Speedup, Efficiency, Iso-efficiency, Overhead, Strong and Weak scaling (Amdahl's law, Gustafson's law.;	T 2	T 2
3-5	Many-core Computing: GPU, CUDA; • Multi-core Programming: Data and task parallelism, Shared memory, OpenMP; • Shared Memory Programming: Thread; • Distributed Memory Programming: Message Passing Interface (MPI)	T 2	T 2
6-8	Clustering for Massive Parallelism: Cluster Design Issues, Cluster System Interconnects, Hardware, Software, and Middleware Support, GPU Clusters for Massive Parallelism, Cluster Job Scheduling Methods, Load Sharing Facility (LSF) for Cluster Computing, MOSIX, Top 500	R 2	R 2
9	Distributed System Overview: Fundamental principles, Key features, Major design issues, Process, Middleware; • Distributed System Architectures: Layered architectures, Object-based architectures, Data-centered architectures, Event-based architectures	T 1	T 1
10-11	Distributed System Communication Model: Sockets • RPC • RMI • Publish-subscribe	T 1	T 1
12-13	Naming: Namespace, Distributed hash tables (DHT), Name resolution, Chord • Migration: Process migration, Code migration;	T 1	T 1
14-16	Time, Clock and Event: Logical clocks, Lamport vector clocks, Ordering of events, Clock synchronization, NTP, Synchronization based on Co-ordination (with Election Algorithms) • Distributed Mutual Exclusion, Distributed Transactions, Locking, Global State, Distributed Snapshot	T 1	R 1
17-18	Consistency and Replication Model: linearizability, eventual, causal, sequential, server-initiated replica, client-initiated replica • Epidemic protocol, Quorum-based protocol;	T 1	R 1
19	Consensus protocols: 2PC, 3PC, Paxos •	T 1	R 1
20-21	Fault, Failure and Recovery: Byzantine Failure, Triple Modular Redundancy, Agreement, Multicasting, Snapshotting, Check- pointing, Message Logging;	T 1	T 1

22-23	Virtualization: Levels of Virtualization Implementation, VMM Design Requirements, Middleware Support for Virtualization, Virtualization of Clusters and Data Centers, Server Consolidation in Data Centers	R 1	R 1
24-25	Peer to peer Computing: P2P Computing Systems, Overlay networks, P2P fault tolerance, P2P trust and security management, P2P file sharing	R 1	R 1
26-27	Overview: Distributed Machine Learning, Edge Computing, Blockchain, Distributed Resource Allocation.	R 1	R 1
28	Reviews and Discussion, Future of Distributed Systems and its Challenges • Assignments/Presentations, etc.	T	R

For the definitions of T and R , Please refer to Section 3.

Course Teacher, CSE 4201
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4202
Parallel and Distributed Systems Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4202
Course Title	*Parallel and Distributed Systems Lab*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	None

2 Syllabus

The lab course aims to provide hands-on experience with designing, implementing, and analyzing Parallel and distributed systems concepts covered in the lecture portion of the theory course. The lab is intended to design and implement the various components and concepts acquired in the CSE4101 Parallel and Distributed Systems Theory courses. The students will be given multiple programming assignments on the development of distributed applications using various communication paradigms: RPC and RMI; parallel programming models (e.g., shared memory, message passing) using OpenMP and MPI; multicore programming using CUDA and OpenACC; analyzing scalability, speedup, and efficiency of parallel programs by implementing a parallel version of a sequential algorithm.

3 Text and Reference Materials

T Textbook:

- *Marteen van Steen*, *Andrew S. Tanenbaum*, **Distributed Systems: Principles and Paradigms**, Fourth Edition, Pearson Prentice Hall, 2023.
- *Ananth Grama*, *Vipin Kumar*, **Introduction to Parallel Computing**, Addison-Wesley, 2003.

R References:

- *Quinn Michael J. Quinn*, **Parallel Programming in C With Mpi and Openmp**, McGraw-Hill Education, 2008.
- *Quinn Michael J. Quinn*, **Parallel Programming in C With Mpi and Openmp**, McGraw-Hill Education, 2008.
- *Marc Snir*, *Jack Dongarra*, *Janusz S. Kowalik*, *Steven Huss-Lederman*, *Steve W. Otto*, **MPI: The Complete Reference**, MIT Press, 1998.

– *arbara Chapman, Gabriele Jost, Ruud Van De Pas, Ruud Van Der Pas, William Gropp, Ewing Lusk,* **Using OpenMP – Portable Shared Memory Parallel Programming (Scientific and Engineering Computation)**, MIT Press, 2007.
– *Rohit Chandra, Ramesh Menon, Leo Dagum, David Kohr, Dror Maydan,* **Parallel Programming in OpenMP**, Morgan Kaufmann, 2000.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Apply the fundamental knowledge on the principles of parallel and distributed systems, including architecture, algorithm, and programming.	PO1	Cognitive (C2)	20%	Please refer to Section 5.
CO2	With assignments and projects, students will analyze complex problems related to parallel and distributed computing, identify requirements, and develop appropriate solutions.	PO2	Cognitive (C3)	30%	
CO3	Students will design and implement solutions of real-life complex engineering problems of parallel and distributed systems, applying appropriate programming models, communication protocols, and using the appropriate technologies.	PO5	Psychomotor (P5)	50%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Class Participation			10%	10%
Continuous Lab Performance	15%	10%	5%	30%
Lab Reports		5%	5%	10%
Lab Viva-Voce			20%	20%
Capstone Project or Demo/Presentation	10%	15%	5%	30%
Total	25%	30%	45%	100%

Course Teacher, CSE 4202
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

17.2 Internship and Final Year Project

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4100 Internship

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 1st semester 2024**
Course Code	CSE 4100
Course Title	*Internship*
Course Credit	3.0 units
Contact Hours Per Week	Minimum 240 hours of industrial experience over 8-12 weeks.
Course Status	Core Course
Prerequisite Course	None

2 Course Rationale

The Internships in the computer, software, and network services Industry provide students with a unique opportunity to gain practical experience in the dynamic fields of computing and information technology by working in real-world industry settings. This intensive internship program is designed to bridge the gap between classroom learning and industry application. Through hands-on projects, guided mentorship, and exposure to industry practices, interns will develop valuable workplace skills, expand their professional network, and contribute to solving real challenges faced by IT companies. During the internship, students will work closely with industry professionals, applying their knowledge to address real business problems. They will engage in diverse projects that involve software requirement analysis, development of programs and databases, report generation, query processing, data mining, writing AI algorithms, mobile application design and development, analyzing the traffic of data networks, network administration and troubleshooting, network programming, software re-engineering, venerability assessment and penetration testing, software quality assurance, embedded systems, and IoT network design and development, distributed systems development, research and investigation, and ethical considerations. By the end of the program, interns will have a comprehensive understanding of the Computer and ICT industry landscape and be better prepared for career opportunities in these fields.

3 Course Description

The course offers students a comprehensive and immersive experience aimed at broadening their understanding of problem-solving activities. Throughout this program, students will gain exposure to a diverse array of technical and practical applications, providing them with a well-rounded perspective on the industry. Beyond technical skills, the course explores various critical facets of a professional environment, including company operations, workplace culture, safety protocols, project management methodologies, effective communication strategies, and the art of delivering impactful presentations.

One of the core requirements of this course is for students to maintain a logbook throughout their industrial training. This logbook content, monitored by an industry supervisor, serves as a valuable repository of their experiences, insights, and the tasks they have undertaken during their time in the industry. Furthermore, students are expected to culminate their industrial training experience with a comprehensive written report that showcases their newfound knowledge and proficiency.

To ensure a holistic evaluation of their performance, an assessment will be conducted collaboratively by academic and industrial supervisors. This assessment process typically involves a report, and a viva, during which students will discuss and defend their experiences, decisions, and the skills they have acquired during their industrial training. Additionally, students may be required to complete questionnaires that help assess their overall comprehension of the course material and its practical application in the industry. Through this multifaceted approach to assessment, students are not only evaluated on their technical competence but also on their ability to adapt, communicate effectively, and thrive within a professional engineering setting. This comprehensive evaluation process is designed to help students develop a deeper appreciation for problem-solving activities and to equip them with the skills and knowledge necessary to excel in their future careers.

4 Academic and Industry Supervisors

A student will work closely with two supervisors to fulfill the internship-related requirements: an academic supervisor and an industry supervisor.

4.1 Role of an Academic Supervisor

The role of the academic supervisor is paramount in overseeing and enhancing the success of the internship program. Typically, this role is fulfilled by a faculty member selected by the Academic Committee of the department. The academic supervisor's responsibilities extend to evaluating the student's performance and contributions throughout the internship period, culminating in a comprehensive assessment as outlined in Section 6.

To enrich the student's internship experience, the academic supervisors play a multifaceted role. First, they provide valuable guidance to students in the selection of industries for their internships. This guidance helps students align their goals and aspirations with the available opportunities in their chosen field. Additionally, academic supervisors assist students in nominating or selecting their industrial supervisors, drawing upon their network of industry contacts and expertise to ensure a productive mentorship.

Another crucial aspect of the academic supervisor's role is the ongoing monitoring of the student's progress. This involves visiting or maintaining regular communication with the industrial supervisor. While a minimum of one visit is mandatory, multiple interactions are encouraged to closely observe the student's development and ensure alignment with the internship's objectives. Furthermore, the academic supervisor takes the initiative to gather assessment feedback and marks from the industrial supervisor, facilitating a comprehensive evaluation of the student's performance.

4.2 Role of an Industry Supervisor

The industrial supervisors, much like the academic supervisors, play a crucial role in shaping the student's internship experience. Nominated from the industry, they bring a wealth of practical knowledge and expertise to the student's learning journey.

The industrial supervisor's responsibilities include actively observing and assessing the student's internship activities, regularly reviewing logbooks, and evaluating performance based on a predetermined rubric. They also oversee the completion of daily tasks, assignments, projects, and experiments, ensuring the student's engagement in meaningful learning experiences. Moreover, the industrial supervisor employs prescribed assessment techniques to gauge the student's progress, contributing valuable insights into their skill development and workplace contributions.

Collaboration between the industrial and academic supervisors is key to the student's comprehensive evaluation. The industrial supervisor responds to queries and provides insights to the academic supervisor, fostering a holistic assessment of the student's performance. Together, they create a symbiotic relationship that shapes the student's internship journey, prepares them for future success in the industry, and enhances the overall quality of the internship experience. Beyond these core responsibilities, industrial supervisors may also take on other pertinent tasks to further enrich the student's professional development during the internship.

5 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Demonstrate technical knowledge and practical skills through learning new tools and techniques as per the requirements of the involved industrial organization or institution.	PO5	Psychomotor (P3)	10%	Please refer to Section 6.
CO2	Demonstrate the ability to adapt health, safety, legal, and cultural requirements in an industrial/institutional working environment.	PO6	Affective (A4)	5%	
CO3	Demonstrate the knowledge of professional engineering techniques in societal and environmental contexts for sustainable development.	PO7	Affective (A4)	5%	
CO4	Demonstrate commitment to professional ethics and institutional responsibilities while performing engineering tasks.	PO8	Affective (A4)	20%	
CO5	Demonstrate interpersonal, oral, and written communication skills in teamwork, technical presentations, and report writing.	PO10	Psychomotor (P4)	30%	
CO6	Demonstrate adaptive learning capacity to cope with the dynamism of working environment and technological changes.	PO12	Affective (A5)	10%	
CO7	Apply problem-solving skills to identify, formulate, and analyze computing problems encountered in an industrial environment, utilizing relevant literature, mathematical principles, and computer engineering fundamentals.	PO2	Cognitive (C3)	20%	

6 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	CO4	CO5	CO6	CO7	Total
Report (Academic)	5%	5%	5%	5%		5%	5%	30%
Logbook (Industry)				5%	15%			20%
Questionnaire (Industry)	5%			5%				10%
Presentation on Final Report					5%	5%	5%	15%
Q/A Session				5%	5%		5%	15%
Final Report Evaluation					5%		5%	10%
Total	10%	5%	5%	20%	30%	10%	20%	100%

Note: Students will present a summary of their final report before an evaluation team of three members comprising of industry and academic supervisors, and a relevant faculty of the department (determined by the Academic Committee) - 40% weight.

Coordinator, CSE 4100
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
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University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
CSE 4110 and CSE 4210 Final Year Project Part A & B

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 1st and 2nd semesters 2024**
Course Code	CSE 4110 and CSE 4210
Course Title	*Final Year Project*
Course Credit	2.0 + 4.0 = 6.0 units
Contact Hours Per Week	Minimum 4 and 6 hours a week in the 1st and 2nd semesters, respectively.
Course Status	Core Course
Prerequisite Course	None

2 Course Rationale

The Final Year Project is the culmination of a student's academic journey, providing an opportunity to apply acquired knowledge, skills, and methodologies to address real-world challenges. This project-driven experience is essential for students to demonstrate their proficiency in developing innovative solutions, working with state-of-the-art tools and techniques, conducting innovation, and effectively communicating their findings. This project fosters innovation, creativity, critical thinking, collaboration, and problem-solving abilities, preparing students to tackle complex engineering problems and contribute meaningfully to the rapidly evolving domains of Computer Science and Engineering.

Through their chosen projects, students embark on a journey of exploration, experimentation, and discovery, reflecting the field's interdisciplinary nature. This final-year project showcases technical prowess and hone soft skills such as project management, teamwork, and communication. This endeavor reinforces the program's commitment to producing well-equipped graduates to address real-world challenges, advance the frontiers of knowledge and skills, and make impactful contributions to emerging IT industries in this rapidly evolving industrial revolution era.

As students immerse themselves in the integrated design project experience, they deepen their understanding of specific domains of computer science and engineering, engage with cutting-edge technologies, and develop a robust portfolio that demonstrates their expertise to potential employers, collaborators, and research institutions.

This course rationale highlights the project's significance as a transformative learning experience that not only culminates academic pursuits but also marks the beginning of a promising journey into innovation and creativity. By completing their final year projects, students emerge as computer scientists or engineering practitioners with the theoretical knowledge, practical skills, and intellectual curiosity necessary to navigate the challenges and opportunities of the ever-evolving landscape in these dynamic fields.

3 Course Description

The Final Year Project is a culminating experience that allows students to demonstrate their expertise in the emerging fields of computer science and engineering through an in-depth innovation and industry

project. This course allows students to tackle complex problems, contribute to advancing knowledge in the field, and showcase their ability to apply theoretical concepts to practical challenges. Students will work under the guidance of a faculty supervisor to design, execute, and present an original development and implementation of a system or an application service or to conduct analysis, synthesize data, and make propositions in different fields of computer science and engineering.

The project comprises two parts envisioned in two subsequent semesters. Throughout the course, students engage in rigorous design, Development, experimental design, data analysis, model development, and evaluation. They contribute new insights, methodologies, or solutions to the field, addressing real-world problems with novel computing techniques.

The final year project is expected to demonstrate the student's mastery of design, development, technical proficiency, and innovation under the type **'Design and Development Project'**, and research investigation, critical thinking, analysis, synthesis, and evaluation skills under the type **'Research Project'** through carrying out the following activities.

(i) **Project Proposal and Planning:** This task is included in CSE 4110 - Final Year Project (Part A). • For Design and Development Project - Motivation, objectives, problem statements, key features, detail methods containing platform or technology tools; • Formulating problem statements, listing key objectives, conducting literature reviews to identify gaps and opportunities, and stating problem-solving methodology.

(ii) **System Design, Development and Analysis:** This task is included in CSE 4110 - Final Year Project (Part A). • For Design and Development Project - Design and Development of the system or application service, implementation, analysis, and testing of operational correctness.

(iii) **Experimental Design and Data Collection:** This task includes CSE 4210 - Final Year Project (Part B). • For Design and Development Project - System integration, Designing databases, input forms, and processes for collecting data from different sources, including humans and machines.

(iv) **Analysis, Evaluation, and Interpretation:** This task is included in CSE 4210 - Final Year Project (Part B). • For Design and Development Project - Conducting User Acceptance Test (UAT) cases, analyzing outcomes, testing system robustness with diverse inputs, and interpreting the results of processed data; • For Research Project - Evaluating model performance using appropriate metrics, Interpreting and analyzing results, Development of propositions of their findings.

(v) **Ethical Considerations and Bias Analysis:** This task is included in CSE 4210 - Final Year Project (Part B). • For Design and Development Project - Addressing ethical concerns related to originality of the system or application service design, Development, and data analysis;

(vi) **Writing a report on the Project:** Writing a comprehensive report in a prescribed format recommended by the evaluation committee, Structuring the document with multiple chapters including Introduction, State-of-the-Art Systems or Studies, Design Methodology, Results, and Discussion. The introduction, state-of-the-art, and initial design concepts are in CSE 4110 (Part A), and the rest is in CSE 4210 (Part B). Reports with a plagiarism similarity percentage of more than 15% (without references, author names, and affiliations) or generated by any AI software are unacceptable.

(vii) **Project Presentation and Defense:** Presenting the contents of the report; Students will defend the Introduction, State-of-the-art, and Initial Design Concepts in CSE 4110 (Part A) and the methodology, results, and interpretations in CSE 4210 (Part B).

4 Teaching Methods

No formal teaching will be conducted. However, students are supposed to meet the supervisor(s) periodically, receive instructions, exchange ideas, and present the progress of their works.

5 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Demonstrate the knowledge of computer science and engineering to solve complex problems innovatively.	PO1	Cognitive (C3)	5%	Please refer to Section 6.
CO2	Analyze a problem for identifying the requirements, methods, tools, and techniques of computer science and engineering necessary for solving it.	PO2	Cognitive (C4)	5%	
CO3	Develop a system, application service, or research design based on analyzing a complex scientific or engineering problem.	PO3	Cognitive (C5)	20%	
CO4	Evaluate the performance of the proposed system design by comparing it with the existing similar systems through experimental results and/or data analysis to infer a rational conclusion of the proposed system.	PO4	Cognitive (C6)	20%	
CO5	Use modern ICT techniques and tools such as computation, software, network, optimization, AI, and machine learning to develop the proposed system.	PO5	Psychomotor (P6)	5%	
CO6	Identify professional practices considering the impacts on societal /health/ legal/ cultural issues, whichever applies to the proposed system.	PO6	Affective (A4)	5%	
CO7	Identify the impact of the proposed system on the environment, alongside the sustainability measures taken into consideration, while designing the system.	PO7	Affective (A4)	5%	
CO8	Demonstrate the ethical principles and responsibilities throughout the development process of the proposed system model and writing reports.	PO8	Affective (A3)	5%	
CO9	Exhibit the leadership skills to work in groups and as an individual member through the entire project lifetime.	PO9	Psychomotor (P6)	5%	
CO10	Write comprehensive and constructive reports of the proposed solution with adequate details and follow the given formats alongside presenting them with adequate confidence.	PO10	Psychomotor (P3)	10%	
CO11	Manage any project effectively in multidisciplinary environments considering the costing and financing, handling conflicts, optimizing resources, and maintaining deadlines to design and implement the system.	PO11	Psychomotor (P4)	5%	
CO12	Explore the state-of-the-art computing knowledge, concepts, and techniques for designing and implementing the problem's solution (s).	PO12	Affective (A5)	10%	

6 Assessment Methods of COs

Part A Criteria - Both for 'Design and Development Project' and 'Research Project'

Assessment Type	CO1	CO2	CO3	CO4	CO5	CO6	CO7	CO8	CO9	CO10	CO11	CO12	Total
Supervisor (30%)	5	5	5					5	5	5			30
Progress Report (40%)	5	5	20					5		5			40
Exam Committee (30%)			15						5	10			30
Total	10	10	40					10	10	20			100

Part B Criteria - Both for 'Design and Development Project' and 'Research Project'

Assessment Type	CO1	CO2	CO3	CO4	CO5	CO6	CO7	CO8	CO9	CO10	CO11	CO12	Total
Supervisor (30%)				10	5	5	5					5	30
Final Report (40%)			15	10				5		5	5		40
Exam Committee (30%)	5	5	5						5	5		5	30
Total	5	5	20	20	5	5	5	5	5	10	5	10	100

Notes:

(i) At the end of the 4th-year 1st semester, only 6 out of 12 outcomes will be evaluated under Part A, weighing 50%

(ii) Two examiners will evaluate item Project reports per the University of Dhaka rules.

(iii) The exam committee will arrange demonstration/presentation/project showcasing or poster presentations as deemed necessary for proper evaluation.

(iv) After completion of the project works, each group of students will submit a book-bonded report, a poster for showcasing in the department premise, and a prototype for an integrated system design or a software system or collected data and model training program codes or simulation environment settings and trace files or program codes, developed project manuals any deliverables appropriate for demonstration, and possible of the project outcomes.

(v) When students are working in a group, their marks may vary from one to another depending on the individual's contribution and demonstrated performance before the supervisor and exam committee members.

TBA
Coordinator, CSE 4110 and CSE 4210
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

17.3 Elective Courses

17.3.1 Elective I

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
CSE 3209 Digital Image Processing

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 1st semester 2024**
Course Code	CSE 3209
Course Title	*Digital Image Processing*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	CSE 3203 - Artificial Intelligence

2 Syllabus

Introduction: Definition of image, Differences between image processing, image analysis and computer vision. Image digitization. **How human eye works**, Digital Image: RGB to Grayscale Conversion, Average method, Weighted Method. Spatial resolution, Image contouring. **Contrast Enhancement:** Histogram, Histogram stretching. Histogram equalization. **Image Gradient:** Magnitude and Phase, Gradient Derivatives: Sobel, Roberts and Prewitt Operators. **Convolution and Correlation:** Cross-Correlation Filtering, Convolution examples: Image Averaging, Edge Detection. **Linear Filters:** Applying a Linear Filter, Practice with Linear Filters, Smoothing and Sharpening, Shift-Invariant linear operation (Convolution), Gaussian Filters. **Laplacian Operator:** Positive and Negative Laplacian Operator, Laplacian of Gaussian: Discrete approximation of LoG function. **Canny edge detection:** Noise Reduction, Gradient Calculation, Non-maximum Suppression, Double Thresholding and Edge Tracking. **Color Image Processing:** Color Models-CMY, HIS, YIQ, YUV and YcbCr. **Image Degradation and Restoration:** Image Degradation/ Restoration Model. **Noise:** Gaussian Noise, Impulse noise, Periodic Noise. Noise Removal: Median filter, Mean filer, Adaptive Median Filter. **Fourier Transform (in 2D):** Trigonometric Fourier Series, Exponential Fourier Series. Discrete Fourier Transform, DFT properties, Magnitude and Phase of DFT. Image Deblurring in frequency domain: Inverse Filter, Wiener Filter. **Image Compression:** Redundancy, General Image Compression and Transmission Model: Encoder and Decoder. **JPEG Coding:** 2D-DCT, Quantization, Zig-Zag Scan etc. **Hough Transform:** Line and Circle Detection by Hough Transform. **Morphological Image Processing:** Erosion and Dilation, Opening and Closing, Some Basic Morphological Algorithms: Boundary Extraction, Hit-or-Miss Transformation, Morphological Thinning, Skeletons, Thickening. Morphological Reconstruction: Reconstruction by (Geodesic) Erosion and Dilation.

3 Text and Reference Materials

T Textbook:

- R. C. Gonzalez and E. E. Woods, Digital Image Processing, Prentice Hall.

R References:

- SE Umbaugh, Digital Image Enhancement, Restoration and Compression, 4th Edition, 2023
- Sandipan Dey, Hands on Image Processing with Python

4 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	**Introduction:** Definition of image, Differences between image processing, image analysis and computer vision. Image digitization.	T	T
3-4	**How human eye works,** Digital Image: RGB to Grayscale Conversion, Average method, Weighted Method. Spatial resolution . Image contouring.	T	T
5-6	**Contrast Enhancement:** Histogram, Histogram stretching. Histogram equalization.	T	T
7	**Image Gradient:** Magnitude and Phase, Gradient Derivatives: Sobel, Roberts and Prewitt Operators.	T	T
8-9	Convolution and Correlation: Cross-Correlation Filtering, Convolution examples: Image Averaging, Edge Detection,	T	T
10-11	**Linear Filters:** Applying a Linear Filter, Practice with Linear Filters, Smoothing and Sharpening, Shift-Invariant linear operation (Convolution), Gaussian Filters.	T	T
12	**Laplacian Operator:** Positive and Negative Laplacian Operator, Laplacian of Gaussian: Discrete approximation of LoG function.	T	R
13	**Canny edge detection:** Noise Reduction, Gradient Calculation, Non-maximum Suppression, Double Thresholding and Edge Tracking.	T	T
14-15	**Color Image Processing:** Color Models- CMY, HIS, YIQ, YUV and YCbCr,	T	T
16-17	**Image Degradation and Restoration:** Image Degradation/ Restoration Model. **Noise:** Gaussian Noise, Impulse noise, Periodic Noise. Noise Removal: Median filter, Mean filer, Adaptive Median Filter.	T	R
18-19	**Fourier Transform (in 2D):** Trigonometric Fourier Series, Exponential Fourier Series. Discrete Fourier Transform, DFT properties, Magnitude and Phase of DFT.	T	R
20	**Image Deblurring in frequency domain:** Motion Blur, Inverse Filter, Wiener Filter	T	R
21-23	**Image Compression:** Redundancy, General Image Compression and Transmission Model: Encoder and Decoder. **JPEG Coding:** 2D-DCT, Quantization, Zig-Zag Scan etc.	T	R
24-25	**Hough Transform:** Line and Circle Detection by Hough Transform.	T	R
26	**Morphological Image Processing:** Erosion and Dilation, Opening and Closing,	T	R
27-28	**Some Basic Morphological Algorithms**: Boundary Extraction, Hit-or-Miss Transformation, Morphological Thinning, Skeletons, Thickening. Morphological Reconstruction: Reconstruction by (Geodesic) Erosion and Dilation.	T	R

For the definitions of T and R , Please refer to Section 3.

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Course Teacher, CSE 3209
April 24, 2024

Prof. Dr. Md. Abdur Razzaque
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April 24, 2024

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Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 3210 Digital Image Processing Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 2nd semester 2024**
Course Code	CSE 3210
Course Title	*Digital Image Processing Lab*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	Check the prerequisite for the related theory course

2 Syllabus

The CSE 3210 Digital Image Processing Lab complements the CSE 3209 Digital Image Processing course, providing practical hands-on experience with digital image processing techniques. Students will implement algorithms for image enhancement, restoration, segmentation, and compression. The lab exercises include image transformations, filtering, edge detection, and morphological operations using standard image processing tools. This applied approach helps students develop the skills necessary to address real-world image processing challenges effectively.

3 Text and Reference Materials

Check the textbook and reference list for the corresponding theory course.

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Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
CSE 3211 Introduction to Data Science

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 2nd semester 2024**
Course Code	CSE-3211
Course Title	*Introduction to Data Science*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	None

2 Syllabus

Introduction: Basic concepts of Data Science; Properties of data: structured vs unstructured, quantitative vs categorical, big data vs little data; Data Objects and Attribute types: What is an attribute? Nominal, Binary, Ordinal and Numeric attributes. **Basic Statistical Description of Data:** Measuring the Central Tendency: Mean, Median, Mode; Measuring the Dispersion of Data: Range, Quartiles, Variance, Standard Deviation, Interquartile Range. **Visualizing Data:** Graphic displays of basic statistical descriptions of data: Boxplots, Tabular data, Dot and Line plots, Quantile plot, Quantile-Quantile plot, Bar and Pie charts, Histograms, Data maps, Scatter plots and data correlation. **Measuring Data Similarity and Dissimilarity:** Data Matrix vs Dissimilarity Matrix; Dissimilarity of numeric data: Euclidean, Manhattan and Minkowski distances; Proximity measures for nominal, binary and ordinal attributes; Dissimilarity for attributes of mixed types; Cosine similarity. **Mathematical and Statistical Analysis:** Linear Algebra: Matrix operations, Eigenvalues and Eigenvectors; Scores and Rankings; Probability, Probability distributions: Binomial, Normal, Poisson; Statistical tests for significance; Bayesian reasoning. **Data Quality:** Basic concepts of data accuracy, completeness, consistency, timeliness, believability and interpretability; Major tasks and challenges in data preprocessing. **Data Cleaning:** Collection process of data: Hunting, Scraping, Logging; Handling missing values and noisy data; Data cleaning as a process; Crowdsourcing. **Data Integration:** Entity identification problem; Redundancy and Correlation analysis: Chi-square correlation test, Correlation Coefficient and Covariance to discover data correlation; Tuple duplication, data value conflict detection and resolution. **Data Reduction:** Dimensionality reduction: Wavelet Transforms, Principal Component Analysis, Attribute Subset Selection; Numerosity Reduction: Parametric and Non-parametric data reduction techniques, Sampling, Data Cube Aggregation; Data Compression. **Data Transformation:** Transformation by normalization: Min-Max, z-score and decimal scaling; Discretization by binning, histogram analysis, cluster, decision tree and correlation analysis; Concept hierarchy generation for nominal data. **Learning from Data:** Supervised Learning: Basic concepts of supervised learning; Classification methods: decision tree, Bayesian classification, k-NN, logistic regression; Model evaluation and selection: accuracy, precision, recall, F-measure, ROC-curves; Cross-validation, bootstrap; Ensemble Methods: bagging, boosting, random forests; Basic concepts of linear and non-linear regression; Unsupervised Learning: Basic concepts of unsupervised learning; Clustering methods: partitioning methods: k-Means, k-Medoids;

Hierarchical methods: agglomerative, divisive; Density-based methods: DBSCAN, OPTICS; Evaluation of Clustering; Outlier detection methods.

3 Text and Reference Materials

T Textbook:

- Steven S. Skiena, **The Data Science Design Manual**, 1st Editions, Springer Publications, 2017.
- Jiawei Han, Jian Pei, H. Tong, **Data Mining: Concepts and Techniques**, 4th Edition, Morgan Kaufmann Publishers, Elsevier., 2006.

R References:

- Dirk P. Kroese, Zdravko I. Botev, Thomas Taimre, Radislav Vaisman, **Data Science and Machine Learning: Mathematical and Statistical Methods**, 2nd Edition, Morgan Kaufmann Publishers, Elsevier., 2006.
- Charu C. AggarWal, **Data Mining: The Textbook**, 2nd Edition, Springer Publications, 2015.

4 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	**Introduction:** Basic concepts of Data Science; Properties of data: structured vs unstructured, quantitative vs categorical, big data vs little data; Data Objects and Attribute types: What is an attribute? Nominal, Binary, Ordinal and Numeric attributes.	T	T
3-4	**Basic Statistical Description of Data:** Measuring the Central Tendency: Mean, Median, Mode; Measuring the Dispersion of Data: Range, Quartiles, Variance, Standard Deviation, Interquartile Range.	T	T
5-6	**Visualizing Data:** Graphic displays of basic statistical descriptions of data: Boxplots, Tabular data, Dot and Line plots, Quantile plot, Quantile-Quantile plot, Bar and Pie charts, Histograms, Data maps, Scatter plots and data correlation.	T	T
7-8	**Measuring Data Similarity and Dissimilarity:** Data Matrix vs Dissimilarity Matrix; Dissimilarity of numeric data: Euclidean, Manhattan and Minkowski distances; Proximity measures for nominal, binary and ordinal attributes; Dissimilarity for attributes of mixed types; Cosine similarity.	T	T
9-10	**Mathematical and Statistical Analysis:** Linear Algebra: Matrix operations, Eigenvalues and Eigenvectors; Scores and Rankings; Probability, Probability distributions: Binomial, Normal, Poisson; Statistical tests for significance; Bayesian reasoning.	T	T
11-12	**Data Quality:** Basic concepts of data accuracy, completeness, consistency, timeliness, believability and interpretability; Major tasks and challenges in data preprocessing.	T	R
13-14	**Data Cleaning:** Collection process of data: Hunting, Scraping, Logging; Handling missing values and noisy data; Data cleaning as a process; Crowdsourcing.	T	T

15-17	**Data Integration:** Entity identification problem; Redundancy and Correlation analysis: Chi-square correlation test, Correlation Coefficient and Covariance to discover data correlation; Tuple duplication, data value conflict detection and resolution.	T	R
18-20	**Data Reduction:** Dimensionality reduction: Wavelet Transforms, Principal Component Analysis, Attribute Subset Selection; Numerosity Reduction: Parametric and Non-parametric data reduction techniques, Sampling, Data Cube Aggregation; Data Compression.	T	R
21-23	**Data Transformation:** Transformation by normalization: Min-Max, z-score and decimal scaling; Discretization by binning, histogram analysis, cluster, decision tree and correlation analysis; Concept hierarchy generation for nominal data.	T	R
24-28	**Learning from Data:** Supervised Learning: Basic concepts of supervised learning; Classification methods: decision tree, Bayesian classification, k-NN, logistic regression; Model evaluation and selection: accuracy, precision, recall, F-measure, ROC-curves; Cross-validation, bootstrap; Ensemble Methods: bagging, boosting, random forests; Basic concepts of linear and non-linear regression; Unsupervised Learning: Basic concepts of unsupervised learning; Clustering methods: partitioning methods: k-Means, k-Medoids; Hierarchical methods: agglomerative, divisive; Density-based methods: DBSCAN, OPTICS; Evaluation of Clustering; Outlier detection methods.	T	R

For the definitions of T and R , Please refer to Section 3.

TBA
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Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
CSE 3212 Introduction to Data Science Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 2nd semester 2024**
Course Code	CSE 3212
Course Title	*Introduction to Data Science Lab*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	None

2 Syllabus

Experiment Lists: 1. Measuring basic statistical description of data such as mean, median, mode, quantile and standard deviation. 2. Visualizing data with different methods such as boxplots, dot and line plots, quantile plot, quantile-quantile plot, bar and pie charts, histograms, data maps, scatter plots. 3. Measuring Data Similarity and Dissimilarity with different methods such as Data Matrix vs Dissimilarity Matrix; Dissimilarity of numeric data: Euclidean, Manhattan and Minkowski distances; Proximity measures for nominal, binary and ordinal attributes; Dissimilarity for attributes of mixed types; Cosine similarity. 4. Perform data collection and cleaning: Collection process of data: Hunting, Scraping, Logging; Handling missing values and noisy data; Crowdsourcing. 5. Perform Data Integration: Redundancy and Correlation analysis: Chi-square correlation test, Correlation Coefficient and Covariance to discover data correlation. 6. Perform Data Reduction: Dimensionality reduction: Wavelet Transforms, Principal Component Analysis, Attribute Subset Selection; Numerosity Reduction: Parametric and Non-parametric data reduction techniques, Data Compression. 7. Perform Data Transformation: Transformation by normalization: Min-Max, z-score and decimal scaling; Discretization by binning, histogram analysis. 8. Design and Implement some methods for supervised learning from data: Classification methods- decision tree, Bayesian classification, k-NN, logistic regression. Model evaluation and selection: accuracy, precision, recall, F-measure; Cross-validation and bootstrap. 9. Design and Implement some methods for unsupervised learning from data: Clustering methods- partitioning methods: k-Means, k-Medoids; Hierarchical methods, Density-based methods; Outlier detection methods.

Programming Language: C/C++/Java/Python/R

3 Text and Reference Materials

T Textbook:

- Steven S. Skiena, **The Data Science Design Manual**, 1st Editions, Springer Publications, 2017.
- Jiawei Han, Jian Pei, H. Tong, **Data Mining: Concepts and Techniques**, 4th Edition, Morgan Kaufmann Publishers, Elsevier., 2006.

R References:

- Dirk P. Kroese, Zdravko I. Botev, Thomas Taimre, Radislav Vaisman, **Data Science and Machine Learning: Mathematical and Statistical Methods**, 2nd Edition, Morgan Kaufmann Publishers, Elsevier., 2006.
- Charu C. AggarWal, **Data Mining: The Textbook**, 2nd Edition, Springer Publications, 2015.

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University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 3213 Bioinformatics

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd Year 2nd Semester 2024**
Course Code	CSE 3213
Course Title	*Bioinformatics*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	CSE 2203

2 Syllabus

The course will cover fundamentals of algorithms, statistics, and mathematics as applied to biological problems. In particular, emphasis will be given to biological problem modeling and understanding the algorithms and mathematical procedures. Practical implementation of the algorithms is taught with small sized synthetic examples. Topics to be covered are: fragment analysis, genome rearrangement, sequence similarity, restriction mapping, pattern search and statistical learning, molecular evolution and phylogenetics, functional genomics and systems level analysis.

3 Course Rationale

The aim of the course is to provide students with basic knowledge to develop and implement algorithm related to biological problem so that student understand the true nature of the complexity of biological problem

4 Text and Reference Materials

T Textbook:

- *P A Pevzner et*, **Computational Molecular Biology, An Algorithmic Approach**, 3rd Edition, MIT Press, 2000.

R References:

- *N C Jones and P A Pevzner*, **Introduction to Bioinformatics Algorithm**, First Edition, McGraw Hill, 2004.

5 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Understand the biological basics of genome reconstruction, genome rearrangement, fragment analysis, phylogenetic analysis, sequence similarity and clustering.	PO1	Cognitive (C2)	20%	
CO2	Understand the algorithmic formulation of problem related to biological topics mentioned.	PO2	Cognitive (C3)	30%	
CO3	Analysis related algorithms to understand the suitability of different algorithm in different context.	PO4	cognitive (C4)	30%	
CO4	Compare and contrast different solutions and find new solution if possible	PO10	Affective (A4)	20%	

6 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	CO4	Total
Final Exam	5%	20%	20%	15%	60%
Mid Term Exam	10%	5%	5%		20%
Class Test/Quizz	5%			5%	10%
Assignment/Presentation		5%			5%
Class Participation			5%		5%
Total	20%	30%	30%	20%	100%

7 Topic Outline

Lecture	Selected Topic	Reading	Exercise
1-2	Introduction to Molecular Biology	T	TR
3-5	Genome reconstruction and fragment analysis	T	TR
6-8	Restriction mapping	T	TR
9-11	Genome rearrangement	T	TR
12-17	Sequence similarity search	T	TR
18-19	Phylogenetic tree construction	T	TR
20-22	Combinatorial Pattern matching	T	TR
23-25	RNA secondary structure prediction	T	TR
26-28	DNA data Clustering	T	TR
29-30	Gene finding in genomic data	T	TR

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Course Outline - CSE 3214 Bioinformatics Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd Year 2nd semester**
Course Code	CSE 3214
Course Title	*Bioinformatics Lab*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	CSE 2203

2 Syllabus

The introduction to Bioinformatics Lab is designed to provide students with hands-on experience in applying algorithmic solution to biological problems. Problems on different topics covered in the theoretical part including fragment analysis, genome rearrangement, sequence similarity, restriction mapping, pattern search and statistical learning, molecular evolution and phylogenetics, functional genomics and systems level analysis will be furnished for the lab. By engaging in coding exercises with synthetic and real life data students will develop fundamental understanding of biological problems and learn the ways to solve them computationally.

3 Course Rationale

The aim of the course is to challenge students with to develop and implement algorithm related to biological problem so that student understand the true nature of the complexity of biological problem and gain understanding of the topics covered in the theoretical course.

4 Text and Reference Materials

T Textbook:

- *P A Pevzner et*, **Computational Molecular Biology, An Algorithmic Approach**, 3rd Edition, MIT Press, 2000.

R References:

- *N C Jones and P A Pevzner*, **Introduction to Bioinformatics Algorithm**, First Edition, McGraw Hill, 2004.

5 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Select biological problems related to genome analysis, restriction mapping and motif finding and design search, greedy and graph algorithms to solve them	PO1	Cognitive (C2)	30%	
CO2	Select biological problems related to local and global alignment, secondary structure prediction, gene prediction and design dynamic programming algorithms to solve them	PO2	Cognitive (C3)	30%	
CO3	Select biological problems related to heuristic similarity, sampling, clustering and design combinatorial pattern matching, randomized and different clustering algorithms to solve them	PO4	cognitive (C4)	40%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

6 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Class Participation			10%	10%
Continuous Lab Performance	15%	10%	5%	30%
Lab Reports		5%	5%	10%
Lab Viva-Voce			15%	20%
Capstone Project or Demo/Presentation	15%	15%	5%	30%
Total	30%	30%	40%	100%

7 Lab Activity Outline

Week	Experiment Title	CO	Activities
1	Familiarize students with general algorithm and complexity.	CO1	Coding and Report Writing
2	Solving problems with genome analysis specially with fragment assembly.	CO1	Coding and Report Writing
3	Solving restriction mapping specially the partial digest problem.	CO1	Coding and Report Writing
4	Solving phylogenetics tree construction using UPGMA	CO2	Coding and Report Writing
5	Solving motif finding problem with combinatorial pattern matching algorithm	CO2	Coding and Report Writing

6	Solving secondary structure prediction problem using Nussinov Algorithm.	CO2	Coding and Report Writing
7	Solving clustering problem using agglomerative algorithm.	CO1	Coding and Report Writing
8	Solving genome rearrangement problem	CO3	Coding and Report Writing
9	Solving gene finding problem using hidden Markov tool.	CO3	Codingand Report Writing
10	Solving gene regulatory network problem	CO2	Coding and Report Writing
11	Solving global sequence similarity search problem	CO2	Coding and Report Writing
12	Solving local sequence similarity search problem	CO3	Coding and Report Writing
13-14	Design, development, demonstration, and defending a small project based on self chosen topic in a group of two	CO3	Coding and Report Writing

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University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
CSE 3215 Mobile Application Development

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 2nd semester 2024**
Course Code	CSE 3215
Course Title	*Mobile Application Development*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	CSE 3101 Software Engineering

2 Syllabus

Overview of Mobile Computing: Dimensions of Mobile Computing, Discussion on Popular Mobile Applications, **Centralized Frameworks:** Fully Centralized Frameworks, Android Architecture, **XML and UI Development:** Introduction to XML, Key XML Technologies for Mobile Computing, Android Layouts, User Interface Development using XML, App Development Tips & Web Content, Android Activity Lifecycle, Android Core Components, **Development Environment:** Android Development Environment Setup, Android Process, **Connectivity and Services:** Introduction to Wireless Connectivity, Quality of Service in Mobile Networks, Wireless Networking Technologies, Mobile IP, SMS, and Mobile Cloud Computing, Prerequisites and Challenges in Mobile Cloud Computing, **Energy and Resource Management:** Energy Analysis for Computing Offloading, **Wireless Application Protocols:** Wireless Application Protocol (WAP), WAP Protocol Stack, I-mode, WAP Gateway, Push Message, Push Architecture, Push Message Types and Formats, Pull Methodology, **Sensor Framework and Applications:** Android Sensor Framework, Hardware and Software Sensors, Sensor Types and their Responsibilities, **User Interface Design:** Introduction to User Interface, Validating Mobile Use Cases before Development, Key Points for UI Development, **Software Testing and Quality Assurance:** The Effects of Software Testing.

3 Text and Reference Materials

T Textbook:

- *Reza B'Far*, **Mobile Computing Principles**, 4th Edition, Cambridge University Press, 2005.

R References:

- *Bryan Sills, Brian Gardner, Kristin Marsicano, Chris Stewart*, **Android Programming: The Big Nerd Ranch Guide**, 5th Edition, Addison-Wesley Professional, 2022.
- *Dawn Griffiths, David Griffiths*, **Head First Android Development**, 3rd Edition, O'Reilly Media, Inc., 2021.

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Course Outline
CSE 3216 Mobile Application Development Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 2nd semester 2024**
Course Code	CSE 3216
Course Title	*Mobile Application Development Lab*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	None

2 Syllabus

Introduction to Android Studio: Installation of Android Studio, setting up the environment, exploring basic features; **Working with XML and Layouts:** Create and manipulate user interfaces using XML, Implementing different Android layouts; **Android Fundamentals:** Understand fundamental Android components and their lifecycle, Referencing and Event Listener, Android Intent, Activity Lifecycle, Fragments; **Application Development:** Design and develop a basic calculator application, Planning, designing UI, coding basic operations, implementing functionalities; **Advanced Android Features:** Implementation of Broadcast intent and Broadcast receiver, Implementing SQLite Databases, Integrating REST API and map into applications; **Integrating Online Services:** Using Firebase for authentication and database management along with other cloud based API integrations.

3 Text and Reference Materials

T Textbook:

- *Reza B'Far*, **Mobile Computing Principles**, 4th Edition, Cambridge University Press, 2005.

R References:

- *Bryan Sills*, *Brian Gardner*, *Kristin Marsicano*, *Chris Stewart*, **Android Programming: The Big Nerd Ranch Guide**, 5th Edition, Addison-Wesley Professional, 2022.
- *Dawn Griffiths*, *David Griffiths*, **Head First Android Development**, 3rd Edition, O'Reilly Media, Inc., 2021.

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Course Outline
CSE 3217 Simulation and Modeling

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 2nd semester 2024**
Course Code	CSE 3217
Course Title	*Simulation and Modeling*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	None

2 Syllabus

System Models: The concepts of a system, system environment, stochastic activities, continuous and discrete systems, system modeling, types of models, static and dynamic physical models, static and dynamic mathematical models, and principles used in modeling. **System Studies:** Subsystems; Major segments of a corporate model: Environment, production, management; Types of system study; System analysis, design and postulation. **System Simulation:** The technique of simulation, the Monte Carlo method, comparison of simulation and analytical methods, experimental nature of simulation, types of system simulation, numerical computation technique for continuous and discrete models, distributed lag models, Cobweb models, progress of a simulation study. **Continuous System Simulation:** Continuous system models, differential equations, analog methods, digital-analog simulators, continuous system simulation languages, hybrid simulation, feedback systems, simulation of an autopilot, interactive and real-time systems. **System Dynamics:** Historical background, exponential growth and decay models, modified exponential growth models, logistic curves, generation of growth models, system dynamics diagrams, multi-segment models, representation of time delays, feedback in socio-economic system, examples of real-life. **Probability concepts in simulation:** Stochastic variables, discrete and continuous probability functions, measures of probability functions, numerical evaluation of continuous probability functions, continuous uniformly distributed random numbers, computer generation of random numbers, a uniform random number generator, generating discrete distributions, non-uniform continuously distributed random numbers, the rejection method. **Arrival Patterns and Service Times:** Congestion in Systems, arrival Patterns, Poisson arrival patterns, Exponential distribution, coefficient of variation, Erlang distribution, Hyper-Exponential distribution, service times, Normal distribution, queuing disciplines, measures of queues, mathematical solutions of queuing problems, utilization as a design factor, grade of service. **Discrete System Simulation:** Discrete events, representation of time, generation of arrival patterns, simulation of a telephone system, delayed calls, simulation programming tasks, gathering statistics, counters and summary statistics, measuring utilization and occupancy, recording distributions and transit times, discrete simulation languages. **Inventory Control and Cost-Effective Models:** Finite/infinite delivery rate with backordering/without backordering, probabilistic inventory model, cost-effectiveness study, life-cycle cost study of an aircraft system.

3 Text and Reference Materials

T Textbook:

- Geoffrey Gordon, **System Simulation**, 2nd Edition, Prentice Hall, 1977.

R References:

- V.P. Singh, **System Modeling and Simulation**, 1st Edition, New Age International Publisher, 2009.
- Deo Narsingh, **System Simulation with Digital Computer**, 1st Edition, PHI Publisher, 2011.

4 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	**System Models:** The concepts of a system, system environment, stochastic activities, continuous and discrete systems, system modeling, types of models, static and dynamic physical models, static and dynamic mathematical models, and principles used in modeling.	T	T
3-4	**System Studies:** Subsystems; Major segments of a corporate model: Environment, production, management; Types of system study; System analysis, design and postulation.	T	T
5-8	**System Simulation:** The technique of simulation, the Monte Carlo method, comparison of simulation and analytical methods, experimental nature of simulation, types of system simulation, numerical computation technique for continuous and discrete models, distributed lag models, Cobweb models, progress of a simulation study.	T	T
9-11	**Continuous System Simulation:** Continuous system models, differential equations, analog methods, digital-analog simulators, continuous system simulation languages, hybrid simulation, feedback systems, simulation of an autopilot, interactive and real-time systems.	T	T
12-14	**System Dynamics:** Historical background, exponential growth and decay models, modified exponential growth models, logistic curves, generation of growth models, system dynamics diagrams, multi-segment models, representation of time delays, feedback in socio-economic system, examples of real-life.	T	T
15-19	**Probability concepts in simulation:** Stochastic variables, discrete and continuous probability functions, measures of probability functions, numerical evaluation of continuous probability functions, continuous uniformly distributed random numbers, computer generation of random numbers, a uniform random number generator, generating discrete distributions, non-uniform continuously distributed random numbers, the rejection method.	T	R
20-22	**Arrival Patterns and Service Times:** Congestion in Systems, arrival Patterns, Poisson arrival patterns, Exponential distribution, coefficient of variation, Erlang distribution, Hyper-Exponential distribution, service times, Normal distribution, queuing disciplines, measures of queues, mathematical solutions of queuing problems, utilization as a design factor, grade of service.	T	R

23-26	**Discrete System Simulation:** Discrete events, representation of time, generation of arrival patterns, simulation of a telephone system, delayed calls, simulation programming tasks, gathering statistics, counters and summary statistics, measuring utilization and occupancy, recording distributions and transit times, discrete simulation languages.	T	R
27-28	**Inventory Control and Cost-Effective Models:** Finite/infinite delivery rate with backordering/without backordering, probabilistic inventory model, cost-effectiveness study, life-cycle cost study of an aircraft system.	T	R

For the definitions of T and R , Please refer to Section 3.

TBA
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Course Outline
CSE 3218 Simulation and Modeling Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 2nd semester 2024**
Course Code	CSE 3218
Course Title	*Simulation and Modeling Lab*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	None

2 Syllabus

Experiment Lists: 1. Designing small system models: static and dynamic physical models, static and dynamic mathematical models. 2. Implement system simulation techniques: Monte Carlo method, Distributed lag models, Cobweb models. 3. Designing a Continuous System Simulation: simulation of an autopilot. 4. Design and Implement System Dynamics: Exponential growth and decay models, modified exponential growth models, logistic curves, generation of growth models, representation of time delays. 5. Simulation of Arrival Patterns and Service Times: Congestion in Systems, arrival Patterns, Poisson arrival patterns and Exponential distribution; Service times, Normal distribution, queuing disciplines, measures of queues, grade of service. 6. Designing a Discrete System Simulation: simulation of a telephone system. 7. Designing Inventory Control and Cost-Effective Models: Finite/infinite delivery rate with backordering/without backordering, life-cycle cost study of an aircraft system.

Programming Language: Python/R/MATLAB/SIMSCRIPT

3 Text and Reference Materials

Look into the textbook and references in CSE 3217 Simulation and Modeling course.

TBA
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Course Outline
CSE-3219 Computer Graphics

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 2nd semester 2024**
Course Code	CSE-3219
Course Title	*Computer Graphics*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	CSE 2209 - Numerical Methods

2 Syllabus

Introduction: Definition and applications of computer graphics. **Display system:** Raster graphic and vector graphic display system. **Graphics hardware:** Frame-buffer, Video-controller. **Basics of line drawing:** Line drawing algorithm: DDA Algorithm. Derivation of initial decision variable and its derivative, algorithm and simulation of (i) Bresenham's/Mid-point Line drawing algorithm, (ii) Mid-point Circle drawing algorithm and (iii) Mid-point Ellipse drawing algorithm. **Line Clipping Algorithms:** (i) Cohen Sutherland line clipping algorithm, (ii) Cyrus Beak line clipping algorithm. **Polygon Filling Algorithm:** Types of polygons, Scan-line algorithm, Edge Table (ET) and Active edge table (AET). **Polygon Clipping algorithm:** Sutherland-Hodgman Polygon Clipping algorithm. **Motion/Transformations:** Classifications, Coordinate system. Mathematics of transformation. 3D rotation matrix, translation, scaling and reflection. **Viewing in 3D (Projection):** Classification, Mathematics of projection. Simple perspective projection matrices. General-purpose projection matrices and its simplification. **Visible Surface Determination:** Z-buffering algorithm, Visible surface Ray-tracing algorithm. **Color Model of Light:** Monochrome color, Comparison between additive and subtractive color. RGB color model and CMY color model. HSV and HLS color model. HSV color model. **Illumination and Shading:** Illumination model. Local light model: Ambient, diffuse light/reflection model. Specular reflection model. Phong's illumination model. Flat/Constant shading, interpolated/smooth shading. Phong-shading vs Gouraud-shading. **Parametric Curves and Surfaces:** Standard equation of Cubic Polynomial, Types of curves. Continuity of curve segments. Derivation of basis matrix and blending functions of (i)Hermite curve, (ii)Bezier curve, Subdivision of curves, spline and bi-cubic surfaces

3 Text and Reference Materials

T Textbook:

- Computer Graphics Principle and Practice, by Foley.

R References:

- Online resources from internet

4 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	**Introduction:** Definition and applications of computer graphics. **Display system:** Raster graphic and vector graphic display system. **Graphics hardware:** Frame-buffer, Video-controller.	T	T
3	**Basics of line drawing:** Line drawing algorithm: DDA Algorithm.	T	T
4-6	Derivation of initial decision variable and its derivative, algorithm and simulation of **Mid-point/Bresenham's Line drawing algorithm,** (Also slope independent line)	T	T
7-8	Derivation of initial decision variable and its derivative, algorithm and simulation of **Mid-point Circle drawing algorithm**	T	T
9-10	Derivation of initial decision variable and its derivative, algorithm and simulation of **Mid-point Ellipse drawing algorithm**	T	T
11-13	**Line Clipping Algorithms:** Cohen-Sutherland line clipping algorithm, Cyrus- Beak line clipping algorithm.	T	R
14-15	**Polygon Filling Algorithm:** Types of polygons, Scan-line algorithm, Edge Table (ET) and Active edge table (AET).	T	T
16	**Polygon Clipping algorithm:** Sutherland-Hodgman Polygon Clipping algorithm.	T	R
17-18	**Motion/Transformations:** Classifications, Coordinate system. Mathematics of transformation. 3D rotation matrix, translation, scaling and reflection.	T	R
19-20	**Viewing in 3D (Projection):** Classification, Mathematics of projection. Simple perspective projection matrices. General-purpose projection matrices and its simplification.	T	R
21	**Visible Surface Determination:** Z-buffering algorithm, Visible surface Ray-tracing algorithm.	T	R
22-23	**Color Model of Light:** Monochrome color, Comparison between additive and subtractive color. RGB color model and CMY color model. HSV and HLS color model. HSV color model.	T	R
24-26	**Illumination and Shading:** Illumination model. Local light model: Ambient, diffuse light/reflection model. Specular reflection model. Phong's illumination model. Flat/Constant shading, interpolated/smooth shading. Phong-shading vs Gouraud-shading.	T	R
27-28	**Parametric Curves and Surfaces:** Standard equation of Cubic Polynomial, Types of curves. Continuity of curve segments. Derivation of basis matrix and blending functions of Hermite curve, Bezier curve, Subdivision of curves, spline and bi-cubic surfaces.	T	R

For the definitions of T and R , Please refer to Section 3.

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University of Dhaka

Department of Computer Science and Engineering
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Course Outline - CSE 3220 Computer Graphics Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 2nd semester 2024**
Course Code	CSE 3220
Course Title	*Computer Graphics Lab*
Course Credit	1.5 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	Check the prerequisite for the related theory course

2 Syllabus

The CSE 3220 Computer Graphics Lab course offers hands-on experience in key computer graphics concepts, where students will learn to program graphical algorithms both directly and using OpenGL. The lab exercises include implementing line drawing, polygon filling, and clipping algorithms, as well as transformations and rendering techniques. Students will also explore parametric curves and surfaces, programming these elements manually and then utilizing OpenGL to understand the differences in implementation and outcomes. This dual approach ensures a deep understanding of both the underlying principles and their practical applications in modern graphics programming.

3 Text and Reference Materials

Check the textbook and reference list for the corresponding theory course.

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Course Outline - CSE 3221 Wireless Networks

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 2nd semester 2024**
Course Code	CSE 3221
Course Title	*Wireless Networks*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	CSE 2109 -Data and Telcommunication

2 Syllabus

Introduction to Wireless Networks: Introduction to wireless network architectures: cellular and mobile networks, wireless local area networks, multi-hop adhoc networks; **Principles of Wireless Communication:** Radio propagation modeling, the performance of digital modulation schemes and coding techniques in fading environments, Multipath Fading, Noise and Interference Mitigation, CDMA and OFDMA, channel diversity and MIMO, Cognitive Radio Networks; **Medium Access Control:** Unslotted and Slotted-ALOHA protocols, System throughput analysis, IEEE 802.11a/b/g/e/i/ac CSMA/CA protocols, CSMA/CA with RTS/CRS; **Multiobjective Channel Allocation:** Channel allocation for both protocol and SINR interference models. Power Optimization, throughput maximization, and fairness; **Fundamentals of Wireless Network Routing:** The AODV and OLSR protocols for mobile ad-hoc networks, Link estimation and neighbor management; **Geographic Routing:** Geographic routing: greedy routing, routing holes, Routing in intermittently connected mobile networks. **Opportunistic routing and Cooperative Routing:** Energy-efficient and Delay-driven opportunistic routing (OR), Cooperative Routing for high throughput and reliability; **Congestion Control in Wireless Networks:** TCP over wireless networks. Congestion sharing (IFRC, WCAP). Centralized and distributed explicit and precise rate control (RCRT, WRCP), Optimization-based rate control with Lagrange duality and queue backpressure; **Emerging Wireless Network Technologies and Standards:** Wi-Fi 6, Wi-Fi 6E, Wi-Fi 7, Wireless Personal Area Network - WPAN IEEE 802.15.1/3/4 (Bluetooth, Zigbee), WMAN - IEEE 802.16a (Wi-Max), LTE, 3GPP, Mi-Fi, Ly-Fi; **Security in Wireless Networks:** Wireless Encryption Protocol, Wi-Fi Protected Access Control 3 (WPA3) and its predecessors, Managing Wi-Fi with Digital Certificates, Opportunistic Wireless Encryption (OWE).

3 Text and Reference Materials

T Textbook:

- *William Stallings*, **Wireless Communications and Networks**, Second Edition, Pearson Publications, 2020.
- *Matthew Gast*, **802.11 Wireless Networks: The Definitive Guide**, Second Edition, O'reilly, 2013.

R References:

– *Jennifer Minella*, **Wireless Security Architecture: Designing and Maintaining Secure Wireless for Enterprise**, First Edition, Wiley Publications, 2022.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Identify architecture, applications, and operation principles of cellular, WLAN, and various adhoc networks.	PO1	Cognitive (C2)	40%	Please refer to Section 5.
CO2	Analyze various medium access and resource allocation techniques such as power control for fixed-rate and rate-adaptive systems, Aloha and CSMA based randomized medium access, scheduling for TDMA/FDMA/CDMA-based wireless networks	PO2	Cognitive (C3)	50%	
CO3	Select appropriate network, transport, and application layer protocols for a given wireless network with specific design considerations.	PO3	Cognitive (C5)	10%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome* (Appendix: ??)
LoBT: *Level of Bloom's Taxonomy* (Appendix: ??)

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	20%	30%		50%
Midterm Exam	15%	10%		25%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation			10%	10%
Class Participation			5%	5%
Total	40%	45%	15%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	Networking and Socialization, sharing course administration and guidelines • **Introduction to Wireless Networks:** Wireless network architectures- cellular and mobile networks, wireless local area networks, multi-hop adhoc networks;	T	T

3-4	**Principles of Wireless Communication:** Radio propagation modeling, the performance of digital modulation schemes and coding techniques in fading environments, • Multipath Fading, Noise and Interference Mitigation, CDMA and OFDMA, channel diversity and MIMO;	T	T
5-7	**Medium Access Control:** Unslotted and Slotted-ALOHA protocols, System throughput analysis, • VIEEE 802.11a/b/g/e/i/ac CSMA/CA protocols, CSMA/CA with RTS/CRS;	T	T
8-10	**Multiobjective Channel Allocation:** Channel allocation for both protocol and SINR interference models, • Power Optimization, throughput maximization, and fairness;	T	T
11-12	**Fundamentals of Wireless Network Routing:** The AODV and OLSR protocols for mobile ad-hoc networksm, Link estimation and neighbor management; • **Geographic Routing:** Geographic routing: greedy routing, routing holes, Routing in intermittently connected mobile networks.	T	T
13-14	**Opportunistic routing and Cooperative Routing:** Energy-efficient and Delay-driven opportunistic routing (OR), Cooperative Routing for high throughput reliability; ;	T	T
15-17	**Congestion Control in Wireless Networks:** TCP over wireless networks. Congestion sharing (IFRC, WCAP), • Centralized and distributed explicit and precise rate control (RCRT, WRCP), • Optimization-based rate control with Lagrange duality and queue backpressure;	T	T
18-22	**Emerging Wireless Network Technologies and Standards:** Wi-Fi 6, Wi-Fi 6E, Wi-Fi 7, • Wireless Personal Area Network - WPAN IEEE 802.15.1/3/4 (Bluetooth, Zigbee), • WMAN - IEEE 802.16a (Wi-Max), LTE, 3GPP, Mi-Fi, Ly-Fi;	T	R
23-26	**Security in Wireless Networks:** Wireless Encryption Protocol, Wi-Fi Protected Access Control 3 (WPA3) and its predecessors, • Managing Wi-Fi with Digital Certificates, Opportunistic Wireless Encryption (OWE);	T	T
27-28	Reviews, Future of Wireless Networks and its Challenges, • Problem-solving practices, • Assignments/Presentations, etc.	T	R

For the definitions of T and R , Please refer to Section 3.

Prof. Dr. Md. Mustafizur Rahman
Course Teacher, CSE 3221
April 24, 2024

Prof. Dr. Md. Abdur Razzaque
Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

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Course Outline - CSE 3222 Wireless Networks Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 2nd semester 2024**
Course Code	CSE 3222
Course Title	*Wireless Networks*
Course Credit	1.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	CSE 2109 -Data and Telcommunication

2 Syllabus

Performance Analysis of wireless MAC protocols: IEEE 802.11a/b/g/e/i/ac CSMA/CA protocols, CSMA/CA with RTS/CRS; **Performance Analysis of Multiobjective Channel Allocation techniques:** Power, throughput, delay and fairness performances; **Analysis of Wireless Network Routing protocols:** The AODV and OLSR protocols and their variants; Geographic, Opportunistic and Cooperative Routing. **Performances of Congestion Control algorithms in Wireless Networks:** IFRC, WCAP, backpressure and rate control algorithms. **Implementation and Analysis of advanced protocols:** Wi-Fi 6, Wi-Fi 6E, Wi-Fi 7, WPAN IEEE 802.15.1/3/4. **Security testing in Wireless Networks:** Configuration and administration of WPA3 and its predecessors, Managing Wi-Fi with Digital Certificates, Opportunistic Wireless Encryption (OWE).

3 Text and Reference Materials

T Textbook:

- *William Stallings*, **Wireless Communications and Networks**, Second Edition, Pearson Publications, 2020.
- *Matthew Gast*, **802.11 Wireless Networks: The Definitive Guide**, Second Edition, O'reilly, 2013.

R References:

- *Jennifer Minella*, **Wireless Security Architecture: Designing and Maintaining Secure Wireless for Enterprise**, First Edition, Wiley Publications, 2022.

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17.3.2 Elective II

University of Dhaka

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Course Outline - CSE 4211 Deep Neural Networks

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4211
Course Title	*Deep Neural Networks*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	CSE 4101 Machine Learning

2 Syllabus

Introduction to Neural Networks: This segment explores the foundations of neural networks including the McCulloch-Pitts (MP) Neuron, Hebbian Learning, The Perceptron as building blocks, Multilayer Perceptrons (MLPs), and Feedforward Neural Networks. Focuses on Activation Functions (Sigmoid, Tanh, ReLU) and Loss functions (Mean Squared Error, Cross-Entropy). **Deep Learning Fundamentals:** Covers Backpropagation as the core training algorithm, Gradient Descent and Optimization techniques such as SGD, Momentum, and Adam, along with Vanishing/Exploding Gradients and Regularization Techniques (Dropout, L1/L2 regularization). **Hyperparameter Tuning and Best Practices:** Discusses strategies for hyperparameter optimization including grid search, random search, and Bayesian optimization, addressing overfitting and underfitting, data augmentation techniques, Compute Unified Device Architecture (CUDA), deep learning frameworks utilizing CUDA, and visualization tools such as TensorBoard. **Convolutional Neural Networks and YOLO:** Details on Convolutional Layers and Filters, Pooling Layers (Max Pooling, Average Pooling), CNN Architectures for Image Classification (LeNet, AlexNet, VGG, ResNet), Object Detection with YOLO, YOLO architecture (bounding boxes, grid cells, confidence scores), variations (YOLOv2, YOLOv3, etc.), Loss function in YOLO, and Applications of YOLO. **Recurrent Neural Networks:** Explores RNN Architectures and Sequence Data, Long Short-Term Memory Networks (LSTMs), Gated Recurrent Units (GRUs), and applications in Natural Language Processing, time series analysis. **Transformers:** Investigates Attention Mechanisms as the core concept behind transformers, Self-Attention and its applications, Multi-Head Attention for richer feature extraction, Transformer Architecture: Encoder-decoder structure and its variants, with applications in Text Generation, Machine Translation, Text Summarization, Question Answering, and more recent advancements like Vision Transformers. **Diffusion Models:** Discusses the Principles of Diffusion for Image Generation, the iterative denoising process, understanding noise schedules, Denoising Diffusion Probabilistic Models (DDPMs), architecture and training process, applications of Diffusion Models in Text-to-Image Generation (DALL-E, Imagen, Stable Diffusion), Image Super-resolution, other emerging applications, and comparisons with other generative models such as Generative Adversarial Networks (GANs). **Graph Neural Networks:** Covers the basics of graph theory and key concepts in GNNs including node embedding, edge embedding, graph and sub-graph embedding and message passing, Graph Convolutional Networks (GCNs), Graph Attention Networks (GATs), and applications in social network analysis, chemical structure prediction, and recommendation systems.

3 Text and Reference Materials

T Textbook:

- *John D. Kelleher*, **Deep Learning**, First Edition, MIT Press, 2019.

R References:

- *Ian Goodfellow and Yoshua Bengio and Aaron Courville*, **Deep Learning**, First Edition, MIT Press, 2016.
- *Eli Stevens*, *Luca Antiga*, *and Thomas Viehmann*, **Deep Learning with PyTorch** , First Edition, Manning, 2020.

4 Topic Outline

Lecture	Selected Topic	Article	Problems
1-3	**Introduction to Neural Networks**: The McCulloch-Pitts (MP) Neuron, Hebbian Learning, The Perceptron - the building blocks, Multilayer Perceptrons (MLPs) and Feedforward Neural Networks, Activation Functions (Sigmoid, Tanh, ReLU), Loss functions (Mean Squared Error, Cross-Entropy)	T	T
4-7	**Deep Learning Fundamentals**: Backpropagation: The core training algorithm, Gradient Descent and Optimization (SGD, Momentum, Adam), Vanishing/Exploding Gradients, Regularization Techniques (Dropout, L1/L2 regularization)	T	T
8-10	**Hyperparameter Tuning and Best Practices**: Strategies for Hyperparameter optimization (grid search, random search, Bayesian optimization), Dealing with overfitting and underfitting, Data augmentation techniques, Compute Unified Device Architecture (CUDA), Deep Learning frameworks utilizing CUDA, Visualization tools for understanding neural networks (TensorBoard)	T	T
11-15	**Convolutional Neural Networks and YOLO**: Convolutional Layers and Filters, Pooling Layers (Max Pooling, Average Pooling), CNN Architectures for Image Classification (LeNet, AlexNet, VGG, ResNet), Object Detection with YOLO, YOLO architecture (bounding boxes, grid cells, confidence scores), Variations (YOLOv2, YOLOv3, etc.), Loss function in YOLO, Applications of YOLO	T	T
16-18	**Recurrent Neural Networks**: RNN Architectures and Sequence Data, Long Short-Term Memory Networks (LSTMs), Gated Recurrent Units (GRUs), Applications: Natural Language Processing, time series analysis	T	T
19-22	**Transformers**: Attention Mechanisms: The core concept behind transformers, Self-Attention and its applications, Multi-Head Attention for richer feature extraction, Transformer Architecture: Encoder-decoder structure and its variants, Applications of Transformers: Text Generation, Machine Translation, Text Summarization, Question Answering, and more recent advancements (e.g., Vision Transformers)	T	T

23-25	**Diffusion Models**: Principles of Diffusion for Image Generation, The iterative denoising process, Understanding noise schedules, Denoising Diffusion Probabilistic Models (DDPMs), Architecture and training process, Applications of Diffusion Models: Text-to-Image Generation (DALL-E, Imagen, Stable Diffusion), Image Super-resolution, Other emerging applications, Compare Diffusion Models to other generative models such as Generative Adversarial Networks (GANs)	T	T
26-27	**Graph Neural Networks**: Basics of graph theory and key concepts in GNNs, including node embedding and message passing. Graph Convolutional Networks (GCNs) and Graph Attention Networks (GATs), Applications in social network analysis, chemical structure prediction, and recommendation systems	T	T

For the definitions of T and R , Please refer to Section 3.

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University of Dhaka

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Course Outline - CSE 4212 Deep Neural Network Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd year 2nd semester 2024**
Course Code	CSE 4212
Course Title	*Deep Neural Network Lab*
Course Credit	1 units
Contact Hours Per Week	2
Course Status	Elective Course
Prerequisite Course	Check the prerequisite for the related theory course

2 Syllabus

This laboratory course complements the theoretical knowledge gained in the Deep Neural Networks course by providing hands-on experience in the practical implementation and optimization of deep learning models. Students will engage with real-world datasets and utilize state-of-the-art deep learning frameworks to develop, analyze, and refine neural network models across various applications. The lab projects are designed to be innovative, practical, and potentially commercially viable, preparing students for future technological challenges in the industry.

Prospective Lab Tasks Description

1. **Introduction to Neural Networks Implementation:**
   - Setup and training of basic MLPs using frameworks like TensorFlow or PyTorch.
   - Experimentation with different activation and loss functions on simple datasets.
2. **Optimizing Deep Learning Models:**
   - Implementing backpropagation manually on a small network.
   - Use of optimization techniques such as SGD, Momentum, and Adam in training models.
   - Handling vanishing and exploding gradients through practical experiments.
3. **Hyperparameter Tuning and Regularization Techniques:**
   - Application of grid search, random search, and Bayesian optimization methods to tune network hyperparameters.
   - Implementing dropout and L1/L2 regularization to combat overfitting.
   - Experiments with data augmentation techniques to enhance model robustness.
4. **Advanced Model Architectures:**
   - Building and training Convolutional Neural Networks for image classification tasks.

- Implementing YOLO for object detection tasks with real-time data.
- Developing RNNs, LSTMs, and GRUs for time series analysis and natural language processing tasks.

5. **Transformers and Advanced Applications:**
   - Implementing Transformer models for tasks like text summarization, translation, and question answering.
   - Exploration of recent advancements such as Vision Transformers.
6. **Diffusion Models for Generative Tasks:**
   - Implementing and training diffusion models for tasks like image generation and super-resolution.
   - Comparing the performance and applicability of diffusion models with other generative models like GANs.
7. **Graph Neural Networks:**
   - Introduction to graph theory and implementation of Graph Neural Networks for social network analysis and recommendation systems.

3 Text and Reference Materials

T Textbook:

– *John D. Kelleher*, **Deep Learning**, First Edition, MIT Press, 2019.

R References:

– *Ian Goodfellow and Yoshua Bengio and Aaron Courville*, **Deep Learning**, First Edition, MIT Press, 2016.

– *Eli Stevens, Luca Antiga, and Thomas Viehmann*, **Deep Learning with PyTorch** , First Edition, Manning, 2020.

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Course Outline
CSE 4213 Natural Language Processing

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4213
Course Title	*Natural Language Processing*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	CSE 4101 Machine Learning

2 Syllabus

Introduction to NLP and Regular Expressions: Overview of NLP and its applications. Detailed practice with regular expressions for text preprocessing tasks. **Text Normalization Techniques:** Explore advanced techniques for text normalization including word and sentence segmentation. Introduction to stemming. **String Operations and Minimum Edit Distance:** Introduction to string comparison using the minimum edit distance algorithm for error correction. **Introduction to N-gram Language Models:** Building and applying N-gram models for word sequence prediction. **Evaluating Language Models:** Methods for evaluating language models, including performance metrics. **Naive Bayes and Logistic Regression for Text Classification:** Recap on Naive Bayes and logistic regression classifiers. Discussion on regularization in logistic regression. **Vector Semantics and Word Embeddings:** Introduction to vector semantics. Practical use of Word2Vec and GloVe. **Neural Networks and Neural Language Models:** Review of neural network basics and their application in NLP. **Advanced Neural Network Models (RNNs, LSTMs, GRUs):** Exploring complex architectures for sequence modeling. **Transformers and Their Impact on NLP:** Introduction to transformer architecture and self-attention mechanism. **Introduction and Pre-training of Transformer Models:** Overview of transformer technology. Importance and methods of pre-training transformers on large text corpora. **Fine-Tuning Transformer Models:** Process and strategies for fine-tuning pre-trained models on specific NLP tasks. **Deep Dive into BERT and Its Variants:** Detailed exploration of BERT, its architecture, training process, and variants like RoBERTa and ALBERT. **Applications of Transformers in NLP:** Use of transformers in sophisticated NLP applications such as named entity recognition and machine translation. Transformers in Machine Translation: Detailed discussion on the use of transformers in machine translation, focusing on the encoder-decoder framework. **Exploring Large Language Models and Their Impact:** Discussion on the impact of large-scale transformer models like GPT-3 on various linguistic tasks and their broader implications. **Context-Free Grammars and Constituency Parsing:** Introduce context-free grammars and the CKY algorithm for parsing them. Discussion on formal definitions, grammar normal forms, and the use of treebanks. **Dependency Parsing:** Introduction to dependency grammar formalisms. Exploration of how syntactic structures are described using directed binary grammatical relations. **Semantic Analysis in NLP:** Introduction to semantic analysis, covering semantic parsing and

relation extraction. Practical techniques and tools used for extracting meaning from text. **Dialogue Systems and Chatbots:** Introduction to the construction and functioning of chatbots and dialogue systems. Hands-on session on designing a simple chatbot using NLP principles.

3 Text and Reference Materials

T Textbook:

- *Daniel Jurafsky and James H. Martin*, **Speech and Language Processing An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition**, Recent Edition, PEARSON.

R References:

- *Chris Manning and Hinrich Schütze*, **Foundations of Statistical Natural Language Processing** , Recent Edition, MIT Press.

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April 24, 2024

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April 24, 2024

University of Dhaka

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University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4214
Natural Language Processing Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4214
Course Title	*Natural Language Processing Lab*
Course Credit	1 units
Contact Hours Per Week	2
Course Status	Elective Course
Prerequisite Course	Check the prerequisite for the related theory course

2 Syllabus

The CSE 4214 Natural Language Processing Lab is structured to enhance hands-on practical experience, complementing the theoretical content taught in the corresponding CSE 4213 Natural Language Processing course. In this lab, students undertake programming assignments and projects focusing on core NLP tasks such as tokenization, syntactic parsing, semantic analysis, machine translation, and sentiment analysis. Additionally, the lab incorporates cutting-edge content involving recent transformer-based models. Students will apply these advanced techniques to real-world datasets, developing, training, and evaluating NLP models using contemporary machine learning tools and libraries. This approach ensures students are well-prepared for both current applications and future developments in the rapidly evolving field of natural language processing.

3 Text and Reference Materials

Check the textbook and reference list for the corresponding theory course.

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April 24, 2024

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April 24, 2024

University of Dhaka

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Course Outline - CSE 4215 Data Mining

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4215
Course Title	*Data Mining*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	None

2 Syllabus

Introduction: Basic concepts of Data Mining, different kinds of data and patterns can be mined, used technologies, targeted applications and major issues and applications of Data Mining. **Mining Frequent Itemsets:** Definitions and background, Market basket analysis, Methods for mining frequent itemsets (i) Apriori algorithm (mining frequent itemsets using candidate generation, improving the efficiency of Apriori), (ii) FP-growth algorithm (mining frequent itemsets without candidate generation), (iii) Mining frequent itemsets using vertical data format. **Mining Association Rules and Correlation:** Mining association rules, generating association rules from frequent itemsets; Mining correlations from association rules, significance of correlation mining in presence of association rules; Pattern evaluation methods, various correlation measures: lift, chi-square, all-conf, max-conf, cosine and Kulc; Performance and applicability analysis of correlation measures. **Mining Sequential Patterns:** Concepts and primitives, applications, domains; Mining methods in transactional sequence databases (i) Apriori based approaches (GSP, SPADE), (ii) Pattern growth based (PrefixSpan); Mining sequential patterns in biological databases, web access databases and time series databases. **Mining Dynamic Data and Data Streams:** Basic ideas of mining incremental and dynamic data, handling high speed stream data, different windowing techniques for data streams such as tilted, decaying and sliding window. **Mining Representative Patterns:** Mining closed and maximal frequent itemsets and sequences; Mining top-k, top-k redundancy aware, k-summarized patterns; Mining compressed or approximate patterns by pattern clustering. **Mining Subgraph Patterns:** Methods for mining frequent subgraphs (i) Apriori based approaches (AGM, FSG), (ii) Pattern growth based (gSpan); Mining variant and constrained substructure patterns. **Mining in Multilevel and Multidimensional Spaces:** Mining multilevel, and multidimensional associations, mining data cube-based and clustering-based quantitative association rules, using statistical theory to discover exceptional behavior. **Constraint-Based Pattern Mining:** Pruning pattern space with pattern pruning constraints: monotonic, antimonotonic, succinct, convertible, inconvertible; Pruning data space with data pruning constraints. **Mining Various Kinds of Data and Patterns:** Mining rare and negative patterns, mining weighted and utility-based patterns, mining patterns from uncertain data, mining spatial and temporal patterns, mining high dimensional data. **Data Mining Applications:** Business intelligence; Web search engines and social media data analysis; Healthcare and biological data analysis; Education; Pattern-based classification, clustering, outlier detection and semantic annotation; Collaborative filtering; Privacy-preserving.

3 Text and Reference Materials

T Textbook:

- Jiawei Han, Jian Pei, H. Tong, **Data Mining: Concepts and Techniques**, 4th Edition, Morgan Kaufmann Publishers, Elsevier..

R References:

- Mohammed J. Zaki, Wagner Meira Jr, **Data Mining and Analysis: Fundamental Concepts and Algorithms**, Cambridge University Press..
- Charu C. AggarWal, **Data Mining: The Textbook**, Springer..

4 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	**Introduction:** Basic concepts of Data Mining, different kinds of data and patterns can be mined, used technologies, targeted applications and major issues and applications of Data Mining.	T	T
3-6	**Mining Frequent Itemsets:** Definitions and background, Market basket analysis, Methods for mining frequent itemsets (i) Apriori algorithm (mining frequent itemsets using candidate generation, improving the efficiency of Apriori), (ii) FP-growth algorithm (mining frequent itemsets without candidate generation), (iii) Mining frequent itemsets using vertical data format.	T	T
7-9	**Mining Association Rules and Correlation:** Mining association rules, generating association rules from frequent itemsets; Mining correlations from association rules, significance of correlation mining in presence of association rules; Pattern evaluation methods, various correlation measures: lift, chi-square, all-conf, max-conf, cosine and Kulc; Performance and applicability analysis of correlation measures.	T	T
10-12	**Mining Sequential Patterns:** Concepts and primitives, applications, domains; Mining methods in transactional sequence databases (i) Apriori based approaches (GSP, SPADE), (ii) Pattern growth based (PrefixSpan); Mining sequential patterns in biological databases, web access databases and time series databases.	T	T
13-14	**Mining Dynamic Data and Data Streams:** Basic ideas of mining incremental and dynamic data, handling high speed stream data, different windowing techniques for data streams such as tilted, decaying and sliding window.	T	T
15-17	**Mining Representative Patterns:** Mining closed and maximal frequent itemsets and sequences; Mining top-k, top-k redundancy aware, k-summarized patterns; Mining compressed or approximate patterns by pattern clustering.	T	R
18-20	**Mining Subgraph Patterns:** Methods for mining frequent subgraphs (i) Apriori based approaches (AGM, FSG), (ii) Pattern growth based (gSpan); Mining variant and constrained substructure patterns.	T	R
21-22	**Mining in Multilevel and Multidimensional Spaces:** Mining multi-level, and multidimensional associations, mining data cube-based and clustering-based quantitative association rules, using statistical theory to discover exceptional behavior.	T	R
23-24	**Constraint-Based Pattern Mining:** Pruning pattern space with pattern pruning constraints: monotonic, antimonotonic, succinct, convertible, inconvertible; Pruning data space with data pruning constraints.	T	R

25-26	**Mining Various Kinds of Data and Patterns:** Mining rare and negative patterns, mining weighted and utility-based patterns, mining patterns from uncertain data, mining spatial and temporal patterns, mining high dimensional data.	T	R
27-28	**Data Mining Applications:** Business intelligence; Web search engines and social media data analysis; Healthcare and biological data analysis; Education; Pattern-based classification, clustering, outlier detection and semantic annotation; Collaborative filtering; Privacy-preserving.	T	R

For the definitions of T and R , Please refer to Section 3.

TBA
Course Teacher, CSE 4215
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4216 Data Mining Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4216
Course Title	*Data Mining Lab*
Course Credit	1.0 units
Contact Hours Per Week	2
Course Status	Elective Course
Prerequisite Course	None

2 Syllabus

Experiment Lists: 1. Implement and compare frequent itemset mining algorithms such as Apriori and FP-growth. 2. Generate association rules from frequent itemsets and discover correlation from them. 3. Implement and compare sequential pattern mining algorithms such as GSP, SPADE and PrefixSpan. 4. Design and implement algorithms for time series and web access sequences. 5. Design and implement algorithms for Dynamic Data and Data Streams. 6. Design and implement algorithms for representative pattern mining such as maximal, closed and top-k patterns. 7. Implement and compare frequent subgraph pattern mining algorithms such as AGM, FSG and gSpan.

Language used: C/C++/Java/Python

A small capstone project: Discover interestingness from any kind of mined patterns, analyze the findings, and apply them to make useful decisions in any real-life domain.

3 Text and Reference Materials

T Textbook:

- Jiawei Han, Jian Pei, H. Tong, **Data Mining: Concepts and Techniques**, 4th Edition, Morgan Kaufmann Publishers, Elsevier..

R References:

- Mohammed J. Zaki, Wagner Meira Jr, **Data Mining and Analysis: Fundamental Concepts and Algorithms**, Cambridge University Press..
- Charu C. AggarWal, **Data Mining: The Textbook**, Springer..

Course Teacher, CSE 4216
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4217 Digital Forensics

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4217
Course Title	*Digital Forensics*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Optional course
Prerequisite Course	CSE 2105 Computer Architecture and Microprocessor, CSE 3109 Operating Systems, CSE 3201 Computer Network

2 Syllabus

Key digital forensics concepts: Computer forensics, network forensics, mobile device forensics, malware forensics, memory forensics, scientific method of digital forensics, digital evidence, circumstantial vs. digital evidence, Evidence integrity and cryptographic hash functions, a chain of custody, using forensic copies, reporting and testimony, a case study of real-world crime investigation involving digital forensics. **Legal system in Bangladesh:** Legal system in Bangladesh, criminal vs civil justice system, courtroom scenario, Lawyers vs prosecutors, defense attorneys, law enforcement, warrant requirement, e-discovery, Judges and decision-makers, laws related to cyber crimes and digital forensics, accepted digital evidence in Bangladesh legal system, fingerprint analysis, privacy law, and digital forensics. **Hard Disk and File Systems:** Different types of disk drives and their characteristics, Logical structure of the disk, Booting process of Windows, Linux, and Mac, Various file systems of Windows, Linux, and Mac, storage systems, and Encoding standards. **Defeating Anti-Forensics Techniques:** Anti-forensics techniques, Data deletion and recycle bin forensics, File carving techniques, password cracking techniques, Detect Steganography and hidden data in the file systems, Anti-forensics countermeasures. **Windows Forensics:** Collect volatile and non-volatile information, Perform Windows memory and registry analysis, Examine cache, cookies and web browser history, Windows files and metadata, Text-based logs, and event-based logs. **Linux and Mac forensics:** Volatile and non-volatile data in Linux, File system analysis in Linux, Mac Forensics. **Network Forensics:** Sources of network-based evidence, Evidence Acquisition: Physical interception, traffic acquisition, and active acquisition, Network intrusion detection and analysis, Event log aggregation, correlation, and analysis, Investigate switch, router, firewall and web proxies. **Mobile Forensics:** Architectural layers and boot processes of Android and ios devices, Investigate cellular network data, SIM file systems and its data acquisition method, Phone locks, rooting of Android and jailbreaking of ios devices, Logical and physical acquisition of Android and ios devices; **Investigating web attacks:** Basics of internet information services logs and Apache web server logs, Functionality of intrusion detection systems and web application firewall, Investigate attacks on web applications and servers. **Malware Forensics:** Static and dynamic analysis of malware, Analyze malware behavior on the system and on the network. **Cloud Forensics:** Basics of cloud computing and cloud forensics, Fundamentals of Amazon web services (AWS) and Microsoft Azure Investigate security incident in AWS and Azure **IoT Forensics:** IoT and IoT security problems, Recognize different types of IoT threats, IoT forensics and perform IoT forensics on IoT devices.

3 Text and Reference Materials

T Textbook:

- *Bill Nelson*, *Amelia Phillips*, *Chris Steuart*, **Guide to Computer Forensics and Investigations**, 6th Edition, Cengage Learning, 2018.

R References:

- *Muhiballah Muhammed*, **Windows Forensics Analyst Field Guide**, 1st Edition, Pact Publishing, 2023.
- *Michael Hale Ligh*, *Andrew Case*, *Jamie Levy*, *AAron Walters*, **The Art of Memory Forensics**, 1st Edition, John WIlley and Sons, 2014.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Apply the knowledge of sciences and engineering fundamentals to interpret the elementary concepts of various architectures, applications, protocols, and background processes dealing with networking architecture and protocol design related problems.	PO1	Cognitive (C3)	40%	Please refer to Section 5.
CO2	Analyze operational details of various protocols, related to application, transport, and routing layers to apply the specialist engineering knowledge to solve the complex networking infrastructure development problem.	PO2	Cognitive (C4)	50%	
CO3	Establish a reliable protocol while planning and designing network services infrastructure, to address networking-related problems and issues that ensure user Quality of Service (QoS) and Quality of Experience (QoE).	PO6	Affective (A4)	10%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	20%	30%	10%	60%
Midterm Exam	10%	10%		20%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation			5%	5%
Class Participation			5%	5%
Total	35%	45%	20%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	Networking and Socialization, Sharing course administration and guidelines, Overview of Digital Forensics and Data Acquisition, • Computer forensics, • network forensics, • mobile device forensics, • malware forensics, • memory forensics • Data Acquisition: Types-Live and Dead, Bit-by-bit, Logical and Sparse, Methodology	T	T
3-4	Legal system in Bangladesh • criminal vs civil justice system, • Lawyers vs prosecutors, • defense attorneys, law enforcement, warrant requirement • Judges and decision maker, • laws related to cyber crimes and digital forensics • Accepted digital evidences in Bangladesh legal system, finger print analysis, privacy law and digital forensics	T	T
5-6	Hard Disk and File Systems • Different types of disk drives and their characteristics, • Logical structure of disk, • Booting process of Windows, Linux and Mac • Various file systems of Windows, Linux and Mac • storage systems and Encoding standard	T	T
7-9	Defeating Anti-Forensics Techniques • Anti-forensics techniques, • Data deletion and recycle bin forensics, • File carving techniques, password cracking techniques • Detect Steganography and hidden data in the file systems • Anti-forensics counter measures;	T	T
10-13	Windows Forensics • Collect volatile and non-volatile information • Perform Windows memory and registry analysis, • Examine cache, cookies and web browser history, • Windows files and meta data • Text-based logs and event-based logs;	T	T
14-15	Linux and Mac forensics • Volatile and non-volatile data in Linux • File system analysis in Linux, • Mac Forensics	T	T
16-18	Network Forensics • Sources of network-based evidence, • Evidence Acquisition: Physical interception, traffic acquisition and active acquisition • Network intrusion detection and analysis, • Event log aggregation, correlation and analysis • Investigate switch, router, firewall and web proxies;	T	R
19-21	Mobile Forensics • Architectural layers and boot processes of android and ios device, • Investigate cellular network data, • SIM file systems and its data acquisition method, • Phone locks, rooting of android and jailbreaking of ios devices • Logical and physical acquisition of android and ios devices;	T	T
22-23	Investigating web attacks • Basics of internet information services logs and Apache web server logs • Functionality of intrusion detection systems and web application firewall • Investigate attacks on web applications and servers	T	R
24-25	Malware Forensics • Static and dynamic analysis of malware • Analyze malware behaviour on system and on network	T	R
26	Cloud Forensics • Basics of cloud computing and cloud forensics • Fundamentals of Amazon web services (AWS) and Microsoft Azure • Investigate security incident in AWS and Azure	T	R
27	IoT Forensics • IoT and IoT security problems • Recognize different types of IoT threats • IoT forensics and perform IoT forensics on IoT devices	T	R

28	Review, Future horizon of digital forensics, • Problem solving practices • Presentation • Assignments, etc	T	R

For the definitions of T and R , Please refer to Section 3.

TBA
Course Teacher, CSE 3105
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4218 Digital Forensics Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4218
Course Title	*Digital Forensics Lab*
Course Credit	1 units
Contact Hours Per Week	2
Course Status	Elective Course
Prerequisite Course	Check the prerequisite for the related theory course

2 Syllabus

The CSE 4218 Digital Forensic Lab laboratory course is designed to complement the theoretical content of CSE 4217 Digital Forensics, offering students hands-on experience in digital forensic analysis through practical exercises. The lab sessions utilize industry-standard tools to conduct studies of various systems, including Windows, Linux, Mac, and mobile and network environments. Students engage in activities such as disk and file system analysis, mobile data acquisition, network traffic capture, malware analysis, and the detection of anti-forensic techniques. Additional labs focus on challenges in cloud and IoT forensics, equipping students with the skills to handle real-world scenarios and understand the legal aspects of digital forensics in the context of Bangladesh's judicial system. This approach ensures that students learn the tools and techniques of digital forensics and apply them to complex investigations across diverse platforms.

3 Text and Reference Materials

Check the textbook and reference list for the corresponding theory course.

Course Teacher, CSE 4224
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4219 Software Security

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th Year 2nd Semester 2024**
Course Code	CSE 4219
Course Title	*Software Security*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course

2 Syllabus

Introduction to Software Security Overview of software security concepts, Security principles and goals, Threat modeling and risk assessment **Secure Software Design** Secure design principles and patterns, Security requirements elicitation, Secure software architecture **Common Vulnerabilities and Attacks**Buffer overflows and memory corruption, Injection attacks (SQL injection, XSS), Authentication, and session management vulnerabilities **Cryptography for Software Security** Cryptographic primitives and algorithms, Encryption, hashing, digital signatures, Key management, and secure protocols **Access Control and Authentication** Role-based access control, Multi-factor authentication, Single sign-on and federated identity **Secure Coding Practices** Input validation and output encoding, Error handling and exception management, Secure coding standards and guidelines **Security Testing and Analysis** Static and dynamic code analysis, Fuzz testing and penetration testing, Security testing tools and frameworks **Secure Software Development Lifecycle (SDLC)** Integrating security into the SDLC, Secure coding practices in agile development, Security requirements management

3 Text and Reference Materials

T Textbook:

- *Robert Seacord*, **Secure Coding in C and C++**, Second Edition, Pearson Publications.
- *Gary McGraw*, **Software Security: Building Security In**, First Edition, Addison-Wesley Professional.
- *Chris Wysopal*, **Art of Software Security Testing, The: Identifying Software Security Flaws: Identifying Software Security Flaws**, First Edition, Addison-Wesley Professional.

R References:

- *William Stallings & Lawrie Brown*, **Computer Security Principles and Practices**, Fifth Edition, Pearson Publications.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Understand fundamental principles of software security and Identify common software vulnerabilities and attacks.	PO1	Cognitive (C3)	40%	Please refer to Section 5.
CO2	Design and implement secure software systems, Conduct security assessments and vulnerability analysis.	PO2	Cognitive (C4)	50%	
CO3	Apply secure coding practices in real-world scenarios and Adopt Secure Software Development Lifecycle practices .	PO6	Affective (A4)	10%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	25%	25%	10%	60%
Midterm Exam	10%	10%		20%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation			5%	5%
Class Participation			5%	5%
Total	40%	50%	10%	100%

Course Teacher, CSE 4219
April 25, 2024

Chairman, Dept. of CSE, DU
April 25, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
CSE 4220 Software Security Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4220
Course Title	*Software Security Lab*
Course Credit	1 units
Contact Hours Per Week	2
Course Status	Elective Course
Prerequisite Course	None

2 Syllabus

The Software Security Lab is designed to provide students with hands-on experience in secure software design, finding faults in programs and detecting different types of security attacks. This laboratory-based course aims to complement the theoretical concepts covered in the corresponding theory lectures, enabling students to apply their knowledge in practical, real-world scenarios.

The lab will focus on the following topics:

- Setup and familiarization with security tools such as Burp Suite, Wireshark, and static code analysis tools.
- Analyzing code snippets to identify common security vulnerabilities like injection flaws, XSS, CSRF, etc.
- Conducting penetration tests on a simulated vulnerable web application to identify security weaknesses.
- Implementing secure coding practices in sample applications to mitigate vulnerabilities.
- Identifying and mitigating security threats in web and mobile applications through practical exercises.

3 Text and Reference Materials

T Textbook:

- *John Viega, Gary R. McGraw*, **Building Secure Software: How to Avoid Security Problems the Right Way**, First Edition, Addison-Wesley Professional.

R References:

– *Wenliang Du*, **Computer Security: A Hands-on Approach**, First Edition, CreateSpace Independent Publishing Platform.

– *Online available resources.*

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Analyze and identify common security vulnerabilities in software applications Perform code review and analysis to detect security flaws in software code.	PO1	Cognitive (C2)	45%	Please refer to Section 5.
CO2	Conduct penetration testing and vulnerability assessment of software systems.	PO2	Cognitive (C3)	30%	
CO3	Apply secure coding practices to develop robust and resilient software applications.	PO9	Cognitive (C6)	25%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Class Participation			10%	10%
Continuous Lab Performance	15%	10%	5%	30%
Lab Examination			20%	20%
Capstone Project or Demo/Presentation	10%	15%	5%	40%
Total	25%	30%	45%	100%

Sarker Tanveer Ahmed Rumee, CSE 4220
April 25, 2024

Chairman, Dept. of CSE, DU
April 25, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4221 Compiler Design

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4221
Course Title	*Compiler Design*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	CSE 3207 Theory of Computation

2 Syllabus

Introduction to Compilers: Introduces the role of compilers in software development, detailing the phases of compilation which include lexical analysis, syntax analysis, semantic analysis, optimization, and code generation. It also covers compiler architecture and organization. **Lexical Analysis:** Explores regular expressions and finite automata, focusing on lexical analyzer generators such as Lex, tokenization, and lexical error handling. **Syntax Analysis:** Delves into context-free grammars and parsing techniques, including top-down parsing (recursive descent, LL(1), predictive parsing) and bottom-up parsing (shift-reduce parsing, LR(0), SLR(1), LR(1), LALR(1)). **Syntax-Directed Translation:** Examines syntax-directed definitions and attribute grammars, translation schemes, and the use of intermediate representations in syntax-directed translation. **Semantic Analysis:** Discusses the management of scope and symbol tables, type checking, type inference, and semantic error handling. **Code Optimization:** Provides an overview of optimization techniques, control flow analysis and optimization, data flow analysis and optimization, and common optimization algorithms. **Code Generation:** Offers insights into code generation techniques, instruction selection and scheduling, register allocation, and code generation for different target machines.

3 Text and Reference Materials

T Textbook:

- *Alfred Aho, Jeffrey Ullman, Ravi Sethi, Monica Lam*, **Compilers: Principles, Techniques, and Tools** , Second Edition, Addison Wesley, 2006.

R References:

- *Keith D. Cooper and Linda Torczon*, **Engineering a Compiler**, Third Edition, Morgan Kaufmann, 2022.

4 Topic Outline

Table 1: Compilers Course Outline

Lecture	Selected Topic	Article	Problems
1-4	**Introduction to Compilers**: Overview of compilers and their role in software development, phases of compilation: Lexical analysis, syntax analysis, semantic analysis, optimization, code generation, compiler architecture and organization	T	T
5-8	**Lexical Analysis**: Regular expressions and finite automata, Lexical analyzer generators (e.g., Lex), Tokenization, Lexical error handling	T	T
9-12	**Syntax Analysis**: Context-free grammars and parsing techniques, Top-down parsing: Recursive descent, LL(1), predictive parsing, Bottom-up parsing: Shift-reduce parsing, LR(0), SLR(1), LR(1), LALR(1)	T	T
13-16	**Syntax-Directed Translation**: Syntax-directed definitions and attribute grammars, Translation schemes, Intermediate representations	T	T
17-20	**Semantic Analysis**: Scope and symbol tables, Type checking and type inference, Semantic error handling	T	T
21-24	**Code Optimization**: Overview of optimization techniques, Control flow analysis and optimization, Data flow analysis and optimization, Common optimization algorithms	T	T
25-28	**Code Generation**: Overview of code generation techniques, Instruction selection and scheduling, Register allocation, Code generation for different target machines	T	T

For the definitions of **T** and **R** , Please refer to Section 3.

Course Teacher, CSE 4221
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4222 Compiler Design Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4222
Course Title	*Compiler Design Lab*
Course Credit	1.0 units
Contact Hours Per Week	2
Course Status	Elective Course
Prerequisite Course	Check the prerequisite for the related theory course

2 Syllabus

The CSE 4222 Compiler Design Lab serves as a practical complement to the theoretical concepts covered in the corresponding CSE 4221 Compiler Design Course. In this lab, students gain hands-on experience in designing and implementing various components of a compiler. They will work on tasks such as lexical analysis, syntax analysis, semantic analysis, and code generation. Through programming assignments, students will build compiler modules, including lexical analyzers, parsers, symbol tables, and intermediate code generators. Additionally, they will learn about optimization techniques and debugging strategies to enhance compiler performance and reliability. By applying theoretical knowledge to real-world compiler development scenarios, students develop a comprehensive understanding of compiler design principles and practices.

3 Text and Reference Materials

Check the textbook and reference list for the corresponding theory course.

Course Teacher, CSE 4222
April 24, 2024

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April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4223 Cloud Computing

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4223
Course Title	*Cloud Computing*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	CSE 3201 -Computer Network

2 Syllabus

Introduction to Cloud Computing: Cloud computing concepts and definitions, Types of cloud services: IaaS, PaaS, SaaS, Benefits and challenges of cloud computing **Cloud Service Models:** Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS) **Cloud Deployment Models:** Public, private, hybrid, and multi-cloud models, Considerations for choosing deployment models **Virtualization and Containers:** Virtualization technologies (e.g., VMware, Hyper-V), Containerization (e.g., Docker, Kubernetes), Virtualization technologies for data centers, Server virtualization, storage virtualization, network virtualization **Cloud Architecture and Design:** Design principles for scalable, reliable, and available cloud applications, Microservices architecture, Serverless computing **Cloud Security and Compliance:** Security considerations in the cloud, Data protection and encryption, Compliance standards (e.g., GDPR, HIPAA) **Cloud Networking and Storage:** Virtual networks, load balancing, and content delivery, Cloud storage services (e.g., AWS S3, Azure Blob Storage) **Cloud Monitoring and Management:** Tools for monitoring and managing cloud resources, Auto-scaling and resource optimization **Cloud Data Center Fundamentals:** Data center components and infrastructure, Cooling, power distribution, and energy efficiency **Cloud Data Center Design and Architecture:** Data center layout and design considerations, Redundancy, fault tolerance, and disaster recovery, Network design for data centers, Network protocols, **Cloud Data Center Security:** Physical security for data centers, Network security, access controls, and monitoring **Cloud Migration Strategies:** Planning and executing cloud migration projects, Lift and shift, re-platforming, refactoring, **Emerging Trends and Technologies:** Edge computing, Green data centers and sustainability, Case Studies and Real-world Applications.

3 Text and Reference Materials

T Textbook:

- *Thomas Erl, Ricardo Puttini, & Zaigham Mahmood*, **Cloud Computing: Concepts, Technology & Architecture**, First Edition, Pearson Publications, 2013.

R References:

- *Gustavo Alessandro Andrade Santana, Yusuf Bhaiji, Maurilio Gorito, & Krishna Arji*, **Data Center Virtualization Fundamentals**, First Edition, Cisco Systems, 2013.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Explain the foundational concepts, principles, and architecture of cloud computing and data center technologies	PO1	Cognitive (C3)	40%	Please refer to Section 5.
CO2	Analyze different cloud and data center principles to meet the user's Service Level Agreement (SLA) and ensure Quality-of-Service (QoS)	PO2	Cognitive (C4)	50%	
CO3	Create designs of emerging system services leveraging cloud resources and modern tools to benefit from cloud infrastructure.	PO5	Psychomotor (P6)	10%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome* (Appendix: ??)
LoBT: *Level of Bloom's Taxonomy* (Appendix: ??)

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	25%	35%		60%
Midterm Exam	10%	10%		20%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation			5%	5%
Class Participation			5%	5%
Total	40%	50%	10%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	Networking and Socialization, sharing course administration and guidelines • **Introduction to Cloud Computing:** Cloud computing concepts and definitions, Types of cloud services: IaaS, PaaS, SaaS, Benefits and challenges of cloud computing;	T	T
3-4	**Cloud Service Models:** Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS) • **Cloud Deployment Models:** Public, private, hybrid, and multi-cloud models, Considerations for choosing deployment models	T	T
5-7	**Virtualization and Containers:** Virtualization technologies (e.g., VMware, Hyper-V), Containerization (e.g., Docker, Kubernetes), • Virtualization technologies for data centers, Server virtualization, storage virtualization, network virtualization;	T	T

8-12	**Cloud Architecture and Design:** Design principles for scalable, reliable, and available cloud applications, Microservices architecture, Serverless computing • **Cloud Security and Compliance:** Security considerations in the cloud, Data protection and encryption, Compliance standards (e.g., GDPR, HIPAA)	T	T
13-14	**Cloud Networking and Storage:** Virtual networks, load balancing, and content delivery, Cloud storage services (e.g., AWS S3, Azure Blob Storage); ;	T	T
15-17	**Cloud Monitoring and Management:** Tools for monitoring and managing cloud resources, • Auto-scaling and resource optimization, • Cost and Quality of Service considerations while allocating cloud resources. • Availability and Fault-tolerant issues of cloud services;	T	T
18-21	**Cloud Data Center Fundamentals:** Data center components and infrastructure, Cooling, power distribution, and energy efficiency • **Cloud Data Center Design and Architecture:** Data center layout and design considerations, Redundancy, fault tolerance, and disaster recovery, Network design for data centers, Network protocols, • **Cloud Data Center Security:** Physical security for data centers, Network security, access controls, and monitoring;	T	R
22-24	**Cloud Migration Strategies:** Planning and executing cloud migration projects, Lift and shift, re-platforming, refactoring;	T	T
25-26	**Emerging Trends and Technologies:** AI and ML in Edge computing, Green data centers and sustainability, Case Studies, and Real-world Applications.	T	T
27-28	Reviews, Future of Cloud Computing and its Challenges • Problem-solving practices, • Assignments/Presentations, etc.	T	R

For the definitions of T and R , Please refer to Section 3.

Course Teacher, CSE 4223
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4224 Cloud Computing Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4224
Course Title	*Cloud Computing Lab*
Course Credit	1 units
Contact Hours Per Week	2
Course Status	Elective Course
Prerequisite Course	CSE 3201 -Computer Network

2 Syllabus

The lab exercises of this course is based on the theory topics taught in the CSE 4223 Cloud Computing course. Major topics: Introduction to a Cloud Service Automation Manager, Creating a VMWare, Deployment and Monitoring of services, Creating and Using a virtual machine, Resizing a virtual machine, Creating backup image of a virtual machine, Creating a new project on a virtual server and generating its monitoring reports, Exploring general hypervisors and virtual machine files, managing data stores, Using a virtual machine console and creating user roles on the hypervisor, etc.

3 Text and Reference Materials

T Textbook:

- *Thomas Erl*, *Ricardo Puttini*, *& Zaigham Mahmood*, **Cloud Computing: Concepts, Technology & Architecture**, First Edition, Pearson Publications, 2013.

R References:

- *Gustavo Alessandro Andrade Santana*, *Yusuf Bhaiji*, *Maurilio Gorito*, *& Krishna Arji*, **Data Center Virtualization Fundamentals**, First Edition, Cisco Systems, 2013.

Course Teacher, CSE 4224
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

17.3.3 Elective III

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4225 Big Data Analytics

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4225
Course Title	*Big Data Analytics*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	None

2 Syllabus

Introduction to Big Data Analytics: Definition of big data and its characteristics (volume, velocity, variety, veracity, and value). Importance of big data analytics in various industries. Some example-based Overview of real-world applications. **Foundations of Data Science:** Basics of data science and its relationship to big data analytics. Data lifecycle: acquisition, storage, processing, analysis, and visualization. Data types, structures, and formats. **Data Acquisition and Preprocessing:** Techniques for collecting, cleaning, and preprocessing large-scale datasets. Data integration and transformation. Data quality assessment and improvement. **Big Data Storage and Management:** Overview of distributed file systems (e.g., Hadoop Distributed File System - HDFS). NoSQL databases (e.g., MongoDB, Cassandra) and their role in big data storage. Data warehousing concepts and architectures. **Big Data Processing Frameworks:** Apache Hadoop ecosystem: Hadoop MapReduce, YARN, and Hadoop ecosystem projects (e.g., Hive, Pig, Spark). Introduction to Apache Spark: RDDs, DataFrames, Spark SQL, and Spark Streaming. **Machine Learning for Big Data Analytics:** Overview of machine learning algorithms commonly used in big data analytics (e.g., classification, regression, clustering). Distributed machine learning frameworks (e.g., Spark MLlib). Feature engineering and model evaluation techniques for big data. **Big Data Visualization and Interpretation:** Data visualization principles and techniques for big data. Tools for interactive data exploration and visualization (e.g., Tableau, D3.js). Interpretation of visualizations and communication of insights. **Mining Data Streams:** The data stream model, Sampling in a data stream, Filtering streams, Counting distinct elements in a stream, Estimating moments, Handling windows in a data stream, Decaying windows, Mining frequent patterns in a data stream. **Scalability, Performance, and Optimization:** Scalability challenges in big data analytics. Techniques for improving performance and optimizing big data processing pipelines. Parallel and distributed computing concepts. **Ethical and Legal Considerations:** Privacy, security, and ethical issues in big data analytics. Compliance with regulations (e.g., GDPR, HIPAA) and industry standards. Responsible use of data and potential biases. **Emerging Trends and Technologies:** Recent advancements in big data analytics (e.g., deep learning, edge computing). Trends in big data tools, platforms, and industry applications. Opportunities and challenges in the future of big data analytics.

3 Text and Reference Materials

T Textbook:

- Nathan Marz, James Warren, **Big Data: Principles and Best Practices of Scalable Realtime Data Systems**, Manning Publications.
- Arshdeep Bahga, Vijay Madisetti, **Big Data Science & Analytics: A Hands-On Approach**, VPT.

R References:

- Saumyadipta Pyne, B.L.S. Prakasa Rao, S.B. Rao, **Big Data Analytics: Methods and Applications**, Springer.
- Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, **Mining of Massive Datasets**, 2nd Edition, Cambridge University Press.

4 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	**Introduction to Big Data Analytics:** Definition of big data and its characteristics (volume, velocity, variety, veracity, and value). Importance of big data analytics in various industries. Some example-based Overview of real-world applications.	T	T
3-4	**Foundations of Data Science:** Basics of data science and its relationship to big data analytics. Data lifecycle: acquisition, storage, processing, analysis, and visualization. Data types, structures, and formats.	T	T
5-6	**Data Acquisition and Preprocessing:** Techniques for collecting, cleaning, and preprocessing large-scale datasets. Data integration and transformation. Data quality assessment and improvement.	T	T
7-10	**Big Data Storage and Management:** Overview of distributed file systems (e.g., Hadoop Distributed File System - HDFS). NoSQL databases (e.g., MongoDB, Cassandra) and their role in big data storage. Data warehousing concepts and architectures.	T	T
11-14	**Big Data Processing Frameworks:** Apache Hadoop ecosystem: Hadoop MapReduce, YARN, and Hadoop ecosystem projects (e.g., Hive, Pig, Spark). Introduction to Apache Spark: RDDs, DataFrames, Spark SQL, and Spark Streaming.	T	T
15-17	**Machine Learning for Big Data Analytics:** Overview of machine learning algorithms commonly used in big data analytics (e.g., classification, regression, clustering). Distributed machine learning frameworks (e.g., Spark MLlib). Feature engineering and model evaluation techniques for big data.	T	T
18-20	**Big Data Visualization and Interpretation:** Data visualization principles and techniques for big data. Tools for interactive data exploration and visualization (e.g., Tableau, D3.js). Interpretation of visualizations and communication of insights.	T	R
21-22	**Mining Data Streams:** The data stream model, Sampling in a data stream, Filtering streams, Counting distinct elements in a stream, Estimating moments, Handling windows in a data stream, Decaying windows, Mining frequent patterns in a data stream.	T	R

23-24	**Scalability, Performance, and Optimization:** Scalability challenges in big data analytics. Techniques for improving performance and optimizing big data processing pipelines. Parallel and distributed computing concepts.	T	R
25-26	**Ethical and Legal Considerations:** Privacy, security, and ethical issues in big data analytics. Compliance with regulations (e.g., GDPR, HIPAA) and industry standards. Responsible use of data and potential biases.	T	R
27-28	**Emerging Trends and Technologies:** Recent advancements in big data analytics (e.g., deep learning, edge computing). Trends in big data tools, platforms, and industry applications. Opportunities and challenges in the future of big data analytics.	T	R

For the definitions of T and R , Please refer to Section 3.

Course Teacher, CSE 4225
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4227 Information Retrieval

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4227
Course Title	*Information Retrieval*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	CSE 3203 Artificial Intelligence

2 Syllabus

Boolean Retrieval: An example of information retrieval problem, Inverted Index, Processing Boolean queries, extended Boolean retrieval. **Term Vocabulary and Postings Lists:** Document delineation and character sequence decoding, Tokenization, Dropping common terms: stop words, Normalization (equivalence classing of terms), Stemming and lemmatization, skip pointers, Biword indexes, Positional indexes. **Dictionaries and Tolerant Retrieval:** Search structures for dictionaries, General wildcard queries, k-gram indexes for wildcard queries, Spelling correction. **Index Construction:** Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, Dynamic indexing, Other types of indexes. **Index Compression:** Statistical properties of terms in information retrieval, Dictionary compression, Posting file compression. **Scoring and Ranking:** Parametric and zone indexes, Term frequency and weighting, The vector space model for scoring, variant tf-idf functions. **Computing Scores in a Complete Search System:** Efficient scoring and ranking: inexact top-k document retrieval, index elimination, champion lists, static quality scores and ordering, impact ordering, cluster pruning; Components of an information retrieval system: tiered indexes, query-term proximity, designing parsing and scoring functions. **Evaluation in Information Retrieval:** Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results, Assessing relevance, Results snippets. **Relevance feedback and query expansion:** The Rocchio algorithm for relevance feedback, Probabilistic relevance feedback, Relevance feedback on the web, Evaluation of relevance feedback strategies, Global methods for query reformulation. **Probabilistic Information Retrieval:** The probability ranking principle; the binary independence model: Deriving a ranking function for query terms, probability estimates in theory and practice. **Language Models for Information Retrieval:** Finite automata and language models, multinomial distributions over words; The query likelihood model. **Text Classification and Clustering:** Naïve Bayes and k- nearest neighbors text classification; The Bernoulli model; Feature selection; K-means and Hierarchical clustering; Evaluation of text classification and clustering. **Web Search Basics, Crawling, Indexes, Link Analysis:** Web Characteristic, Index size and estimation, Crawling, Web As a graph, Page Rank, Hubs and Authorities, Information Retrieval Applications.

3 Text and Reference Materials

T Textbook:

– *Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze*, **Introduction to Information Retrieval**, Recent Edition, Cambridge University Press.

R References:

– *Ricardo Baeza-Yates, Berthier Ribeiro-Neto*, **Modern Information Retrieval**, Recent Edition, Addison Wesley.

4 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	**Boolean Retrieval:** An example of information Retrieval Problem, Inverted Index, Processing Boolean queries, extended Boolean retrieval.	T	T
3-5	**Term Vocabulary and Postings lists:** Document delineation and character sequence decoding, Tokenization, Dropping common terms: stop words, Normalization (equivalence classing of terms), Stemming and lemmatization, skip pointers, Biword indexes, Positional indexes.	T	T, R
6-7	**Dictionaries and Tolerant Retrieval:** Search structures for dictionaries, General wildcard queries, k-gram indexes for wildcard queries, Spelling correction.	T	T
8-9	**Index Construction:** Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, Dynamic indexing, Other types of indexes.	T	T, R
10-11	**Index Compression:** Statistical properties of terms in information retrieval, Dictionary compression, Posting file compression.	T	T, R
12-13	**Scoring and Ranking:** Parametric and zone indexes, Term frequency and weighting, The vector space model for scoring, variant tf-idf functions.	T	T, R
14-16	**Computing Scores in a Complete Search System:** Efficient scoring and ranking: inexact top-k document retrieval, index elimination, champion lists, static quality scores and ordering, impact ordering, cluster pruning; Components of an information retrieval system: tiered indexes, query-term proximity, designing parsing and scoring functions.	T	T, R
17-18	**Evaluation in Information Retrieval:** Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results, Assessing relevance, Results snippets.	T	T, R
19-21	**Relevance feedback and query expansion:** The Rocchio algorithm for relevance feedback, Probabilistic relevance feedback, Relevance feedback on the web, Evaluation of relevance feedback strategies, Global methods for query reformulation.	T	T, R
21-22	**Probabilistic Information Retrieval:** The probability ranking principle; the binary independence model: Deriving a ranking function for query terms, probability estimates in theory and practice.	T	T, R
23-24	**Language Models for Information Retrieval:** Finite automata and language models, multinomial distributions over words; The query likelihood model.	T	T, R

Continued on next page

Table 1 – continued from previous page			
Lecture	**Selected Topic**	**Article**	**Problems**
25-26	**Text Classification and Clustering:** Naïve Bayes and k-nearest neighbors text classification; The Bernoulli model; Feature selection; K-means and Hierarchical clustering; Evaluation of text classification and clustering.	T	T, R
27-28	**Web search basics, crawling, indexes, Link analysis:** Web Characteristic, Index size and estimation, Crawling, Web As a graph, Page Rank, Hubs and Authorities, Information Retrieval Applications.	T	T, R

For the definitions of **T** and **R** , Please refer to Section 3.

Course Teacher, CSE 4227
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4229 Human Robot Interaction

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4229
Course Title	*Human Robot Interaction*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	None

2 Syllabus

Introduction: Different types of Robots and interactions, Working principles of Robots, Hardware and Software of Robots. **Design in HRI:** design principles, anthropomorphization. **Spatial Interaction:** Use of space in HHI and HRI, proxemics, navigations. **Nonverbal Interaction:** gaze and eye movement, gesture, imitation, touch, posture, rhythm, timing. Verbal Interaction: speech production, speech recognition, dialogue management. **Emotion:** mood, affect, emotional interaction strategies, perception and models of emotion; Applications of Robots in industry and society. Perception of Robots in media and the real world. **Ethics in HRI:** Three and Five ethical rules, emotional and abusive HRI. **Future of HRI:** Emerging issues of HRI, Research Methodologies, Discussion about different steps of research in HRI.

3 Text and Reference Materials

T Textbook:

- *C. Bartneck, T. Belpaeme, F. Eyssel, T. Kanda, M. Keijsers, S. Sabanovi*, **Human–Robot Interaction: An Introduction**, 1st edition, Cambridge University Press, 2020.

R References:

- *Ramana Vinjamuri*, **Human-Robot Interaction: Perspectives and Applications**, 1st Edition, Intech Open, 2023.

4 Course Outcomes

After completion of this course, the students are expected to -

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Identify a broad range of research topics in HRI for designing and developing a robot that can successfully interact with humans.	PO8	Affective (A3)	30%	Please refer to Section 5.
CO2	Compare various types of Human-Robot interactions including non-verbal/verbal robot behavior, learning and collaborating with humans, group interactions, and ethical considerations and challenges.	PO6	Affective (A2)	20%	
CO3	Conduct scientifically rigorous human-subject research to test for HRI-related research questions and hypotheses, and how HRI research is currently applied in real-world applications.	PO12	Psychomotor (P5)	50%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome* (Appendix: ??)
LoBT: *Level of Bloom's Taxonomy* (Appendix: ??)

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	25%	10%	25%	60%
Midterm Exam		10%	10%	20%
Class Test/Quiz	5%		5%	10%
Assignment/Presentation			5%	10%
Class Participation			5%	5%
Total	30%	20%	50%	100%

Course Teacher, CSE 4229
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4231 Computer Vision

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4231
Course Title	*Computer Vision*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	CSE 3203 - Artificial Intelligence

2 Syllabus

Introduction: Definition, Brief history. **Image formation:** Geometric primitives and transformations, Photometric image formation, The digital camera. **Image processing:** Feature detection and matching: Points and patches, Edges, Lines. **Segmentation:** Active contours, Split and merge, Mean shift and mode finding. **Feature-based alignment:** 2D and 3D feature-based alignment, Pose estimation, Geometric intrinsic calibration. **Structure from motion:** Triangulation, Two-frame structure from motion, Factorization, Bundle adjustment, Constrained structure and motion. **Dense motion estimation:** Translational alignment, Parametric motion, Spline-based motion, Optical flow. **Image stitching:** Motion models, Global alignment, Compositing. **Computational photography:** Photometric calibration, High dynamic range imaging, Super-resolution and blur removal, Image matting and compositing, Texture analysis and synthesis. **Stereo correspondence:** Epipolar geometry, Sparse correspondence, Dense correspondence, Local methods, Global optimization, Multi-view stereo. **3D reconstruction:** Shape from X, Active rangefinding, Surface representations, Point-based representations, Volumetric representations, Model-based reconstruction, Recovering texture maps and albedos. **Image-based rendering:** View interpolation, Layered depth images, Light fields and Lumigraphs, Environment mattes, Video-based rendering. **Recognition:** Object detection, Face recognition, Instance recognition, Category recognition, Context and scene understanding.

3 Text and Reference Materials

T Textbook:

- Richard Szeliski, Computer Vision: Algorithms and Applications, 2022

R References:

- David Forsyth & Jean Ponce, Computer Vision: A Modern Approach, 2nd Ed.
- Kulkarni, Computer Vision and Fuzzy Neural Systems, 2001

4 Topic Outline

Lecture	Selected Topic	Article	Problems
1	**Introduction:** Definition, Brief history.	T	T
2-3	**Image formation:** Geometric primitives and transformations, Photometric image formation, The digital camera.	T	T
4-5	**Image processing:** Feature detection and matching: Points and patches, Edges, Lines.	T	T
6-7	**Segmentation:** Active contours, Split and merge, Mean shift and mode finding.	T	T
8-9	**Feature-based alignment:** 2D and 3D feature-based alignment, Pose estimation, Geometric intrinsic calibration.	T	T
10-11	**Structure from motion:** Triangulation, Two-frame structure from motion, Factorization, Bundle adjustment, Constrained structure and motion.	T	T
12-13	**Dense motion estimation:** Translational alignment, Parametric motion, Spline-based motion, Optical flow.	T	R
14-15	**Image stitching:** Motion models, Global alignment, Compositing.	T	T
16-17	**Computational photography:** Photometric calibration, High dynamic range imaging, Super-resolution and blur removal, Image matting and compositing, Texture analysis and synthesis.	T	T
18-20	**Stereo correspondence:** Epipolar geometry, Sparse correspondence, Dense correspondence, Local methods, Global optimization, Multi-view stereo.	T	R
21-23	**3D reconstruction:** Shape from X, Active rangefinding, Surface representations, Point-based representations, Volumetric representations, Model-based reconstruction, Recovering texture maps and albedos.	T	R
24-25	**Image-based rendering:** View interpolation, Layered depth images, Light fields and Lumigraphs, Environment mattes, Video-based rendering.	T	R
26-28	**Recognition:** Object detection, Face recognition, Instance recognition, Category recognition, Context and scene understanding.	T	R

For the definitions of T and R , Please refer to Section 3.

Course Teacher, CSE 4231
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4233
Software Testing and Quality Assurance

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4233
Course Title	*Software Testing and Quality Assurance*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	None

2 Syllabus

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.

3 Text and Reference Materials

T Textbook:

- Kshirasagar Naik & Priyadarshi Tripathy, **Software Testing and Quality Assurance: Theory and Practice**, 1st Edition, John Wiley & Sons, 2011.

R References:

- Online Resources from the Internet.

Course Teacher, CSE 4233
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4235
VLSI Design and Formal Verification

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE
Course Title	*VLSI Design and Formal Verification*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	None

2 Syllabus

Introduction to VLSI; design metrics; MOS Devices, CMOS Inverter; Combinational logic, layout, design rules. Manufacturing process; Simulation; Mentor Graphics CAD tools, Low Power design strategies; Logic Styles; Boolean matching, Equivalence checking, VLSI circuits Dynamic CMOS logic Timing and clock synchronization, Pipelining. Static, Dynamic sequential circuits Deep sub-micron designs; design for performance. Wires; Coping with Interconnects. Adders, Multipliers, data paths; timing issues. Memory structures; Variability and. CMOS system design, Floor plan, Placement and routing, VHDL and Verilog to simulate. Project design.

3 Text and Reference Materials

T Textbook:

- *Weste Harris*, **CMOS VLSI Design: A Circuits and Systems Perspective**, Third Edition, Addison Wesley, 2005.

R References:

- • *N H E Weste & K Eshraghian*, **Principles of CMOS VLSI Design**, Second Edition, Pearson, 1993.

4 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	Networking and Socialization, sharing course administration and guidelines Introduction to VLSI and design metrics.	T	T
3-4	Introduce to create models of moderately sized CMOS circuits that realize specified digital functions. Introduction to CMOS Inverter.	T	T
5-7	Introduction to Combinational logic, layout, design rules and Manufacturing process	T	T
8-12	Introduce to design integrated circuits and Mentor Graphics using Computer Aided Design (CAD) tools. (CAD) Tools.	T	T
13-14	Introduction to Boolean matching, Equivalence checking and VLSI circuits Dynamics.	T	T
15-17	Introduction to Low Power design strategies; CMOS logic Timing and clock synchronization and Pipe-lining	T	T
18-21	Introduction to Static and Dynamic sequential circuits Deep sub-micron designs; design for performance. Wires, Coping with Interconnects.	T	R
22-24	Introduction to Adders, Multipliers, data paths; timing issues	T	T
25-26	Introduction to Memory structures; Variability and CMOS system design	T	T
27-28	Introduction to VHDL and Verilog to simulate. Project design.	T	R

For the definitions of T and R , Please refer to Section 3.

Course Teacher, CSE 1203
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4237
Parallel and Distributed Database Systems

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th Year 2nd Semester 2024**
Course Code	CSE 4237
Course Title	*Parallel and Distributed Database Systems*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	None

2 Syllabus

Introduction: Distributed Database System, Principles, Architecture and Design Issues **Distributed Database Design:** Alternative Design Strategies, Fragmentation, Allocation, Combined and Adaptive Approaches **Distributed Query Processing and Optimization:** Layers of Query Processing, Query Decomposition, Localization of Distributed Data, Join Ordering in Distributed Queries, Distributed Cost Model, Distributed Query Optimization Approaches **Distributed Transaction Processing:** Properties and Types of Transactions, Distributed Concurrency Control: Serializability, Concurrency Control Mechanisms, Lock-Based and Timestamp-Based Concurrency Control Algorithms, Deadlock Management, Multiversion Concurrency Control and Optimistic Algorithms **Replicated Data Management:** Consistency of Replicated Databases, Update Management Strategies and Replication Protocols, Replication and Failure **Distributed DBMS Reliability:** Reliability Concepts and Measures, Fault-Tolerance and Failures in Distributed DBMS, Local and Distributed Reliability Protocols, Site Failures and Network Partitioning **Parallel Database Systems:** Database System Architectures, Parallel Data Placement, Parallel Query Processing, Load Balancing, Fault-tolerance, Database Clusters **P2P Data Management:** P2P, Blockchain **Big Data Processing:** Map-Reduce, Cloud Computing Systems, Distributed NoSQL Database Systems **Web Data Management:** Web Search, Web Querying, Web Data Integration

3 Text and Reference Materials

T Textbook:

- *Tamer Oszu and Patrick Valduriez*, **Principles of Distributed Database Systems**, 4th Edition, Springer, 2020.

R References:

- *Abraham Silberschatz, Henry F. Korth, S. Sudarshan*, **Database System Concepts**, 7th Edition, McGraw-Hill, 2020.

TBA
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April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4239 Applied Cryptography

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4239
Course Title	*Applied Cryptography*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	None

2 Syllabus

Introduction and classical ciphers, block ciphers, stream ciphers, security notions for encryption and authentication, game reduction techniques, hash functions, message authentication codes (MACs), public key cryptography, RSA encryption, other public key systems and signature schemes, authentication, secret sharing, key establishment, interactive proofs, zero knowledge proof, cryptanalysis of cryptographic primitives and protocols, side-channel attacks, differential cryptanalysis, or replay attacks, cryptanalytic techniques on deployed systems, memory remanence, timing attacks, and differential power analysis, physically unclonable function, trusted platform module, threshold-based cryptography, oblivious transfer, perfectly secure encryption, universal hash functions, computing on encrypted data in cloud (homomorphic encryption, secure multiparty computation), access control of cloud data (attribute-based encryption - cipher policy attribute-based encryption, key policy attribute-based encryption), blockchain and cryptocurrency, post quantum cryptography.

3 Text and Reference Materials

T Textbook:

- *Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone*, **Handbook of Applied Cryptography**, https://cacr.uwaterloo.ca/hac/.
- *David Evans, Vladimir Kolesnikov, Mike Rosulek*, **A PragmaticIntroduction to Secure Multi-Party Computation** , https://securecomputation.org/.

R References:

- *Online available resources.*
- *Relevant research papers from conferences and journals.*

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Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4241 Wireless Network Security

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4241
Course Title	*Wireless Network Security*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	CSE-3221: Wireless Networks

2 Syllabus

Wireless Communication: Wireless Network Overview, Wireless Channel, Signal Propagation, Signal-to-Noise Ratio, Unintentional and Intentional Interference. **Risks and Threats of Wireless Communication**: Wireless Security Objectives, Passive and Active Threat Model, Performance vs. Security Trade-offs. **Review of Cryptographic Primitives and algorithms**: symmetric ciphers, asymmetric ciphers, hash functions, message authentication codes, digital signature and pseudorandom generators. **Wireless Physical Layer Technologies**: Anti-jamming/Jamming-resistance, CSMA/CA, Coverage and Exposure, Selfishness at MAC layer, MAC misbehavior, Data-driven misbehavior detection, Frequency Hopping Spread Spectrum (FHSS), Direct Sequence Spread Spectrum (DSSS), Orthogonal Frequency Division Multiplexing (OFDM). **Wireless Network security**: key exchange and key management protocols in wireless networks, Authentication and Authorisation in WLAN, 801.X EAP. **Secure routing**: Selfishness in packet forwarding, Wireless transport security, attacks on naming and addressing, sybil and replication attacks, security associations, secure neighbor discovery. **Security of WiFi and Bluetooth Networks**: IEEE 802.11 Architecture and Protocols, Control and Management Frames, Rogue Access Points, WEP, IEEE 802.11i, IEEE 802.11w, WEP, 802.11i & Wi-Fi Protected Access (WPA) protocols, Bluetooth security features, Kerberos and RADIUS authentication. **Security of Cellular Networks**: GSM and UMTS Network Structure and Architectures, GSM and UMTS Authentication and Confidentiality, Overview of Attacks and Countermeasures, secure handover, security in mobile IP, Beyond 3G. **Security of Wireless Sensor Networks (WSNs)**: WSN Architectures and Protocols, Security Threats, Cryptographic Primitives, Key Establishment and Distribution, Security of different Wireless technologies used in WSN. **Security of Near Field Communications (NFCs) and RFIDs**: Introduction to NFC and RFID Technologies, Tags and Readers, Security and Privacy Issues, Real-World Attacks, Standardisation Activities, Authentication and Access Control Protocols. **Advanced Topics**: Emerging Wireless Technologies, Device Pairing, Secure Localization and Positioning, Broadcast Authentication, trust establishment, anonymity; anonymous sensory data collection, etc.

3 Text and Reference Materials

T Textbook:

– *Yi Qian, Feng Ye, & Hsiao-Hwa Chen*, **Security in Wireless Communication Networks**, John Wiley & Sons, Ltd, 2022.

R References:

– *Wolfgang Osterhage*, **Wireless Network Security**, Second Edition, CRC Press.

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University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
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University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4243 Graph Theory

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4243
Course Title	*Graph Theory*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Optional
Prerequisite Course	CSE 1101 Discrete Mathematics

2 Syllabus

Introduction: Graphs and multigraphs, Adjacency, Incidence and degree, regular graphs, Subgraphs; important class of graphs- Null graphs, complete graphs, independent set and bipartite graphs, Path graphs, cycle graphs and wheel graphs. **Operations on graphs:** Union and intersection, complement, subdivision of edges, contraction of edges, graph isomorphism; **Eulerian and Hamiltonian graph:** Walks, Trails, Paths and Cycles; Eulerian graphs and Hamiltonian graph;. **Data structures and graph representation:** Adjacency matrix, adjacency list, incidence matrix.**Graph connectivity:** Connectivity-edge connectivity, vertex connectivity, connected separable graphs, block cut vertex tree, 2-connected graphs.**Trees:** properties of trees, rooted trees, spanning trees of a graph,Counting of trees, distances in trees and graphs, graceful labeling.**Matching:** perfect matching, maximum matching; Independent set, covers, dominating set, factors of a graph,. **Planar Graphs:** Characterization of planar graphs, plane graphs, Euler's formula, dual graph, thickness of a graph, straight line drawing of planar graphs. **Graph coloring:** Vertex coloring, edge coloring, map coloring, acyclic coloring, chromatic polynomials **Digraphs:** Terminologies, Eulerian digraphs, Hamiltonian digraphs, Digraphs and tournaments, flow network **Special classes of graphs:** Outer planar graphs, triangulated plane graphs, chordal graphs, series and parallel graphs, perfect graphs. **Applications of graphs** Bioinformatics, wireless sensor networks, etc

3 Text and Reference Materials

R Textbook:

- *Douglas west*, **Introduction to graph theory**, subsequent Edition, Pearson, 2000.

T Reference:

- *Md. Saidur Rahman*, **Basic graph theory**, 1st Edition, Springer, 2017.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Apply the knowledge of sciences and engineering fundamentals to interpret the elementary concepts of various architectures, applications, protocols, and background processes dealing with networking architecture and protocol design related problems.	PO1	Cognitive (C3)	35%	Please refer to Section 5.
CO2	Analyze operational details of various protocols, related to application, transport, and routing layers to apply the specialist engineering knowledge to solve the complex networking infrastructure development problem.	PO2	Cognitive (C4)	45%	
CO3	Establish a reliable protocol while planning and designing network services infrastructure, to address networking-related problems and issues that ensure user Quality of Service (QoS) and Quality of Experience (QoE).	PO6	Affective (A4)	20%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome* (Appendix: ??)
LoBT: *Level of Bloom's Taxonomy* (Appendix: ??)

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	20%	30%	10%	60%
Midterm Exam	10%	10%		25%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation			5%	5%
Class Participation			5%	5%
Total	35%	45%	20%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	Overview of graph theory, sharing course administration and guidelines • Graphs and multigraphs, Adjacency, Incidence and degree, regular graphs, Subgraphs, • important class of graphs- Null graphs, complete graphs, independent set and bipartite graphs, Path graphs, cycle graphs and wheel graphs.	T	T
3-4	Operations on graphs: • Union and intersection, complement, subdivision of edges, contraction of edges, graph isomorphism;	T	T

5-8	Eulerian and Hamiltonian graph: • Walks, Trails, Paths and Cycles; Eulerian graphs and Hamiltonian graph;	T	T
9	Data structures and graph representation: • Adjacency matrix, adjacency list, incidence matrix;	T	T
10-12	Graph connectivity: • Connectivity-edge connectivity, vertex connectivity, connected separable graphs, block cut vertex tree, 2-connected graphs;	T	T
13-14	Trees: • properties of trees, rooted trees, spanning trees of a graph,Counting of trees, distances in trees and graphs, graceful labeling;	T	T
15-16	Matching: • perfect matching, maximum matching; Independent set, covers, dominating set, factors of a graph;	T	R
17-19	Planar Graphs: • Characterization of planar graphs, plane graphs, Euler's formula, dual graph, thickness of a graph, straight line drawing of planar graphs;	T	T
20-24	Graph coloring: • Vertex coloring, edge coloring, map coloring, acyclic coloring, chromatic polynomials;	T	T
24-25	Digraphs: • Terminologies, Eulerian digraphs, Hamiltonian digraphs, Digraphs and tournaments, flow network;	T	R
26	Special classes of graphs: • Outer planar graphs, triangulated plane graphs, chordal graphs, series and parallel graphs, perfect graphs;	T	R
27	Applications of graphs • Bioinformatics, wireless sensor networks, etc;	T	R
28	Review, research direction in graph theory, • Problem solving practices, • Assignments, Presentations, etc.	T	R

For the definitions of T and R , Please refer to Section 3.

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University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
CSE 4245 Operations Research

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd Semester 2024**
Course Code	CSE 4245
Course Title	*Operations Research*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Courses
Prerequisite Course	MATH 1207 Linear Algebra

2 Syllabus

Linear Programming (LP) as a tool of Operational Research (OP). The history of LP and the contribution of G. Dantzig. Modeling a problem as an LP problem by defining the objective function and the set of linear constraints determines its feasible solutions. Forms of an LP problem include a unique optimal solution and infinitely many optimal solutions. Incompatible constraints, unbounded feasible solution set, and unbounded variables; **Mathematical Modeling:** Linear, nonlinear, and integer programming models; **Convex Analysis:** Convex sets, polyhedral sets and polyhedral cones, Extreme points and extreme directions, Representation of polyhedral sets, Basic feasible solution and its relation with extreme points. Degenerated basic feasible solutions. The Extreme Point Theorem. Finding the optimal solution by the use of Linear Algebra; **Linear Programming:** Motivation of the simplex method and the revised simplex method, Farkas' lemma and the Karush-Kuhn-Tucker optimality conditions, Duality and sensitivity analysis, Interior point methods; **The big M method** and its application on various problems. **The two-phase method** and its application on various problems. LP Problems with Unbounded Variables. The Dual LP problem. Economic Interpretation of the Dual LP Problem. Duality theorem. Dual Simplex method and its application on various problems. **Computational Complexity Theory**: Complexity issues, polynomial-time algorithms, Decision problems, and classes NP and P; **Network Optimization:** Network simplex method, Matching and assignment problems, Min-cost, max-flow problems.

3 Text and Reference Materials

T Textbook:

- *Hanif D. Sherali, John J. Jarvis, and M. S. Bazaraa*, **Linear Programming and Network Flows**, Edition 3, illustrated, John Wiley & Sons, 2011
- *Frederick S Hillier and Gerald J. Lieberman*,**Introduction to Operations Research**, 11th Edition McGraw Hill, 2021

R References:

– *HAMDY A TAHA*, **Operations Research: An Introduction**, 10Th Edition, PEARSON, January 1, 2019

4 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	Course Introduction, Operation Research and Mathematical Modeling • Branch of Operation Research, Applications in Operations Research, Optimization, OR Institutes and Associations, Mathematical Modeling in Optimization	T	T
3-5	Review of Linear Algebra and Convex Analysis • Linear Algebra, Review of Linear Algebra, Linear Independence, Spanning Set, Simultaneous Linear Equations, • Convex Analysis: Convex Sets, Convex Sets, Extreme Point, • Hyperplanes, Directions and Rays, Convex Cones, Polyhedral Sets	T	T
5-6	Feasible State and Geometric Solution • Minimization and Maximization Problem, Linear Programming in Matrix Form, Solving linear equation by Gauss-Jordan reduction, Singular and non-singular matrix, Feasible Region, Solution, Required Condition for feasibility	T	T
8-10	Linear Programming & Simplex Method • The Representation (or Caratheodory) Theorem, Extreme Point and Optimality, Basic Feasible Solutions, Characteristics of a Basic Feasible Solution, Facts about Linear Programming, Key to the Simplex Method, Simplex Algorithm	T	T
11-13	Simplex method Algebra of the simplex method, Simplex algorithms, optimality and unboundedness, Unique and Alternate solutions, degeneracy,	T	T
14-15	Modified Simplex Method, • Simplex Starting and Convergence, Use of artificial variables, Two-phase method, Example: Two-Phase method, Big-M method	T	T
16-17	Revised Simplex method • Revised simplex method and duality theory	T	T
18-21	Duality: Farkas Lemma and KKT Condition: An Example: Where Farkas Lemma in action Proof of Farkas Lemma, KKT condition, KKT Condition and Optimality, KKT condition examples, Lagrange multiplier, and solution of equality constraint	T	T
22-24	Decomposition: Column generation: Linear Programming: Decomposition Principle, Decomposition principles, Master Problem, Sub-problem	T	T
25-28	Network Flow Problem • Introduction to Network Optimization, Minimum Cost Flow Problem, Shortest Path Problem, Maximum Flow Problem, The Assignment Problem, The Multicommodity Flow Problem, The Multicommodity Capacitated Network Design Problem, Simplex method for network optimization, Tree Properties, Network Presentation Matrix, Network flow problem using simplex method	T	R

For the definitions of T and R , Please refer to Section 3.

TBA
Course Teacher, CSE 3103
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University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
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Course Outline - CSE 4247 Quantum Computing

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	CSE 4247
Course Title	*Quantum Computing*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	None

2 Syllabus

Linear algebra and operators. Introduction to quantum mechanics. Quantum gates and quantum circuits. Superposition and entanglement: Superposition Polarization of light, Single qubit notation Measurement of Qubit BB84, Bloch Sphere Notation. Entangled States, Testing for Entangled States, Bell Pair and Bell States EPR, Paradox and Bell Theorem. Simple Quantum Algorithms: Deutsch Deutsch-Jozsa, Grover. Project design and presentation.

3 Text and Reference Materials

T Textbook:

- *M. A. Nielsen and I. L. Chuang*, **Quantum Computation and Quantum Information**, Tenth Edition, Cambridge University Press , 2011.

R References:

- *N. D. Mermin*, **Quantum Computer Science: An Introduction**, First Edition, Pearson, 2007.

R References:

- *Hafiz Md. Hasan Babu*, **Quantum Computing: A Pathway to Quantum Logic Design**, Second Edition, Iop Publishing Ltd, 2023.

4 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	Networking and Socialization, sharing course administration and guidelines Introduction to Linear algebra and operators.	T	T
3-4	Introduction to quantum mechanics.	T	T
5-7	Basics of quantum gates and quantum circuits.	T	T
8-12	Methods of the Superposition Polarization of light.	T	T
13-14	Introduction to Single qubit notation Measurement of Qubit BB84.	T	T
15-17	Basics of Bloch Sphere Notation.	T	T
18-21	Introduction to Entangled States and testing for Entangled States.	T	R
22-24	Introduction to Bell Pair and Bell States EPR, Paradox and Bell Theorem.	T	T
25-26	Introduction to Simple Quantum Algorithms such as Deutsch Deutsch-Jozsa and Grover.	T	T
27-28	Project design and presentation.	T	R

For the definitions of T and R , Please refer to Section 3.

Course Teacher, CSE 1203
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University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - CSE 4249 Game Theory

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2 Semester 2024**
Course Code	CSE 4249
Course Title	*Game Theory*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Courses III
Prerequisite Course	None

2 Syllabus

Introduction: Introduction to game theory, History, different families of games, strategies, payoffs, rationality, equilibrium **Normal-form games:** simultaneous-move games with pure and mixed strategies, zero-sum game, constant-sum game, rollback, dominance, best-response algorithms, Min-Max methods, Nash equilibrium, price of anarchy; **Extensive-form games:** sequential-move games, game trees, strategy, centipede game, combining sequential and simultaneous moves, two-stage and multi-stage game, sub-game, sub-game perfection, rollback equilibrium; **Uncertainty and Information:** games with perfect and imperfect information (Bayesian game), complete and incomplete information game, cheap talk, conflicting interests, signaling game, BayesNash equilibrium; **Repeated games:** finite and infinite repetition, Grims strategy, tit-for-tat, asymmetric information, pooling and separation **Mechanism Design** reverse game theory, incentive compatibility constraint, participation constraint, social choice and voting theory, social welfare, Groves-Clarke Mechanisms; **Auction:** types, auction rules and design, Dutch and English auctions, bidding strategy, Vickery Auctions.

3 Text and Reference Materials

T Textbook:

- *D. Fudenberg and J. Tirole*, **Game Theory**, 1st Edition, The MIT Press, August 29, 1991
- *Roger B. Myerson*,**Game Theory: Analysis of Conflict**, Harvard University Press, August, 1997

R References:

- *Yoav Shoham, Kevin Leyton-Brown*, **Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations**, Cambridge University Press, 2008
- *Prajit K. Dutta*, **Strategies and Games: Theory and Practice**, The MIT Press

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University of Dhaka

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Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
CSE 4251 Human Computer Interaction

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 1st semester 2024**
Course Code	CSE 4251
Course Title	*Human Computer Interaction*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Elective Course
Prerequisite Course	CSE 3101 - Software Engineering

2 Syllabus

Overview: Definition, scope, core HCI design principles, history of HCI, good and bad design examples. **Cognitive aspects:** Cognitive processes: attention, perception, problem-solving, planning, reasoning and decision-making. Design implications of the above processes. Cognitive frameworks: mental models, gulf of execution and evaluation, metaphors, user's conceptual models. Design philosophies: User-centered, participatory, agile. **Interaction and Interfaces Types:** Direct manipulation, navigation by selection, menu, forms, dialog box, content organization, grouping of menu items, presentation of sequence of items, command languages, speech technology. Interaction types and devices: Command, Graphical, Multimedia, augmented and virtual reality, Web, Mobile, Appliance, Voice, pen, touch, gesture, haptic, multimodal, shareable, tangible, augmented reality, wearable, robot, smart. Design consideration of all above. **Guidelines, principles, and theories:** platform-based guidelines and domain-specific guidelines, guideline document: navigation, display, user's attention, data entry facilitation. Well-accepted guidelines: Norman's, Nielsen's, Shneiderman's, Dix's, ISO9241. Theories: web-design theory, design-by-level theory: GOMS model, states of action theory: e.g. Norman's 7 stages and 4 design principles etc.. **Phases of interaction design:** design process cycle: Shneiderman's, Preece's, Norman's, Google sprint. Discovering Requirements or Needfinding: functional, non-functional, UX requirements. Use case, survey, interview, focus group, ethnographic observation, diaries and cultural probe, personas, contextual inquiry, Requirement statement template. Design process / phases: conceptual design, concrete design, design alternatives, sketching, scenario development and storyboarding, prototypes. Design methods: ideation, alternatives and creativity. Prototyping Using scenarios, sketching, storyboarding, Index card. Generating prototypes: customer journey map. **Evaluation and user experience:** Expert reviews and heuristics. Conducting a heuristic evaluation, benefits and bottlenecks, expert review report. Usability test and labs. Web usability by Budd, Travis and others. Think-aloud, cognitive walkthrough and related techniques. Ethical issues of usability test. A/B testing, user acceptance test, controlled experiments, survey techniques, ethnographic observation, field study, statistical experiments. Web analytics as evaluation. Evaluation case studies. **Collaborative Interaction and Social Interaction:** Remote conversation, video conferencing, telepresence, co-presence, social engagement: design issues of all above. Predictive Laws of HCI: Fitt, Hip, Miller, Pareto, Zipf laws. Social and legal issues related to design.

3 Text and Reference Materials

T Textbook:

- Designing the User Interface; by Shneiderman et al., 6th Ed. (2016)
- Interaction Design: Beyond Human Computer Interaction; by Sharp, Rogers and Preece, 5th Ed. (2019)

R References:

- Human Computer Interaction; by Dix, Finlay, Abowd and Beale, 3rd Ed. (2003)

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Understand evolution of human computer interaction, basic concepts of HCI, interpret and apply core HCI principles.	PO1	Cognitive (C3)	40%	Please refer to Section 5.
CO2	Understand and apply phases of interaction design.	PO2	Cognitive (C4)	50%	
CO3	Use HCI principles, practices and guidelines to solve real life complex problems, demonstrate HCI skills and write report on HCI concepts.	PO6	Affective (A4)	10%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	20%	30%		60%
Midterm Exam	15%	10%		20%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation			10%	5%
Class Participation			5%	5%
Total	40%	45%	15%	100%

Course Teacher, CSE4230
April 24, 2024

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17.4 Mathematics and Statistics Courses

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
MATH 1107 Differential and Integral Calculus

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**1st year 1st semester 2024**
Course Code	MATH 1107
Course Title	*Differential and Integral Calculus*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	GED Course
Prerequisite Course	None

2 Syllabus

Functions: Graphing Functions, Mathematical Models and Commonly used Functions (Linear, Polynomial, Power), Mathematical Models and Commonly Used Functions (Algebraic, Trigonometric, Exponential, and Logarithmic Functions), Transformations (Scaling, Reflection, Composition), Inverse of Functions, Growth of Functions. **Limits:** Concepts, One Sided Limits, Infinite limits, Limit Laws, Sandwich Theorem, Formal Definition of Limits and Continuity of Functions, Intermediate Value Theorem and Its Application, Limits at Infinity and the Horizontal Asymptotes. **Derivatives:** Derivatives and Rate of Change, Derivatives as Functions, Differentiability of Functions, Rules and Techniques of Differentiation, Chain Rule, Indeterminate Forms and L'Hospital's Rule. **Applications of Differentiation:** Rates of Change in Natural and Social Sciences, Finding Minimum and Maximum Value of Functions and the First and Second Derivative Tests. **Integrals:** Riemann Sum and Definite Integrals, Properties of Integrals, Fundamental Theorem of Calculus, Antiderivative and Indefinite Integral, Net Change Theorem. **Techniques of Integration:** Substitution Rule, Integration by Parts, Trigonometric Substitution, Partial Fractions, Approximate Integration, Improper integrals. **Application of Integration:** Average Value of a Function, Mean Value Theorem for Integrals, Finding Area between Curves, Volumes by Slicing, Disks and Washers.

3 Text and Reference Materials

T Textbook:

- Calculus: Early Transcendentals by James Stewart

R References:

- Calculus: Early Transcendentals by Howard Anton, Irl Bivens, and Stephen Davis

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Understand the basics of functions, limit and continuity.	PO1	Cognitive (C3)	40%	Please refer to Section 5.
CO2	Interpret the core mechanisms of differentiation and apply these techniques to solve real-life problems.	PO2	Cognitive (C4)	50%	
CO3	Understand the relation between differentiation and integrattion and apply integration techniques to solve real-life problems.	PO6	Affective (A4)	10%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome* (Appendix: ??)
LoBT: *Level of Bloom's Taxonomy* (Appendix: ??)

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	25%	35%		60%
Midterm Exam	10%	10%		20%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation			5%	5%
Class Participation			5%	5%
Total	40%	50%	10%	100%

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Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
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University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
MATH 1207 Linear Algebra

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**1st year 2nd semester 2024**
Course Code	MATH 1207
Course Title	*Linear Algebra*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	GED Course
Prerequisite Course	MATH 1107: Differential and Integral Calculus

2 Syllabus

Basics: Matrices, Linear Equations and Gaussian Elimination, Inverse Matrices, LU Factorization. **Vector Spaces**: Solving system of linear equations and row space, column space, null space, and Rank. **Linear independence**: basis and dimension. **Orthogonal vectors**: Subspaces, inner products, projection onto subspaces, projection matrices and least squares, orthogonal basis and GramSchmidt orthogonalization. Determinants and their properties, Co-factors, Cramer's rule and other applications of determinants. **Eigenvalues and Eigenvectors**: Basics, application in diagonalization, computing powers of matrices, and solving difference equations. **Various Matrices**: Symmetric matrices, Hermitian matrices, Spectral theorem, positive definite matrices and minima. **Introduction to Linear Transformations**: change of basis, and Singular Value Decomposition, norm of a matrix and condition number, Left and Right inverse and pseudoinverse, QR decomposition.

3 Text and Reference Materials

T Textbook:

- *Howard Anton and Chirs Rorres*, **Elementary Linear Algebra**, Eleventh Edition, Wiley Publications.

R References:

- *Dan Margalit and Joseph Rabinoff*, **Interactive Linear Algebra** , Georgia Intitute of Technology, *https://textbooks.math.gatech.edu/ila/*.

R References:

* *Gilbert Strang*, **Linear Algebra and Its Applications**, Cengage Learning, Fourth Edition.

R References:

* *Kenneth Kuttler*, **Linear Algebra, Theory And Applications**, Saylor Foundation, *https://resources.saylo content/uploads/2012/02/Linear-Algebra-Kuttler-1-30-11-OTC.pdf*.

R References:

* *David Lay, Steven Lay, and Judi McDonald*, **Linear Algebra and Its Applications**, Pearson, Fifth Edition, *https://home.cs.colorado.edu/ alko5368/lecturesCSCI2820/mathbook.pdf*.

Course Teacher, MATH 2107
April 23, 2024

Chairman, Dept. of CSE, DU
April 23, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - MATH 2107
Differential Equation, Laplace Transformation and Fourier Analysis

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**2nd year 1st semester 2024**
Course Code	MATH 2107
Course Title	*Differential Equation, Laplace Transformation and Fourier Analysis*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	GED Course
Prerequisite Course	MATH 1207: Linear Algebra

2 Syllabus

Differential Equations: Modeling with Differential Equations, Solving First Order Differential Equations, Direction Fields and Euler's Method, Methods for Separable Equations and Linear Equations. **Partial Differential Equation (PDE)**: Introduction and formation of PDE; Solution of linear and non-linear PDE of order one. **Laplace Transformation** : Forward transform, inverse transform. Examples of transform pairs. The Laplace transform of a differential equation. The use of Laplace transforms for the solution of initial value problems, existence and uniqueness of Laplace transforms. **Fourier Analysis**: Properties of Fourier series, Fourier sine and cosine series, Fourier transform of continuous and discrete signals, Fourier Coefficients and orthogonality, General periodic functions, odd and even functions, Fourier transform of continuous and discrete signals and the discrete Fourier transform and the FFT algorithm.

3 Text and Reference Materials

T Textbook:

1. *Phil Dyke*, **An Introduction to Laplace Transforms and Fourier Series**, Second Edition, Springer.
2. *Shepley L. Ross*, **Differential Equations**, Third Edition.

R References:

1. *Dennis G. Zill*, **Differential Equations with Boundary-Value Problems**, Ninth Edition.
2. *V. Sundarapandian*, **Ordinary and Partial Differential Equations with Laplace Transforms, Fourier Series and Applications**.

4 Topic Outline

Lecture	Selected Topic	Article	Problems
1-3	Classification of Differential Equation, their origin and application • Solutions of Differential Equation and their Existences • Initial-value problems, Boundary-value problems	T2	T2, R1
3-7	Exact Differential Equation and Integrating Factors • Separable, Linear and Bernoulli Equation • Special Integrating Factors and Transformation	T2	T2, R1
8-11	Partial Differential Equations (PDE): Basic Concepts and Examples • The method of separation of variables • Solution of linear and non-linear PDE	T2	T2, R1
12-14	Laplace Transformation : Forward transform, inverse transform. Examples of transform pairs. • The Laplace transform of a differential equation	T1	T1
15-18	The use of Laplace transforms for the solution of initial value problems • Existence and uniqueness of Laplace transforms.	T1	T1, R2
19-21	Properties of Fourier series • Fourier sine and cosine series • Fourier transform of continuous and discrete signals	T1	T1, R2
22-25	Fourier Coefficients and orthogonality • General periodic functions, odd and even functions	T1	T1, R2
26-28	Fourier transform of continuous and discrete signals • The discrete Fourier transform • FFT algorithm	T1	T1, R2

Course Teacher, MATH 1207
April 24, 2024

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April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - STAT 2207 Probability and Statistics

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**2nd Year 2nd Semester 2024**
Course Code	STAT 2207
Course Title	*Probability and Statistics*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	GED Course
Prerequisite Course	None

2 Syllabus

Introduction: Descriptive and Inferential Statistics, Populations and Samples **Data with Graphs:** Pie, Bar, Line Charts, Dot Plots, Stem and Leaf plots, Frequency tables and Graphs, Grouped Data and Histograms **Data with Numerical Measures:** Measures of Centre (Mean, Median, Mode) and Variability (Range, Variance, Standard Deviation), Tchebysheff's Theorem and Empirical Rules, Z-score, Percentile and Quartiles, The Five-Number Summary and the Box Plot, Scatterplots **Probability:** Events, Simple Events and Sample Space, Counting Rules, Probability Axioms of Probability, Conditional Probability and Independence, Bayes' Rule **Discrete Random Variables and Probability Distributions:** Discrete Random Variables with Mean and Standard Deviation and Probability Distribution; Bernoulli's, Binomial, Poisson, Hypergeometric Random Variables and their Probability Distribution, Continuous Random Variables and Probability Distributions: Continuous Random Variable, Uniform and Exponential Probability Distribution, Normal Random Variable and Probability Distribution, Probabilities associated with Standard, Normal Random variable, Normal approximation to the Binomial Probability Distribution **Sampling Distribution:** Sampling Plan and Statistics, Central Limit Theorem and Sample Mean, Laws of Large Numbers, Sampling Distribution of Sample Mean and Sample Proportion **Linear Regression and Correlation:** Simple Linear Regression Model, Method of Least Squares, Analysis of Variance (ANOVA), Testing Linear Regression Model, Correlation Analysis, Introduction to Multiple Regression Analysis **Analysis of Categorical Data:** Multinomial Experiment and Chi-square statistic, Contingency Table, Chi-Square Test for Independence, Chi-Square Test for Goodness-of-Fit

3 Text and Reference Materials

T Textbook:

- *William Mendenhall, Robert J Beaver and Barbara M. Beaver*, **Introduction to Probability and Statistics**, 15th Edition, Cengage Learning, Inc., 2020.

R References:

- *Sheldon M. Ross*, **Introductory Statistics**, 4th Edition, Elsevier, 2017.
- *Prem S Mann*, **Introductory Statistics**, 10th Edition, John Willy and Sons, Inc., 2020.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Compute and interpret descriptive statistics using numerical and graphical techniques.	PO1	Cognitive (C2)	20%	Please refer to Section 5.
CO2	Apply key concepts of probability, basic rules, counting rules and theorems in probability including Bayes's and the Central Limit Theorem (CLT), probability distributions, conditioning, independence, expectations, and variances.	PO2	Cognitive (C3)	35%	
CO3	Define and demonstrate discrete and continuous random variables and their statistical distributions, sampling theory, method of least squares to estimate the parameters in a regression model and analysis of categorical data.	PO3	Cognitive (C2)	45%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	10%	20%	30%	60%
Midterm Exam	10%	10%		20%
Class Test/Quiz		5%	5%	10%
Assignment/Presentation			5%	5%
Class Participation			5%	5%
Total	20%	35%	45%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1-4	• Descriptive and Inferential Statistics, Populations and Samples • Pie, Bar, Line Charts, Dot Plots, Stem and Leaf plots • Frequency tables and Graphs, Grouped Data and Histograms • Measures of Centre (Mean, Median, Mode) and Variability (Range, Variance, Standard Deviation) • Tchebysheff's Theorem and Empirical Rules, Z-score • Percentile and Quartiles, The Five-Number Summary and the Box Plot, Scatterplots	T	T
5-8	• Events, Simple Events and Sample Space • Counting Rules • Axioms of Probability, Conditional Probability and Independence, Bayes' Rule	T	R

9-13	• Discrete Random Variables with Mean and Standard Deviation and Probability Distribution • Bernoulli's, Binomial, Poisson, Hypergeometric Random Variables and their Probability Distribution	T	T
14-18	• Continuous Random Variable, Uniform and Exponential Probability Distribution, Normal Random Variable and Probability Distribution • Probabilities associated with Standard, Normal Random variable • Normal approximation to the Binomial Probability Distribution	T	T
19-21	• Sampling Plan and Statistics, Central Limit Theorem and Sample Mean • Laws of Large Numbers • Sampling Distribution of Sample Mean and Sample Proportion	T	T
22-25	• Simple Linear Regression Model, Method of Least Squares, Analysis of Variance (ANOVA), Testing Linear Regression Model • Correlation Analysis • Introduction to Multiple Regression Analysis	T	R
26-28	• Multinomial Experiment and Chi-square statistic, Contingency Table • Chi-Square Test for Independence • Chi-Square Test for Goodness-of-Fit	T	R

For the definitions of T and R , Please refer to Section 3.

TBA
Course Teacher, STAT 2207
April 24, 2024

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April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - STAT 3107 Random Processes

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**3rd Year 1st Semester 2024**
Course Code	STAT 3107
Course Title	*Random Processes*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	GED Course
Prerequisite Course	None

2 Syllabus

The fundamentals of Probability: Probability Spaces, conditional probability, independence, Discrete and Continuous Random Variables, Multiple RVs, Random Vectors, Function of Random Variables, Expectation, Variance, Conditional Expectation and Convergence **Bounds:** Jensen, Markov, Chebyshev, Chernoff **Limit Theorems:** Strong and Weak Laws of Large numbers, Central Limit Theorem **Estimation:** Types of Estimators, Point Estimator of Population Mean and Proportion, Estimating a Population Variance, Interval Estimators of Population Mean and Proportion, Difference between Two Population Means and Two Binomial Proportions **Statistical Hypotheses Testing:** Hypothesis Tests and Significance Levels, Hypothesis Tests concerning Population Proportions for Large Sample, Hypothesis Tests concerning the Mean of a Normal Population **Markov Chain:** Random Processes, Discrete Time Markov Chains - PageRank, Chapman-Kolmogorov Equations, Gambler's Ruin Problem, Law of Large Numbers for Markov Chains, Continuous Time Markov Chains, Birth and Death Processes, Irreducible and Reducible Markov Chains, Ergodicity, Markov Decision Process (MDP), Expectation-Maximization Algorithm, Hidden Markov Models; **Queuing System:** Principles of Queuing System, M/M/1, M/M/1/K, Queue Tandem, Littl's Law, Foster-Lyapunov stability criterion and moment bounds.

3 Text and Reference Materials

T Textbook:

- *Alberto Leon-Garcia*, **Probability, Statistics and Random Processes for Electrical Engineering**, 3rd Edition, Pearson, 2008.

R References:

- *William Mendenhall, Robert J Beaver and Barbara M. Beaver*, **Introduction to Probability and Statistics**, 15th Edition, Cengage Learning, Inc., 2020.
- *Dimitris P. Bertsekas and John N. Tsitsiklis*, **Introduction to Probability**, 2nd Edition, Athena Scientific, 2008.

– *Jean Walrand*, **Probability in Electrical Engineering and Computer Science: An Application-Driven Course**, e-book, 2014.

TBA
Course Teacher, STAT 3107
April 24, 2024

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April 24, 2024

17.5 General Education Courses

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
HUM 1109 History of Emergence of Bangladesh

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**1st year 1st semester 2024**
Course Code	HUM 1109
Course Title	*History of Emergence of Bangladesh*
Course Credit	2.0 units
Contact Hours Per Week	2
Course Status	GED Course
Prerequisite Course	None

2 Syllabus

Ancient Period: Prehistoric Bengal, Maurya dynasty; **Early Middle Ages:** Gauda Kingdom, Pala dynasty, Chandra dynasty, Sena dynasty, Deva Kingdom; **Late Middle Ages:** Turko Afghan rule, Sonargaon Sultanate. **Bengal Sultanate:** Ilyas Shahi dynasty, Ganesha dynasty, Hussain Shahi dynasty; **Mughal period:** Nawabs of Bengal, Europeans in Bengal, Battle of Plassey. **British rule:** British Rules in Indian Subcontinent, The Early Resistance Movements, Bengal Renaissance, Muslim League and its significance, Partition of Bengal, Lahore Resolution, Communal riots, Creation of Pakistan. **Pakistan period:** Bengali Language Movement, Politics: 1958–1971: United front, elections, six points movement, 11 Point Program of Students, Agartala Conspiracy case, Mass Uprising (1969), The Election of 1970, Non-Cooperation Movement. **The Liberation War of Bangladesh:** Formal Declaration of Independence, Operation Search Light, Mujibnagor Government, Interactive Timeline of the Bangladesh Liberation War, Major operations of Bangladesh freedom fighters, East Pakistani paramilitary forces, Role of India and other Major Powers in the Liberation War, Heroes of 1971, killing of Bangladeshi intellectuals, Surrender of Pakistan. **Role of the Dhaka University in the emergence of Bangladesh. Political history of Bangladesh (1972 – present):** Formation of the constitution, Situation of Bangladesh just after independence, Famine of 1974, Assassination of the father of the nation, Killing in jail, Military coups, Different governments in this period. **Resources and Achievements of Bangladesh.**

3 Text and Reference Materials

T Textbook:

- *Badruddin Umar*, **The Emergence of Bangladesh, Part 1 2**, 1st Edition, Oxford Press, 2004.

R References:

- *Barrister Md. Omar Faruque*, **Emergence of Bangladesh**, ?? Edition, ?? Publisher, ?? Year.

4 Course Outcomes

At the completion of this course, the students are expected to -

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Identify the main events of the history of Bangladesh from the pre-historic time to the Emergence of Bangladesh as a sovereign state in 1971.	PO1	Cognitive (C3)	40%	Please refer to Section 5.
CO2	Explain post-liberation facts, events, and initiatives taken behind the emerging economic growth of Bangladesh.	PO2	Cognitive (C4)	50%	
CO3	Compare the impacts of different periods in the cultural, social, educational, and economic development of the country.	PO6	Affective (A4)	10%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	25%	35%		60%
Midterm Exam	10%	10%		20%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation			5%	5%
Class Participation			5%	5%
Total	40%	50%	10%	100%

Course Teacher, HUM 1109
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

Course Outline
EEE 1105 Electrical Circuits

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**1st year 1st semester 2024**
Course Code	EEE 1105
Course Title	*Electrical Circuits*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	GED Course
Prerequisite Course	None

2 Syllabus

Resistor: Properties, Types of Resistors, Ohm's Law, Power, Energy, Efficiency, etc.; **Series DC Circuits** Kirchhoff's Voltage Law, Voltage Divider Rule, Power Distribution, Voltage Regulation, Voltage Sources in Series, etc.; **Parallel DC Circuits:** Conductance and Resistance, Kirchhoff's Current Law, Current Divider Rule, Open Circuit, Short Circuit, Voltage Sources in Parallel, etc.; **Parallel Network:** Reduce and Return Approach, Block Diagram Approach, Ladder Networks.; **Methods of Analysis for DC Networks:** Current Source, Source Conversion, Current Sources in Series and Parallel, Branch- Current Analysis, Mesh Analysis, Nodal Analysis, Bridge Network and Y- and -Y Conversions.; **Network Theorems (DC):** Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Millman's Theorem, Substitution Theorem, Reciprocity Theorem etc. ; **Capacitor:** Electric Field, Capacitance, Dielectric Strength, Leakage Current, Types of Capacitors, Charging and Discharging Phase, Energy Stored by a Capacitor, Capacitors in Series and Parallel.; **Inductor:** Magnetic Field, Inductance, Types of Inductors, Faraday's Law and Lenz's Law, Inductors in Series and Parallel. R-L, R-C and R-L-C Circuits with DC Input.; **Introduction to Sinusoidal Alternating Waveform:** Definitions, General Format for the Sinusoidal Voltage or Current, Phase Relations, Ordinary and Frequency Response of Basic R, L and C Elements, Average Power and Power Factor, Rectangular and Polar Form, Phasor.;

3 Text and Reference Materials

Textbook:

- *Robert L. Boylestad*, **Introductory Circuit Analysis**, Thirteenth Edition, Pearson Publications, 2015.

References:

- *Charles Alexander & Matthew Sadiku*, **Fundamentals of Electric Circuits**, Sixth Edition, McGraw Hill, 2016.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Analyze the operational principles and characteristics of resistors, dc serial and parallel circuits.	PO1	Cognitive (C3)	40%	Please refer to Section 5.
CO2	Explain methods of analysis and network theorems for dc networks.	PO2	Cognitive (C4)	50%	
CO3	Provides basic introductions to capacitors, inductors, and Sinusoidal Alternating Waveform	PO6	Affective (A4)	10%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	20%	40%		60%
Midterm Exam	10%	10%		20%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation			5%	5%
Class Participation			5%	5%
Total	35%	55%	10%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	Networking and Socialization, sharing course administration and guidelines • Resistor Properties • Types of Resistors • Temperature affect on the resistance of a material • Become familiar with the broad range of commercially available resistors.		
3-4	Ohm's law, power and energy • Understand the importance of Ohm's law and its application • Become aware of the differences between power and energy levels.		
5-7	Series dc network •Become familiar with the characteristics of a series circuit • Develop a clear understanding of Kirchhoff's voltage law • Application of the voltage divider rule.		
8-12	Series-Parallel dc network •• Become familiar with the characteristics of a parallel network • Develop a clear understanding of Kirchhoff's current law • Application of the current divider rule • Clearly understand the impact of open and short circuits on the behavior of a network.		

13-14	Methods of Analysis • Become familiar with the terminal characteristics of a current source • Application of branch-current analysis and mesh analysis to find the branch currents • Application of nodal analysis to find all the terminal voltages of any series-parallel network • Become familiar with bridge network configurations and how to perform Delta to Y or Y to Delta conversions.	
15-17	Network Theorems: • Superposition Theorem • Thévenin's Theorem • Norton's Theorem • Maximum Power Transfer Theorem • Millman's Theorem • Substitution Theorem • Reciprocity Theorem	
18-21	Capacitor: • Introduction to basic construction of a capacitor and the factors that affect its ability to store charge on its plates. • Methods of o determining the transient (time-varying) response of a capacitive network and plot the resulting voltages and currents. • Understand the impact of combining capacitors in series or parallel ;	
22-24	Inductor • Become familiar with the basic construction of an inductor, the factors that affect the strength of the magnetic field established by the element • Methods of o determining the transient (time-varying) response of an inductive network and plot the resulting voltages and currents • Understand the impact of combining inductors in series or parallel.	
25-26	Introduction to Sinusoidal Alternating Waveform • Become familiar with the characteristics of a sinusoidal waveform • Determine the phase relationship between two sinusoidal waveform of the same frequency •	
27-28	Reviews • Problem-solving practices, • Assignments/Presentations, etc.	

Course Teacher, EEE 1105
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

Course Outline
EEE 1106 Electrical Circuits Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**1st year 1st semester 2024**
Course Code	EEE 1106
Course Title	*Electrical Circuits Lab*
Course Credit	0.75 units
Contact Hours Per Week	3 hours in alternate weeks
Course Status	GED Course
Prerequisite Course	None

2 Syllabus

Lab experiments of this course will be based on the theory topics covered in EEE 1105 Electrical Circuits. The major experiments include verification of Ohm's Law, Series and Parallel DC circuit design, methods of analysis such as Branch Current Analysis, Mesh Analysis, Nodal Analysis. Other lab experiments include verification of DC Network theorems, Current flow and Voltage drop analysis of RL, RC, and RLC circuits.

3 Text and Reference Materials

Textbook:

- *Robert L. Boylestad*, **Introductory Circuit Analysis**, Thirteenth Edition, Pearson Publications, 2015.

References:

- *Charles Alexander & Matthew Sadiku*, **Fundamentals of Electric Circuits**, Sixth Edition, McGraw Hill, 2016.

Course Teacher, EEE 1105
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - PHY 1205 Physics

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**1st year 2nd semester 2024**
Course Code	PHY 1205
Course Title	*Physics*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	Core Course
Prerequisite Course	None

2 Syllabus

Waves and Oscillations: Differential equation of a simple harmonic oscillator, total energy and average energy, Lissajous figures, spring-mass-system, calculation of period of a 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; **Physical Optics:** Interference of light, Young's double slit experiment, Displacements of fringes and its uses, Newton's rings, Diffraction of light, Fresnel and Fraunh offer diffraction, diffraction by a 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. **Structure of Matter:** Crystalline and Non-Crystalline Solids, Single Crystal and Polycrystal Solids, Unit Cell, Crystal Systems, Co-ordinations Number, Crystal Planes and Directions, Packing Factor, Miller Indices, Bragg's Law, Interatomic Distances, Introduction to Band Theory, Distinction between Metal, Semiconductor and Insulator. **Electricity:** Coulomb's Law, The Electric field, Electric field due to: a charged particle, a dipole, a line of charge, a charged disk; A point charge and a dipole in an Electric field; Electric Flux, Gauss' law, Applying Gauss' law: Cylindrical Symmetry, Planar Symmetry, Spherical Symmetry; Electric Potential, Potential and Field Strength, Potential due to: a charged particle, an Electric dipole; **Magnetism:** Magnetic fields and the definition of $\overrightarrow{B}$, Crossed fields: Discovery of the Electron, The Hall effect; Magnetic force on a current-carrying wire, Torque on a current loop, Magnetic dipole moment; Magnetic Fields due to currents: Biot-Savart law, Force between two parallel currents; Ampere's law, Solenoids and Toroids, A current-carrying coil as a Magnetic Dipole, Faraday's law and Lenz's law, Induction and Energy transfers, Induced Electric Fields, Inductor and Inductance, Self Induction, RL circuit, Energy stored in a Magnetic field, Energy density of a magnetic field.

3 Text and Reference Materials

T Textbook:

- *David Halliday, Robert Resnick and Jearl Walker.*, **Fundamentals of Physics - Volume 2**, 10th Edition, Wiley Publications.
- *Hugh D. Young and Roger A. Freedman*, **University Physics with Modern Physics**, 15th Edition, Pearson Publications.

R References:

- *Christopher Hammond*, **The Basics of Crystallography and Diffraction**, 3rd Edition, Oxford Science Publications.

4 Topic Outline

Lecture	Selected Topic	Article	Problems
1-4	**Waves and Oscillations:** Differential equation of a simple harmonic oscillator, total energy and average energy, Lissajous figures, spring-mass-system, calculation of period of a 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;	T	T
5-9	**Physical Optics:** Interference of light, Young's double slit experiment, Displacements of fringes and its uses, Newton's rings, Diffraction of light, Fresnel and Fraunh offer diffraction, diffraction by a 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.	T	T
10-14	**Structure of Matter:** Crystalline and Non-Crystalline Solids, Single Crystal and Polycrystal Solids, Unit Cell, Crystal Systems, Co-ordinations Number, Crystal Planes and Directions, Packing Factor, Miller Indices, Bragg's Law, Interatomic Distances, Introduction to Band Theory, Distinction between Metal, Semiconductor and Insulator.	T	T
15-20	**Structure of Matter:** Crystalline and Non-Crystalline Solids, Single Crystal and Polycrystal Solids, Unit Cell, Crystal Systems, Co-ordinations Number, Crystal Planes and Directions, Packing Factor, Miller Indices, Bragg's Law, Interatomic Distances, Introduction to Band Theory, Distinction between Metal, Semiconductor and Insulator.	T	T
21-28	**Magnetism:** Magnetic fields and the definition of $\uparrow \boldsymbol{B}$, Crossed fields: Discovery of the Electron, The Hall effect; Magnetic force on a current-carrying wire, Torque on a current loop, Magnetic dipole moment; Magnetic Fields due to currents: Biot-Savart law, Force between two parallel currents; Ampere's law, Solenoids and Toroids, A current-carrying coil as a Magnetic Dipole, Faraday's law and Lenz's law, Induction and Energy transfers, Induced Electric Fields, Inductor and Inductance, Self Induction, RL circuit, Energy stored in a Magnetic field, Energy density of a magnetic field.	T	T

Course Teacher, PHY 1205
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - PHY 1206 Physics Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**1st year 2nd semester 2024**
Course Code	PHY 1206
Course Title	*Physics Lab*
Course Credit	0.75 units
Contact Hours Per Week	3 hours in alternate weeks
Course Status	Elective Course
Prerequisite Course	None

2 Syllabus

Lab experiments will be conducted in the Physics Lab on some selected topics from the theory course PHY 1205. Experiments such as Diffraction grating, Newton's ring, Surface tension, Newton's law of cooling, RC circuit and RL circuit, etc. can be demonstrated in the lab.

3 Text and Reference Materials

T Textbook:

- *David Halliday, Robert Resnick and Jearl Walker.*, **Fundamentals of Physics - Volume 2**, 10th Edition, Wiley Publications.
- *Hugh D. Young and Roger A. Freedman*, **University Physics with Modern Physics**, 15th Edition, Pearson Publications.

R References:

- *Christopher Hammond*, **The Basics of Crystallography and Diffraction**, 3rd Edition, Oxford Science Publications.

Course Teacher, PHY 1206
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
EEE 1209 Electronic Devices and Circuits

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**2nd year 1st semester 2024**
Course Code	EEE 1209
Course Title	*Electronic Devices and Circuits*
Course Credit	3.0 units
Contact Hours Per Week	3
Course Status	GED Course
Prerequisite Course	EEE 1105 Electrical Circuits

2 Syllabus

Introduction to Semiconductors: Properties, bonds and types of semiconductors. **Semiconductor Diodes and Special Purpose Diodes:** The PN junction diode: formation, properties and V-I characteristics, Basic constructions, characteristics, operations and uses of special diodes: Light-emitting diode (LED), Zener diode etc. **Diode Application:** Half-wave and full-wave rectifiers – operation and efficiency, Ripple factor, Filter circuits, Clipping and Clamping circuits, Voltage regulation and regulator circuits - Zener diode and transistor voltage regulator. **Bipolar Junction Transistors:** NPN and PNP transistors, amplifying and switching actions of transistor, transistor characteristics in CB, CE & CC configurations, transistor load line and Operating point. **BJT Biasing:** Linear amplification, inherent variation of transistor parameters and thermal runway, stabilization and stability factor, methods of BJT biasing, analysis and design of biasing circuits. **Single Stage Transistor Amplifier:** Single stage amplifier circuit, phase reversal, dc and ac equivalent circuits, load line analysis, voltage gain and power gain, classification of amplifiers, amplifier equivalent circuits. **Field Effect Transistors:** Classification of FET, construction, operation and characteristics of JFET and MOSFET, transfer characteristics and Shockley's equation, DC biasing of JFET. **Power Electronics:** operations, characteristics and applications of industrial electronics devices: SCR (Silicon Controlled Rectifier), TRIAC, DIAC etc. **Feedback Techniques and Op-amps:** Concepts- negative and positive feedback, characteristics and gain with negative voltage and current feedback**,** emitter follower, basic Op-amps- characteristics, inverting, non-inverting, integrators, differentiators, summing amplifiers. **Oscillators:** Theory of oscillation and characteristics of different oscillators.

3 Text and Reference Materials

T Textbook:

- *Thomas L. Floyd*, **ELECTRONIC DEVICES, Conventional Current Version**, 10th Edition, Pearson, 2018.

R References:

– *Robert Bolyestad, Louis Nashelsky*, **ELECTRONIC DEVICES and CIRCUIT THEORY** , 11th Edition, Pearson, 2012.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	**Understanding of Semiconductor Physics:** •Explain the fundamentals of semiconductor materials and their behavior. •Describe the principles of electron and hole movement in semiconductors. •Analyze doping techniques and their effects on semiconductor properties.	PO1	Cognitive (C2)	10%	Please refer to Section 5.
CO2	**Understanding of Diodes and Transistors:** •Analyze diode circuits and their applications in rectification, clipping, clamping. •Differentiate between different types of transistors (BJT, MOSFET, etc.) and their operating principles. •Analyze transistor biasing circuits and their stability. •Design and analyze transistor amplifier circuits.	PO2	Cognitive (C2)	60%	
CO3	**Operational Amplifiers:** •Explain the principles of ideal operational amplifiers (Op-Amps) and their characteristics. •Analyze the behavior of Op-Amp circuits, including inverting and non-inverting amplifiers, summing amplifiers, integrators, and differentiators. •Design and analyze Op-Amp circuits for specific applications.	PO2	Cognitive (C3)	30%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	5%	35%	20%	60%
Midterm Exam	5%	10%	5%	20%
Class Test/Quiz		5%		5%
Assignment/Presentation		5%	5%	10%
Class Participation		5%		5%
Total	10%	60%	30%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	Introduction to Semiconductors: Semiconductor Materials: Ge, Si, and GaAs, Covalent Bonds, Energy Levels, N-type and P-type materials, PN Junction, I-V Characteristics.	T , R	T , R
3-5	Diode Applications: Diode Approximations, Half and Full-Wave Rectifiers. Average and RMS values of Half and Full-Wave Rectifiers. Power Supply Filters and Regulators, Zener Diode.	T , R	T , R
6-7	Diode Limiters and Clampers Circuits, Voltage Multipliers.	T , R	T , R
8	Bipolar Junction Transistor: BJT Structure, Operation, Characteristics.	T , R	T , R
9-10	Common-Base, Common-Emitter, Common-Collector Configurations and their I-V Characteristics.	T	T , R
11-12	DC Biasing: Fixed Bias, Collector Feedback Bias, Voltage Divider Bias.	T , R	T , R
13-14	Bias Stabilization: Stability Factors for various types of BJT Bias Configurations.	T	T
15-16	Single Stage Transistor Amplifier: Transistor AC Models. CE, CC, and CB Amplifiers.	T , R	T , R
17-18	Field Effect Transistors: JFET and its Characteristics. DC Biasing of JFET.	T	T , R
19-20	MOSFET and its Characteristics. Depletion-Type and Enhancement-Type MOSFETs.	T	T
21-22	Operational Amplifiers: Introduction to Operational Amplifiers (OP Amp). Differential Amplifiers. Input and Output Characteristics. Op-Amp parameters, CMRR, Slew Rate.	T , R	T , R
23-25	Op-Amp Applications: Negative Feedback. Inverting and Non-Inverting Amplifiers, Summing Amplifier, Integrator, Differentiator, Voltage Buffer Circuits. Analog-to-Digital and Digital-to-Analog Converters using Op-Amps.	T , R	T , R
26-28	Power Electronics: Thyristors Operation and I-V Characteristics. Diac and Triac: Characteristics and Operations. Device Applications.	T	T , R

For the definitions of T and R , Please refer to Section 3.

TBA
Course Teacher, CSE 2109
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
EEE 1210 Electronic Devices and Circuits Lab

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**2nd year 1st semester 2024**
Course Code	EEE 1210
Course Title	*Electronic Devices and Circuits Lab*
Course Credit	0.75 units
Contact Hours Per Week	3 hours in alternate weeks
Course Status	GED Course
Prerequisite Course	None

2 Syllabus

Diode Characteristics and Applications: *Forward and Reverse Bias Characteristics:* Plot the current-voltage (IV) characteristics of a PN junction diode under forward and reverse bias condition. *Rectifier Circuit Design:* Design and construct a half-wave and full-wave rectifier circuit using diodes. Measure output voltage and ripple factor. *Clipping and Clamping Circuits:* Implement diode-based clipping and clamping circuits and observe their effects on input signal. *Zener Diode Voltage Regulation:* Construct a Zener diode voltage regulator circuit and verify its ability to maintain a constant output voltage.

Transistor Characteristics and Applications: *Input and Output Characteristics:* Plot the input and output characteristics of Bipolar Junction Transistors (BJT) and Field Effect Transistors (FET). *DC Biasing:* Set up a BJT/FET amplifier circuit with proper biasing. Measure the DC operating point and calculate the transistor parameters (Beta, VBE). *Common Emitter Amplifier:* Design and construct a common emitter amplifier circuit. Measure the voltage gain, input, output impedance, and frequency response.

Operational Amplifiers (Op-Amp): *Op-Amp Characteristics:* Measure the input offset voltage, slew rate of an operational amplifier. *Inverting and Non-Inverting Amplifiers:* Construct and measure the voltage gain, input and output impedance, and bandwidth of Inverting and Non-Inverting amplifiers. *Analog-to-Digital and Digital-to-Analog:* Implement Op-Amp based analog-to-digital and digital-to-analog converter circuits.

3 Text and Reference Materials

T Textbook:

- *Thomas L. Floyd*, **ELECTRONIC DEVICES, Conventional Current Version**, 10th Edition, Pearson, 2018.

R References:

– *Robert Bolyestad*, *Louis Nashelsky*, **ELECTRONIC DEVICES and CIRCUIT THEORY** , 11th Edition, Pearson, 2012.

TBA
Course Teacher, CSE 2110
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
HUM 4105 Professional Ethics and Environment

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 1st semester 2024**
Course Code	HUM 4105
Course Title	*Professional Ethics and Environment*
Course Credit	2.0 units
Contact Hours Per Week	2
Course Status	GED Course
Prerequisite Course	None

2 Syllabus

Human Values: Morals, Values and Ethics, Different values of human. **Introduction to Professional Ethics:** Basic Concepts, Governing Ethics, Personal & Professional Ethics, Ethical Dilemmas, Life Skills, Emotional Intelligence, Thoughts of Ethics, Value Education, Dimensions of Ethics, Profession and professionalism, Professional Associations, Professional Risks, Professional Accountabilities, Professional Success, Ethics and Profession. **Basic Theories:** Basic Ethical Principles, Moral Developments, Deontology, Utilitarianism, Virtue Theory, Rights Theory, Casuist Theory, Moral Absolution, Moral Rationalism, Moral Pluralism, Ethical Egoism, Feminist Consequentialism, Moral Issues, Moral Dilemmas, Moral Autonomy. **Professional Practices in Engineering:** Norms of Professional Conduct vs. Profession; Work Place Rights & Responsibilities of Engineers, Obligations and Moral Values in Professional Ethics, Professional codes of ethics, the limits of predictability of the engineering profession; Engineers and Managers; Organizational Complaint Procedure, difference of Professional Judgment; Case study (for example: lessons from 1979 American Airlines DC-10 Crash and Kansas City Hyatt Regency Walk away Collapse). **Ethics in Research Domain:** research misconduct, mistakes and errors; the emerging emphasis on understanding and fostering responsible conduct, responsible authorship, reviewing editing. **Global and Environmental issues in Professional Ethics:** Introduction – Current Scenario, Technology Globalization of Multinational Corporations, Environment-friendly technology development, Sustainable Industrial Revolutions 4.0 and 5.0, International Trade, World Summits, Business Ethics and Corporate Governance, Sustainable Development Ecosystem, Energy Concerns, Ozone Deflection, Pollution, Ethics in Manufacturing and Marketing, Media Ethics, War Ethics, Bioethics, Intellectual Property Rights, Climate Justice and Equity, Circular Economy and Zero-Waste Practices, Impact of Artificial Intelligence on Sustainability, Indigenous Rights and Environmental Ethics, Ethics of Geoengineering, Transnational Environmental Policies and Corporate Accountability.

3 Text and Reference Materials

T Textbook:

- *R. Subramanian*, **Professional Ethics**, 1st Edition, Oxford University Press, 2017.
- *R. S. Naagarazan*, **A Textbook on Professional Ethics And Human values**, 1st Edition, New Age International (P) Ltd, Publishers, 2016.

R References:

- *Caroline Whitbeck*, **Ethics in Engineering Practice & Research**, 2nd Edition, Cambridge University Press, 2011.

4 Course Outcomes

After completion of this course, the students are expected to -

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Develop their awareness on Engineering Ethics and Human Values.	PO8	Affective (A3)	30%	Please refer to Section 5.
CO2	Understand responsibilities as an engineer to develop sustainable and environment-friendly technologies and work for the betterment of society.	PO6	Affective (A2)	20%	
CO3	Appreciate ethical dilemma while discharging duties in professional life.	PO12	Psychomotor (P5)	50%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	25%	15%	20%	60%
Midterm Exam		5%	15%	20%
Class Test/Quiz	5%		5%	10%
Assignment/Presentation			5%	5%
Class Participation			5%	5%
Total	35%	20%	50%	100%

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University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline - MIS 4203 IT Project Management

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	MIS 4203
Course Title	*IT project Management*
Course Credit	2.0 units
Contact Hours Per Week	2
Course Status	GED
Prerequisite Course	CSE 3101 Software Engineering

2 Syllabus

Introduction: What is project? What is project management? Program and project portfolio management, role of project manager, project management profession. **Project management and information technology context:** A system view of project management, understanding organization, stakeholder management, project phases and the project Life cycle, The context of information technology projects, recent trends affecting IT project management. **Project management process groups:** process groups, mapping the process groups to the knowledge areas, developing an IT project management methodology, case study. **Project Integration Management:** Strategic planning and project selection, developing a project management plan, directing and managing project work, monitoring and controlling project work, performing integrated change control, closing projects or phases. **Project Scope Management:** Planning scope management, collecting requirements, defining scope, controlling scope. **Project Schedule Management:** Planning schedule management, defining activities, sequencing activities, estimating activity resources, estimating activity duration, developing the schedule, controlling the schedule. **Project Cost Management:** Basic principles of cost management, planning cost management, estimating costs, determining the budget, controlling costs. **Project Quality Management:** Planning quality management, performing quality assurance, controlling quality, tools and techniques of quality control, modern quality management, improving IT project quality. **Project Human Resource Management:** Keys to managing people, developing the human resource plan, acquiring the project team, developing the project team, managing the project team. **Project Communication Management:** Keys to good communications, planning communications management, managing communications, controlling communications. **Project Risk Management:** Planning risk management, common sources of risk on IT projects, identifying risks, performing qualitative risk analysis, planning risk responses, controlling risks. **Project Procurement Management:** Planning procurement management, conducting procurements, controlling procurements. **Project Stakeholder Management:** Identifying stakeholders, planning stakeholder management, managing stakeholder engagement, controlling stakeholder engagement

3 Text and Reference Materials

T Textbook:

- *Kathy Schwalbe*, **Information Technology Project Management**, 9th Edition, Cengage, 2018.

R References:

- **PMBOK Guide**, Sixth Edition, Project Management Institute, 2017.

4 Course Outcomes

CO	CO Description	PO	Domain (LoBT)	Weight	Assessment Methods
CO1	Apply the knowledge of sciences and engineering fundamentals to interpret the elementary concepts of various architectures, applications, protocols, and background processes dealing with networking architecture and protocol design related problems.	PO1	Cognitive (C3)	35%	Please refer to Section 5.
CO2	Analyze operational details of various protocols, related to application, transport, and routing layers to apply the specialist engineering knowledge to solve the complex networking infrastructure development problem.	PO2	Cognitive (C4)	45%	
CO3	Establish a reliable protocol while planning and designing network services infrastructure, to address networking-related problems and issues that ensure user Quality of Service (QoS) and Quality of Experience (QoE).	PO6	Affective (A4)	20%	

Legend:
CO: *Course Outcome* **PO**: *Program Outcome*
LoBT: *Level of Bloom's Taxonomy*

5 Assessment Methods of COs

Assessment Method	CO1	CO2	CO3	Total
Final Exam	20%	30%	10%	60%
Midterm Exam	10%	10%		20%
Class Test/Quiz	5%	5%		10%
Assignment/Presentation			5%	5%
Class Participation			5%	5%
Total	35%	45%	20%	100%

6 Topic Outline

Lecture	Selected Topic	Article	Problems
1-2	Networking and Socialization, sharing course administration and guidelines • What is project? What is project management? Program and project portfolio management, role of project manager, project management profession. • Project management and information technology context: A system view of project management, understanding organization, stakeholder management, project phases and the project Lifecycle, The context of information technology projects, recent trends affecting IT project management;	T	T
3-4	Project management process groups • Process groups, mapping the process groups to the knowledge areas, developing an IT project management methodology, case study;	T	T
5-7	Project Integration Management • Strategic planning and project selection, developing a project management plan, directing and managing project work, monitoring and controlling project work, performing integrated change control, closing projects or phases;	T	T
8-12	Project Scope Management • Planning scope management, collecting requirements, defining scope, controlling scope;	T	T
13-14	Project Schedule Management • Planning schedule management, defining activities, sequencing activities, estimating activity resources, estimating activity duration, developing the schedule, controlling the schedule;	T	T
15-17	Project Cost Management • Basic principles of cost management, planning cost management, estimating costs, determining the budget, controlling costs;	T	T
18-21	Project Quality Management • Planning quality management, performing quality assurance, controlling quality, tools and techniques of quality control, modern quality management, improving IT project quality;	T	R
22	Project Resource Management • Keys to managing people, developing the human resource plan, acquiring the project team, developing the project team, managing the project team;	T	T
23	Project Communication Management • Keys to good communications, planning communications management, managing communications, controlling communications;	T	T
24-25	Project Risk Management • planning risk management, common sources of risk on IT projects, identifying risks, performing qualitative risk analysis, planning risk responses, controlling risks;	T	R
26	Project Procurement Management • Planning procurement management, conducting procurement, controlling procurement	T	R
27	Project Stakeholder Management • Identifying stakeholders, planning stakeholder management, managing stakeholder engagement, controlling stakeholder engagement	T	R
28	Review, Challenges of Project management • Problem solving practices • Presentation, Assignment, etc.	T	R

For the definitions of T and R , Please refer to Section 3.

Course Teacher, CSE 3105
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

University of Dhaka

Department of Computer Science and Engineering
Faculty of Engineering and Technology (FoET)
Second Science Complex, Mokarram Bhaban Area
University of Dhaka, Dhaka 1000, Bangladesh

Course Outline
BUS 4205 ICT Business Entrepreneurship

1 Basic Information

Faculty	Faculty of Engineering and Technology (FoET)
Department	Department of Computer Science and Engineering
Programme	Bachelor of Science in Computer Science and Engineering
Semester	**4th year 2nd semester 2024**
Course Code	BUS 4205
Course Title	*ICT Business Entrepreneurship*
Course Credit	2.0 units
Contact Hours Per Week	2
Course Status	GED
Prerequisite Course	None

2 Syllabus

Introduction to Entrepreneurship: The nature and importance of entrepreneurship, roles of entrepreneurship in the global economy and society, navigating the current business trend in diverse fields of Information and Communication Technology, the entrepreneurial mindset, myths about entrepreneurship, pros and cons of entrepreneurship - some recent examples at home and abroad; **Entrepreneurship as Innovation and Problem Solving:** Entrepreneurs are innovators and problem solvers to meet the needs and wants of people, major competencies of an entrepreneur, Social Entrepreneurship -concept and importance, **Creativity and the business idea:** Preliminary assessment and detailed analysis of multiple candidate ideas, Selection of the most promising idea, Creating and starting the venture - how it enhances standard of living, promotes innovation and development, creates new jobs and puts impact on community development, Risk taking - concepts and types of various risks including economic risk, reputation risk, operational risk, and competition risk; **Understanding the market and the marketing plan:** Identifying the salient features of the planned product or service, Determining sellers, consumers and competitors, Market survey and SWOT analysis, Pricing and factors affecting prices, Strategies for popularizing the product in the community, Power of social media for product marketing; **The organizational plan:** Organizational size and location, human and capital resource based classification of entrepreneurship, Registration of the organization, association and state laws and policies, GANTT chart for growth plan; **Financial plan of the business:** Challenges of financial planning, sources of capital, informal risk capital, venture capital and going public, income-expenditure statements, vat and taxes, cash flow projections, break-even analysis, strategies for growth and managing the implications of growth; **Resource Mobilization:** Types of Resources - Human, Capital and other Resources, mobilization of various resource types, utilization of human resource, human resource accounting, selection and utilization of human resources and professionals like accountants, lawyers, auditors, board members, role and importance of a mentor. **Ethics and Social Responsibility in Business:** Practices of professional ethics as an entrepreneur, specially in managing physical, financial and human resource management processes, Dimensions and attributes of social responsibilities of an entrepreneur.

3 Text and Reference Materials

T Textbook:

- *Eric Ries*, **The Lean Startup**, 2nd Edition, Crown Currency, 2011.

R References:

- *Peter Thiel & Blake Masters*, **Zero to One**, First Edition, Crown Currency, 2014.

4 Topic Outline

Lecture	Selected Topic	Article	Problems
1-4	Overview of Entrepreneurship in Information and Communication Technology context, sharing course administration and guidelines • **Introduction to Entrepreneurship:** The nature and importance of entrepreneurship, roles of entrepreneurship in the global economy and society, navigating the current business trend in diverse fields of Information and Communication Technology, the entrepreneurial mindset, myths about entrepreneurship, pros and cons of entrepreneurship - some recent examples at home and abroad;	T	T
5-6	**Entrepreneurship as Innovation and Problem Solving:** Entrepreneurs are innovators and problem solvers to meet the needs and wants of people, major competencies of an entrepreneur, Social Entrepreneurship - concept and importance;	T	T
7-10	**Creativity and the business idea:** Preliminary assessment and detailed analysis of multiple candidate ideas, Selection of the most promising idea, Creating and starting the venture - how it enhances standard of living, promotes innovation and development, creates new jobs and puts impact on community development, Risk taking - concepts and types of various risks including economic risk, reputation risk, operational risk, and competition risk;	T	T
11-14	**Understanding the market and the marketing plan:** Identifying the salient features of the planned product or service, Determining sellers, consumers and competitors, Market survey and SWOT analysis, Pricing and factors affecting prices, Strategies for popularizing the product in the community, Power of social media for product marketing;	T	T
15-17	**The organizational plan:** Organizational size and location, human and capital resource based classification of entrepreneurship, Registration of the organization, association and state laws and policies, GANTT chart for growth plan;	T	T
18-21	**Financial plan of the business:** Challenges of financial planning, sources of capital, informal risk capital, venture capital and going public, income-expenditure statements, vat and taxes, cash flow projections, break-even analysis, strategies for growth and managing the implications of growth;	T	R
22-25	**Resource Mobilization:** Types of Resources - Human, Capital and other Resources, mobilization of various resource types, utilization of human resource, human resource accounting, selection and utilization of human resources and professionals like accountants, lawyers, auditors, board members, role and importance of a mentor;	T	T

26-28	**Ethics and Social Responsibility in ICT Business Entrepreneurship:** Practices of professional ethics as an entrepreneur, specially in managing physical, financial and human resource management processes, Dimensions and attributes of social responsibilities of an entrepreneur.	T	R

For the definitions of T and R , Please refer to Section 3.

Course Teacher, CSE 3105
April 24, 2024

Chairman, Dept. of CSE, DU
April 24, 2024

IV ♦ Part D

18 Evaluation and Grading

18.1 Examination Committee

An examination committee consisting of 4 teachers will be proposed by the Academic Committee of the department. There will be separate examination committees for every academic semester.

The committee will consist of a chairman, 2 internal members, and an external member. The committee may have an external member from other departments of the University of Dhaka or outside of the University of Dhaka. The chairman of the committee will serve as the course coordinator for that academic semester. The role of a course coordinator is to monitor the academic activities and report to the chairman to avoid any unexpected situation.

The chairman of the examination committee, with the help of the committee members, will be responsible for all activities related to the examination as per the University rules including getting questions from the respective course teachers, moderating the questions and printing them, holding examinations, and publishing results on time.

18.2 Tabulators

The examination committee will appoint two tabulators. Course teachers/examiners will submit their mark sheets in detail.

The tabulators will enter the marks given by each course teacher/examiner in the tabulation sheets independently, process the examination results, and compare them to check correctness. Thereafter, they submit the signed tabulation sheets to the office of the controller of examinations through the chairman of the committee.

The answer scripts of final examinations will be evaluated by two examiners and the average mark will be considered as the obtained mark the difference between the two does not exceed 20%. Otherwise, the script will be evaluated by a third examiner and the nearest two marks will be averaged to determine the obtained mark. If the third examiner's mark has the same difference from both the others, the average of three marks will be the obtained mark.

The controller's office will publish the examination results at the end of every semester and issue the transcripts.

18.3 Class Representative

Each batch/section of students will have two class representatives (one male and one female) to maintain liaison with the Course Coordinator, course teachers, and the office of the chairman of the Department regarding their class progress and problems.

18.4 Marks Distribution

Letter grading is made to assess students' performance. The grade is assigned on the overall evaluation of a student's performance based on the semester final examination, midterm exam, class test, assignments, and class attendance in aggregate and the following weight distribution is applicable for the B.Sc. Engg. in CSE program. Following the needs of a specific laboratory course, the course teachers may change the weights of different mark heads or may merge multiple heads of marking together, e.g., viva-voce and continuous lab performance may be evaluated together.

Theory Courses		**Laboratory Courses**	
Class Participation	5	Class Participation	10
Class Test (Best 1 of 2)	10	Continuous Lab Performance	30
Group Assignment or Presentation	10	Lab Reports	10
Midterm Examination	25	Lab Viva-Voce	20
Semester Final Examination	50	Capstone Project or Demo/Presentation	30
Total	**100**	**Total**	**100**

Class Participation is a qualitative evaluation of the performances of a student by the respective course teacher based on regularity in attending classes, responding answers to the questions, giving valuable feedback, taking part in discussions, making inquisitive questions, eagerness to learn, supporting keep the classroom environment noise-free, etc. It mainly evaluates the attitude of a person and less cognitive or psychomotor skills. For lab courses, affective domain skills of the students at different levels (A1 to A5) can better be quantified depending on the courses.

Class Tests are highly effective both for the students and the course teacher to assess whether the learning process is going correctly or not. Test results will be communicated to the students within a week or two so that they can identify their mistakes, and errors in ways followed to learn a certain topic and get good guidance from the faculty. Similarly, the course teacher can identify more accurately the rate of learning of the students and getting feedback from this formative assessment tool, s/he can make changes in the teaching and learning process to be followed in the subsequent classes.

Group Assignment or Presentation helps a student to work in a group to solve a complex engineering problem, mathematically or logically translating a problem of the natural world into a digital one, design and nurture alternate or effective solutions, compare multiple algorithms, protocols or systems and evaluate their effectiveness, and defend his/her own understanding through presenting before a large group of audience. It helps the course teacher to assess student's psychomotor skills including teamwork capacity and communication at different levels (P1 to P7) as well as higher-order cognitive domain skills (C4, C5).

Midterm and Final Examinations mainly contribute to assessing the amount of knowledge (from lower to mid levels in cognitive domains: C1 to C3) gained by a student on the course matters. Evaluated midterm

exam scripts are shown to the students, which helps them a lot to correct and prepare themselves in the right way for the semester's final examinations.

Continuous Lab Performance in laboratory courses is very effective for students to increase their technical skills. In each lab class, one problem or assignment is given which has to be solved by the students individually or in a group. The total number of problems or assignments given per lab course will be determined by the respective lab teachers. Each assignment has to be submitted during the lab time on the same day as the assigning date or some time later on a different day which will be determined by the respective lab teachers. For late submission, there will be some sort of penalty which will also be determined by the respective lab teachers. There can be bonus marks for fast solvers if needed and felt necessary by the respective lab teacher.

Lab Reports and Viva-Voce are essential for engaging students to enhance their technical report writing skills and defending the solutions they have prepared, respectively. The viva-voce also helps course teachers to better evaluate the level of understanding of the individual students and to identify whether the students have solved the problem by themselves (or copied from others) and/or whose contribution is comparatively higher while they are working in a group.

Capstone Projects or Demo Presentations Some of the courses will contain small capstone projects to be developed by the students individually or in a group. Hands-on experiences of the students in accumulating multiple technical skills while solving a complex engineering problem and their demonstrations help them to grow technically proficient. For other lab courses, especially for the labs having 0.75 credits only, viva-voce and demonstration on a given experiment can be merged for evaluation.

18.5 Submission of Marks

18.5.1 Internal Evaluation Marks

For a theory course, the course teacher will evaluate the continuous performances of the students by taking Class Tests/Quizes, Midterm examinations, assignments/presentations, and class participation, and submit their obtained marks out of 50% of the total to the chairman of the examination committee and controller of examinations before commencement of the semester final examinations.

The evaluated answer scripts of the midterm and class tests must be shown to the students before the last class of a semester and the total internal evaluation marks must be shared with the students before commencement of the final examinations.

For laboratory courses, the marks obtained by each student will be submitted by the course teachers in a prescribed format (determined by the Academic Committee of the Department) before the beginning of the semester final examinations.

18.5.2 Semester Final Examination Marks

Generally, there will be two examiners, following the University rule, for evaluating answer scripts of the semester final examinations. Both of them separately submit the marks on-time in a prescribed format to the chairman of the examination committee and controller of examinations.

18.6 Eligibility to sit for the Final Examination

i. Students with 75% attendance and above on average will be eligible to sit for the semester final examinations.

ii. Students having attendance greater than 60% and less than 75% will be considered to sit for the examination after paying the required fines.

iii. Students having attendance below 60% will not be eligible to appear at the examination and they may seek re-admission.

iv. Duration of the semester final examinations will be 3 hours and 2.5 hours for 3-credit and 2-credit courses, respectively.

v. Duration of the midterm examinations will be 1.0 to 1.5 hours, determined by the respective course teacher.

18.7 Grading Scale

The University of Dhaka follows a grading scale of 4.0.

18.8 Letter Grades and Grade Points

A teacher responsible for conducting the course determines the internal assessment marks (50% of the total). The question of the final examination is prepared by two examiners and moderated by the examination committee. Similarly, the answer scripts are evaluated by two examiners, and by a third examiner if more than 20% deviation is found among the marks of the first two examiners for a given answer script. The closer two marks are averaged to calculate the final examination mark of a student.

The Grade Point (GP) earned by a student in a certain course will be determined by his/her total score including the internal assessment marks and final examination marks. The final result will be prepared by cumulating the grade point average (CGPA) over the courses. The uniform grading system, recommended by the University Grants Commission, is adopted for assigning a letter grade and grade point. This is given in the following table:

Numerical grade	Letter Grade	Grade Point (GP)
80 or Above	A+	4.00
75 to < 80	A	3.75
70 to < 75	A-	3.50
65 to < 70	B+	3.25
60 to < 65	B	3.00
55 to < 60	B-	2.75
50 to < 55	C+	2.50
45 to < 50	C	2.25
40 to < 45	D	2.00
Less than 40	F	0.00
	I	Incomplete
	W	Withdrawn

18.9 Assigning 'W' and 'I' Grades

A 'W' grade is assigned to a course for a student if he/ she withdraws from the course taking the necessary official permission. 'W' grade will not be considered for GPA/ CGPA calculation. Such courses need to be re-registered in the next year or semester, whichever is applicable.

A student will be assigned an 'I' grade,

i. If he/she has been absent in the Semester final examination.

ii. An 'I' grade will automatically be converted to an 'F' grade if he/she fails to sit for an improvement examination within the stipulated time.

18.10 Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

A student obtaining a 'D' or higher grade will be counted as credits earned by him/her. A student obtaining an 'F' grade will not be counted towards his earned credits. The Semester Grade Point Average (SGPA) is calculated for the courses taken in a semester and the Cumulative Grade Point Average (CGPA) is calculated for all the courses taken up to the semester to which it refers by the student. The calculation of SGPA and CGPA are as follows:

$$\text{SGPA} = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i} \tag{1}$$

$$\text{CGPA} = \frac{\sum_{i=1}^{N} C_i G_i}{\sum_{i=1}^{N} C_i} \tag{2}$$

where, C_i, stands for credits of the ith course. G_i, stands for grade points earned in the ith course. n, stands for the number of courses taken in the semester. N, stands for the number of courses taken up to the semester to which refers. Both SGPA and CGPA will be rounded off to the second place of decimal for reporting.

19 Improvement Examination

i. To clear an 'F' grade in any course, a student can get a chance in two consecutive academic years (complying with the maximum allowable 6 years) to reappear at the final examination. In this case, the best grade that a student can be awarded is B+ (B Plus).

ii. A student may improve the grade of any course by reappearing at the Final examination within consecutive two years if he/she obtains a grade less than or equal to C+ (C Plus) and the best grade that a student can achieve in case of grade improvement is B+ (B Plus). However, if the grade is not improved, the previous one will remain valid.

iii. A student will not be allowed for grade improvement once s/he is eligible for the degree.

iv. A student taking advantage of the improvement policy will not be eligible for receiving a gold medal or any other award.

v. In addition to the usual fees, a fine, as per university rules, will be imposed for each course chosen for improvement.

vi. A student will have to be mentally prepared to sit for the examination of a particular course chosen for improvement even if it is held on the same day as his/her other regular examination.

20 Re-admission and Drop Out

20.1 Re-admission

A minimum CGPA (Cumulative Grade Point Average) of 2.00 will be required for getting promotion to the next academic year. Securing a CGPA below the above minimum respective threshold will hinder a student from getting promoted to the next academic year.

A student failing to get a promotion to the next academic year may seek re-admission to study with the following batch. Re-admission may be sought by a student due to his/her prolonged sickness or any other acceptable reasons. In the case of re-admission, all previously earned grades for the two semesters of that year will be canceled.

20.2 Drop Out

A student may take re-admission only 2 times. If required, a student may take re-admission in the same class or year, but the degree must be completed within 6 years from the date of admission at 1st year 1st semester.

A student failing to get the minimum required CGPA even after taking re-admissions twice will be dropped out of the program.

SPECIAL NOTES:

- The cases that can't be resolved by the above rules will be discussed in the Academic Committee of the Department and the usual practices of the university/faculty will be applied to address it.

- Disciplinary and punishable actions will be applied according to the existing rules of the University of Dhaka.

Conclusions

In conclusion, the updated curriculum for the Bachelor of Science in Computer Science and Engineering is a forward-thinking and comprehensive program designed to empower students with the knowledge and skills needed to excel in the emerging fields of computing. By striking a balance between theoretical foundations and practical applications, the curriculum equips students with a strong academic base, and industrial exposure while nurturing their ability to address real-world challenges.

The program's interdisciplinary approach encourages collaboration with other fields, enabling students to understand the diverse applications of computer science and engineering knowledge in various industries and domains. Furthermore, the emphasis on ethical considerations ensures that graduates are not only skilled professionals but also responsible computer engineering practitioners.

With a focus on project-based learning and industry exposure, students gain invaluable hands-on experience and develop the confidence to apply their knowledge in practical settings. The curriculum's emphasis on research and innovation fosters a culture of continuous learning, preparing students to stay at the forefront of the rapidly evolving computing, software, network, Artificial Intelligence, and machine learning technologies throughout their careers.

As a result of the proposed curriculum, the Department of Computer Science and Engineering of University of Dhaka aims to produce highly competent and ethically-driven computer science and engineering professionals, ready to make a positive impact on society and contribute to the growth and advancement of these fields both locally and globally. By providing a transformative educational experience, the university strives to nurture the next generation of engineering leaders who will lead the way in shaping the smart Bangladesh in the near future.

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