

DEPARTMENT OF
COMPUTER SCIENCE AND ENGINEERING

CURRICULUM

(Effective from Spring 2026)

School of Engineering



VARENDRA UNIVERSITY

CURRICULUM COMMITTEE – CSE DEPT, VU

The undergraduate curriculum of the Department of Computer Science and Engineering (CSE) at Varendra University (VU) has been evaluated by the committee as detailed below and will be implemented from the 1st Year Odd Semester of the Spring 2026 session.

A. Chairman	
Prof. Dr. Shamim Ahmad Head, Dept. of CSE, VU	
B. Internal Members	
Prof. A.H.M. Rahmatullah Imon, Ph.D. Professor, Dept. of CSE, VU	Sabina Yasmin Coordinator, Dept. of CSE, VU
Dr. Ahammad Hossain Associate Professor, Dept. of CSE, VU	Md. Mizanur Rahman Assistant Professor, Dept. of CSE, VU
Umme Rumman Assistant Professor, Dept. of CSE, VU	Mst. Jannatul Ferdous Assistant Professor, Dept. of CSE, VU
Sumaia Rahman Assistant Professor, Dept. of CSE, VU	Tanver Ahmed Assistant Professor, Dept. of CSE, VU
A.S.M. Delwar Hossain Lecturer, Dept. of CSE, VU	Md. Toufikul Islam Lecturer, Dept. of CSE, VU
Md. Nour Noby Lecturer, Dept. of CSE, VU	Ayesha Akter Lima Lecturer, Dept. of CSE, VU
Md. Golam Shahriar Lecturer, Dept. of CSE, VU	Salma Akter Lima Lecturer, Dept. of CSE, VU
Ipshita Tasnim Raha Lecturer, Dept. of CSE, VU	Sumaiya Tasnim Lecturer, Dept. of CSE, VU
Shamim Reza Lecturer, Dept. of CSE, VU	Samira Tareque Lecturer, Dept. of CSE, VU
Akib Iqbal Lecturer, Dept. of CSE, VU	Mohammad Faisal Al-Naser Lecturer, Dept. of CSE, VU
Ahmed-Al-Azmain Lecturer, Dept. of CSE, VU	Md. Muktar Hossain Lecturer, Dept. of CSE, VU
Md. Fatin Ilham Lecturer, Dept. of CSE, VU	Md. Jamil Chaudhary Lecturer, Dept. of CSE, VU
Md. Shahid Ahammed Shakil Lecturer, Dept. of CSE, VU	Zannatul Mifta Lecturer, Dept. of CSE, VU
Sushmit Jahan Lecturer, Dept. of CSE, VU	Arun Kumar Sikder Lecturer, Dept. of CSE, VU
Md. Mahfujur Rahman Lecturer, Dept. of CSE, VU	Md. Ruhul Amin Lecturer, Dept. of CSE, VU

Israt Jahan Rinky Lecturer, Dept. of CSE, VU	D.M. Asadujjaman Lecturer, Dept. of CSE, VU
Shorav Paul Lecturer, Dept. of CSE, VU	Protik Chakroborty Lecturer, Dept. of CSE, VU
Md. Taufiq Khan Lecturer, Dept. of CSE, VU	Arshad Wasif Lecturer, Dept. of CSE, VU
Sumaya Hannan Shova Lecturer, Dept. of CSE, VU	Md. Khalid Sakib Lecturer, Dept. of CSE, VU
Md. Fayzul Islam Lecturer, Dept. of CSE, VU	Nafia Islam Lecturer, Dept. of CSE, VU
Md. Adnan Sami Lecturer, Dept. of CSE, VU	Mst. Mazeda Noor Tasnim Lecturer, Dept. of CSE, VU
Adrita Alam Lecturer, Dept. of CSE, VU	Md. Rakibul Islam Lecturer, Dept. of CSE, VU
Afroza Islam Lecturer, Dept. of CSE, VU	Rokaiya Tasnim Lecturer, Dept. of CSE, VU
Asim Moin Saad Lecturer, Dept. of CSE, VU	Humayra Tasnim Lecturer, Dept. of CSE, VU
Zuairia Raisa Bintay Makin Lecturer, Dept. of CSE, VU	Afifa Tasneem Quanita Lecturer, Dept. of CSE, VU
Anupoma Barman Shetu Lecturer, Dept. of CSE, VU	Md. Alamin Hossain Pappu Lecturer, Dept. of CSE, VU
Tahrima Sayem Sowa Lecturer, Dept. of CSE, VU	Sajeeb Kumar Ray Lecturer, Dept. of CSE, VU
Barisha Chowdhury Lecturer, Dept. of CSE, VU	Syeda Tamanna Alam Monisha Lecturer, Dept. of CSE, VU
Mehedi Hasan Shakil Lecturer, Dept. of CSE, VU	Shakil Hossan Lecturer, Dept. of CSE, VU
C. External Members	
Dr. Md. Nazrul Islam Mondal Professor, Dept. of CSE, RUET	Dr. Mirza A. F. M. Rashidul Hasan, Professor, Dept. of ICE, RU
D. Members (External: Professional Organization/ Industry)	
ASM Akhtaruzzaman Masud, CEO, rajIT Solutions Ltd, Rajshahi	
E. Members (External: Alumni)	
Md. Mostafizur Rahman Software Engineer, Business Automation Ltd, Rajshahi	

CONTENTS

Outcome-based Education Curriculum				
PART A				
1.	Title of the Academic Program			3
2.	Name of the University			3
3.	Vision of the University			3
4.	Mission of the University			3
5.	Name of the Program Offering Entity			3
6.	Vision of the Program Offering Entity			3
7.	Mission of the Program Offering Entity			3
8.	Objectives of the Program Offering Entity			3
9.	Name of the Degree			3
10.	Description of the Program			4
11.	Graduate Attributes			4
12.	Program Educational Objectives (PEOs)			4
13.	Program Outcomes (POs) and Assessment			4
14.	Mapping missions of the university with PEOs			7
15.	Mapping among the missions of the university and missions of the department			7
16.	Mapping POs with the PEOs			7
17.	Mapping courses with the POs			7
18.	Mapping Courses with the Complex Engineering Problem Solving and Complex Engineering Activities			12
PART B				
19.	Structure of the Curriculum			17
	a)	Duration of the program		17
	b)	Admission Requirements		17
	c)	Total minimum credits requirement to complete the program		17
	d)	Total class weeks in a semester		17
	e)	Minimum CGPA requirements for graduation		17
	f)	Maximum academic years of completion		17
	g)	Category of Courses		18
		i.	Course Designation and Numbering System	18
		ii.	Distribution of Courses	18
		iii.	Language Courses	19
		iv.	General Education Courses	19
		v.	Basic Science Courses	19
		vi.	Mathematics Courses	19
		vii.	Core Courses	19
		viii.	Other Engineering Courses	21
		ix.	Elective Courses	21
		x.	Capstone course/ Internship/ Thesis/ Projects	21

20.	Year & Semester wise distribution of courses		22
	a)	1st Year Odd Semester	22
	b)	1st Year Even Semester	22
	c)	2nd Year Odd Semester	23
	d)	2nd Year Even Semester	23
	e)	3rd Year Odd Semester	24
	f)	3rd Year Even Semester	24
	g)	4th Year Odd Semester	25
	h)	4th Year Even Semester	26
PART C			
21.	Description of all courses of the program		29
PART D			
22.	Grading/ Evaluation		185
	i. Grading Scales and Grades		185
	ii. Cumulative Grade Point Average		186
	iii. Retake		186
	iv. Improvement		187
	v. Semester Drop & Cancellation of Admission		187
Appendix A: FYDP Book Template			191

CURRICULUM

(Effective from Spring 2026)

Part A

1. **Title of the Academic Program:** B.Sc. in Computer Science and Engineering (CSE)
2. **Name of the University:** Varendra University
3. **Vision of the University:**

The vision of Varendra University is to be established as a top-ranking university nationally and internationally through continuous innovation in education, research, creativity, and entrepreneurship.

4. **Mission of the University:**

M1	Prepare students to become competent, compassionate, ethically driven, and socially responsible professionals.
M2	Educate students through research to foster both intellectual and social transformation.
M3	Enhance lifelong learning skills to build adaptability for the challenges of the 21st century.

5. **Name of Program Offering Entity:** Department of Computer Science and Engineering
6. **Vision of the Program Offering Entity:**

To become a prominent department of Computer Science & Engineering producing competent professionals with research and innovation skills, inculcating moral values and societal concerns.

7. **Mission of the Program Offering Entity:**

M1	Provide learning ambience to generate innovative and problem-solving skills with professionalism.
M2	Create facilities and expertise in advanced computer technology thereby promote research.
M3	Enhance Industry Institute Interaction program to get acquainted with corporate culture
M4	Induce ethical values and spirit of social commitment

8. **Objectives of the Program Offering Entity:**

- To develop and deliver the highest quality technical and professional education, training and research using ground-breaking technology;
- To provide services of the highest quality both curricular and co-curricular; so that our students can integrate their skills and serve the industry and society equally well at a global level;
- To focus on teaching excellence through diverse approaches to learning, teaching and assessment that enable all students to maximize their potential;
- To provide world-class academic research programs to make sustainable social and economic impacts both nationally and internationally.

9. **Name of the Degree:** B.Sc. (Honors) in Computer Science and Engineering

10. **Description of the Program**:

Undergraduate students in Computer Science and Engineering emphasizes both theoretical concepts as well as practical application and experiments. The students will be provided the related knowledge to get an advanced projection on the computer architecture, programming languages, operating systems, theory of computing, computer networking, database systems, artificial intelligence and other advanced areas of information & communication technology. The program deals with analysis and design experiences with laboratory work. Undergraduate programs prepare the student career in application development and systems analysis along with implementation of computer science knowledge in almost every field from business to education, from humanities to social sciences as well as from natural sciences to engineering.

11. **Graduate Attributes:**

Attribute 1: Deep knowledge in discipline.
Attribute 2: Creative thinking and problem-solving ability.
Attribute 3: Teamwork and communication skills.
Attribute 4: Professionalism and leadership readiness.
Attribute 5: Intercultural and ethical competency.

12. **Program Educational Objectives (PEOs):**

PEO1	**Sufficient skill for ICT problem solving:** The graduates will have a sufficient understanding of the field of computer science including scientific principles, analysis techniques, and design methodologies.
PEO2	**Graduate prepared for desired future:** Be successfully employed, pursue a graduate study, or continue their professional development.
PEO3	**Management ability and leadership:** Apply their skills in clear communication, efficient teamwork, and time management. Demonstrate adaptability or leadership by, for example, being promoted, moving up to a better job, or by taking a leadership role in a team.
PEO4	**Wide knowledge to serve the society:** Prove the understanding of the context and broader impacts of technology in their organization by engaging stakeholders outside their immediate team, or by identifying ethical, economic, cultural, legal or environmental issues related to work projects.
PEO5	**Responsible professionals:** Graduates will be informed and involved members of their communities, and responsible engineering and computing professionals who take appropriate account, in their professional work, of such issues as privacy, security, copyright etc. As a responsible professional, it's important to be mindful of the potential misuse of the Fourth Industrial Revolution (4IR), especially when it comes to AI, and its impact on society

13. **Program Outcomes (POs) and Assessment:**

a) Program Outcomes (POs):

PO1	Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop solutions of complex engineering problems.
PO2	Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences with holistic considerations for sustainable development (WK1 to WK4).
PO3	Design creative solutions for complex engineering problems and design systems, components or processes to meet identified needs with appropriate consideration for

	public health and safety, whole-life cost, net zero carbon as well as resource, cultural, societal, and environmental considerations as required (WK5).
PO4	Conduct investigations of complex engineering problems using research methods including research-based knowledge, design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions (WK8).
PO5	Create, select and apply and recognize limitations of appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering problems (WK2, WK6).
PO6	When solving complex engineering problems, analyze and evaluate sustainable development impacts to: society, the economy, sustainability, health and safety, legal frameworks, and the environment (WK1, WK5, and WK7).
PO7	Apply ethical principles and commit to professional ethics and norms of engineering practice and adhere to relevant national and international laws. Demonstrate an understanding of the need for diversity and inclusion (WK9).
PO8	Function effectively as an individual, and as a member or leader in diverse and inclusive teams and in multi-disciplinary, face-to-face, remote and distributed settings (WK9).
PO9	Communicate effectively and inclusively 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, taking into account cultural, language, and learning differences.
PO10	Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team and to manage projects and in multidisciplinary environments.
PO11	Recognize the need for, and have the preparation and ability for i) independent and lifelong learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change (WK8).
PO12	Demonstrate knowledge and understanding of the competences necessary to transform opportunities and ideas into a new business.

Legends	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	PO-a	PO-b	PO-c	PO-d	PO-e	PO-f	PO-g	PO-h	PO-i	PO-j	PO-k	PO-l

b) Knowledge Profile (WK):

	Attribute
WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences
WK2	Conceptually based mathematics, numerical analysis, data analysis, statistics and the formal aspects of computer and information science to support detailed analysis and modeling applicable to the discipline
WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline
WK5	Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area

WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
WK7	Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as professional responsibility of an engineer to public safety and sustainable development
WK8	Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues
WK9	Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes

c) Range of Complex Engineering Problem Solving (WP):

	Attribute	**Complex Engineering Problems** have characteristic WP1 and some or all of WP2 to WP7
WP1	Depth of knowledge required	Cannot be resolved without in-depth engineering knowledge at the level of one or more of WK3, WK4, WK5, WK6 or WK8 which allows a fundamentals-based, first principles analytical approach
WP2	Range of conflicting requirements	Involve wide-ranging or conflicting technical, non-technical issues (such as ethical, sustainability, legal, political, economic, societal) and consideration of future requirements
WP3	Depth of analysis required	Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models
WP4	Familiarity of issues	Involve infrequently encountered issues or novel problems
WP5	Extent of applicable codes	Address problems not encompassed by standards and codes of practice for professional engineering
WP6	Extent of stakeholder involvement and conflicting requirements	Involve collaboration across engineering disciplines, other fields, and/or diverse groups of stakeholders with widely varying needs
WP7	Interdependence	Address high level problems including many components or sub-problems that may require a systems approach

d) Range of Complex Engineering Activities (EA):

	Attribute	**Complex activities** mean (engineering) activities or projects that have some or all of the following characteristics:
EA1	Range of resources	Involve the use of diverse resources including people, data and information, natural, financial and physical resources and appropriate technologies including analytical and/or design software.
EA2	Level of interaction	Require optimal resolution of interactions between wideranging and/or conflicting technical, non-technical, and engineering issues
EA3	Innovation	Involve creative use of engineering principles, innovative solutions for a conscious purpose, and research-based knowledge.

EA4	Consequences for society and the environment	Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation
EA5	Familiarity	Can extend beyond previous experiences by applying principles-based approaches

14. **Mapping among the missions of the university and missions of the Program Offering Entity (department)**

	Mission of the University		
Mission of the Program Offering Entity	**M1**	**M2**	**M3**
M1	√		
M2			√
M3			√
M4		√	

15. **Mapping missions of the Program Offering Entity (department) with PEOs:**

	Program Educational Objectives (PEOs):				
Mission of the Program Offering Entity	**PEO1**	**PEO2**	**PEO3**	**PEO4**	**PEO5**
M1	√	√	√		
M2					√
M3					√
M4				√	

16. **Mapping POs with the PEOs:**

	Program Outcomes (POs)											
PEO/s	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
PEO1	√	√	√	√								√
PEO2					√					√		
PEO3		√		√					√	√	√	
PEO4	√					√	√	√				√
PEO5						√		√				

17. **Mapping Courses with the POs:**

Course Code	**Program Outcomes (POs)**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CSE 1100	✓				✓							
EEE 1131	✓	✓										

Course Code	Program Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
EEE 1132		✓		✓								
MAT 1141	✓	✓		✓								
PHY 1151	✓											
PHY 1152	✓	✓										
CHE 1161	✓	✓										
ENG 0002										✓		✓
CSE 1201	✓	✓	✓									
CSE 1202	✓	✓	✓									
CSE 1203	✓	✓										
EEE 1231	✓		✓									
EEE 1232	✓		✓									
MAT 1241	✓											
BAN 0001				✓				✓				✓
ECO 1271							✓				✓	
CSE 2101	✓	✓										
CSE 2102	✓		✓									
CSE 2103	✓	✓	✓									
CSE 2104		✓	✓									
CSE 2105	✓	✓	✓									
CSE 2106	✓		✓									
CSE 2107	✓	✓										
MAT 2141	✓											
CSE 2201	✓	✓										
CSE 2202	✓			✓					✓			
CSE 2203	✓	✓	✓									
CSE 2204	✓	✓	✓									
CSE 2205	✓	✓	✓									
CSE 2206	✓		✓									
CSE 2207	✓	✓	✓									
CSE 2208	✓		✓									
MAT 2241	✓											

Course Code	Program Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CSE 3101	✓	✓	✓									
CSE 3102		✓	✓									
CSE 3103	✓	✓	✓									
CSE 3104	✓		✓									
CSE 3105	✓	✓	✓									
CSE 3106	✓	✓	✓									
CSE 3107	✓	✓										
CSE 3122	✓	✓								✓		
MAT 3141	✓	✓										
CSE 3201	✓	✓									✓	
CSE 3203	✓		✓		✓							
CSE 3204		✓			✓							
CSE 3205	✓	✓										
CSE 3206		✓	✓		✓							
CSE 3207	✓	✓	✓									
CSE 3208	✓	✓		✓								
CSE 3209	✓			✓	✓							
CSE 3210			✓		✓							
ACC 3271	✓	✓			✓							
CSE 4101	✓	✓		✓					✓			
CSE 4102	✓		✓		✓							
CSE 4103	✓	✓										✓
CSE 4104	✓		✓	✓								
CSE 4105							✓	✓				
CSE 4100	✓	✓	✓	✓	✓	✓						
CSE 4120			✓							✓		
CSE 4109		✓	✓	✓								
CSE 4110	✓	✓										
CSE 4111		✓		✓	✓							
CSE 4112	✓										✓	
CSE 4113	✓		✓									

Course Code	Program Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CSE 4114			✓		✓	✓						
CSE 4201	✓		✓		✓							
CSE 4202					✓				✓			✓
CSE 4203	✓	✓										
CSE 4204		✓	✓									
CSE 4205		✓		✓								
CSE 4206			✓									✓
CSE 4207	✓	✓		✓								
CSE 4208	✓		✓									
CSE 4200							✓	✓	✓	✓	✓	✓
CSE 4209		✓			✓							
CSE 4210			✓	✓								
CSE 4211	✓	✓		✓								
CSE 4212	✓		✓	✓								
CSE 4213		✓			✓							
CSE 4214		✓			✓							

18. **Mapping Courses with the Complex Engineering Problem Solving and Complex Engineering Activities:**

Course Code	Complex Engineering Problem Solving							Complex Engineering Activities				
	WP1	WP2	WP3	WP4	WP5	WP6	WP7	EA1	EA2	EA3	EA4	EA5
CSE 1100												
EEE 1131												
EEE 1132												
MAT 1141												
PHY 1151												
PHY 1152												
CHE 1161												
ENG 0002												
CSE 1201												

Course Code	Complex Engineering Problem Solving							Complex Engineering Activities				
	WP1	WP2	WP3	WP4	WP5	WP6	WP7	EA1	EA2	EA3	EA4	EA5
CSE 1202												
CSE 1203												
EEE 1231												
EEE 1232												
MAT 1241												
BAN 0001												
ECO 1271												
CSE 2101												
CSE 2102												
CSE 2103												
CSE 2104	✓	✓	✓					✓		✓		
CSE 2105												
CSE 2106												
CSE 2107												
MAT 2141												
CSE 2201												
CSE 2202												
CSE 2203												
CSE 2204	✓	✓	✓					✓	✓			
CSE 2205												
CSE 2206												
CSE 2207												
CSE 2208	✓	✓	✓					✓	✓			
MAT 2241												
CSE 3101												
CSE 3102	✓	✓	✓					✓	✓			
CSE 3103												
CSE 3104	✓	✓	✓					✓	✓			
CSE 3105												
CSE 3106												
CSE 3107												

Course Code	Complex Engineering Problem Solving							Complex Engineering Activities				
	WP1	WP2	WP3	WP4	WP5	WP6	WP7	EA1	EA2	EA3	EA4	EA5
CSE 3122												
MAT 3141												
CSE 3201												
CSE 3203												
CSE 3204	✓	✓	✓					✓		✓		
CSE 3205												
CSE 3206												
CSE 3207												
CSE 3208												
CSE 3209												
CSE 3210	✓	✓	✓					✓		✓		
ACC 3271												
CSE 4101												
CSE 4102												
CSE 4103												
CSE 4104												
CSE 4105												
CSE 4100	✓	✓	✓									
CSE 4120												
CSE 4109												
CSE 4110												
CSE 4111												
CSE 4112												
CSE 4113												
CSE 4114	✓	✓	✓					✓		✓		
CSE 4201												
CSE 4202												
CSE 4203												
CSE 4204												
CSE 4205												
CSE 4206												

Course Code	Complex Engineering Problem Solving							Complex Engineering Activities				
	WP1	**WP2**	**WP3**	**WP4**	**WP5**	**WP6**	**WP7**	**EA1**	**EA2**	**EA3**	**EA4**	**EA5**
CSE 4207												
CSE 4208												
CSE 4200	✓	✓		✓				✓	✓			
CSE 4209												
CSE 4210												
CSE 4211												
CSE 4212												
CSE 4213												
CSE 4214												

CURRICULUM
(Effective from Spring 2026)

Part B

19. **Structure of the Curriculum**

a) Duration of the Program: **Years:** 4 Years **Semester:** 8

There will be two semesters/academic sessions in each academic year. They are as follows:

Name of the Semester	Duration
Spring	January to June
Summer	July to December

b) Admission Requirement:

i. Total GPA 5 with minimum 2.5 either in SSC or HSC/equivalent is required for admission in Honors Programs. But a student having a minimum GPA 2.00 in SSC/HSC/equivalent with total GPA 6.00 or above may apply.
ii. Minimum five subjects from O-Level and two subjects from A-Level are required for the admission of new students. Out of seven subjects, students must have obtained B-grade or GPA 4.00 in four subjects and C grade or GPA 3.50 in other three subjects respectively.
iii. Total GPA of 5.00 in both SSC and HSC Examinations for the children of the Freedom Fighter.
iv. All diploma holders from the Govt. and the UGC or related Council approved Institutions/Institutes will be considered as HSC/Equivalent, and they will have to take usual admission test for any existing programs of this University.

For Computer Science and Engineering

i. Candidate must obtain at least GPA 3.0 in each stage of SSC and HSC/equivalent public examinations.
ii. Candidate must pass HSC/Diploma/equivalent examination from science group.
iii. Candidate must obtain HSC/Diploma/equivalent examination with a minimum GPA 3.00 in Mathematics (in a scale of 5.00).

c) The bachelor degree program requires minimum 150 credits and is extended over a period of 4 years.

d) Each semester is of 26 weeks duration (out of 26 weeks, 14 weeks for theory/lab classes).

e) Minimum CGPA requirements for Graduation

All required credits of the programs should be earned within the maximum length of period.

i. Minimum CGPA should be 2.50 out of 4.00 are required to obtain B.Sc. Degree.
ii. Students having 'F' grade(s) in any course(s) will not be eligible for the degree.

f) Maximum academic years of completion

A student must complete the program within 7 (seven) academic years.

g) Category of courses:

i. Course Designation and Numbering System:

Each course is designated by a three-letter word identifying the department, which offers it following, by a four-digit number with the following criteria:

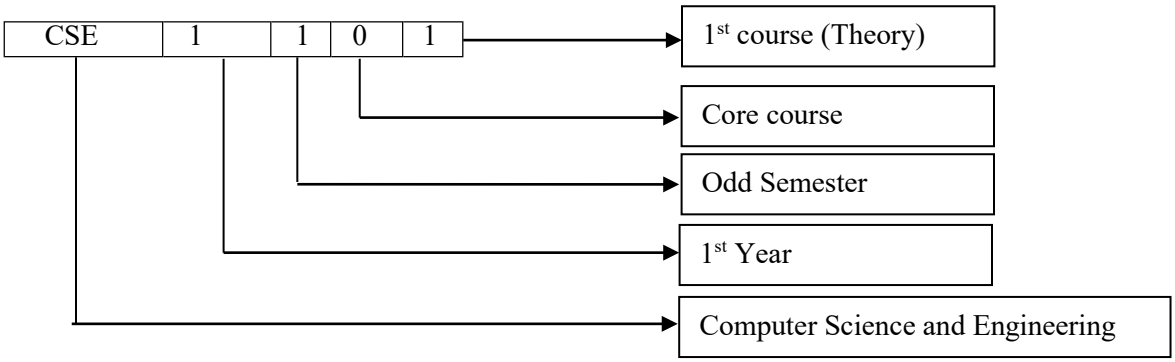
a) The 1st digit corresponds to the year in which the course is normally taken by the students.

b) The 2nd digit represents the semester (Odd/Even) in which the course is normally taken by the students.

c) The 3rd digit corresponds to the course category (Core courses, Mathematics, Humanities, etc.)

d) The 4th digit represents the course sequence. Odd sequence number corresponds to theory courses and even sequence number corresponds to lab courses.

The course designation system is illustrated by one example as shown below: **Course Code:** CSE 1101



ii. Distribution of Courses:

Course Type	Credits	% of Credits
Mathematics and Basic Sciences	21	14%
(a) Mathematics	12	
(b) Statistics	3	
(c) Physics	4	
(d) Chemistry	2	
Humanities	12	8%
(a) Economics	2	
(b) Accounting	2	
(c) English	3	
(d) Engineering Ethics and Environmental Protection	2	
(e) History of the Emergence of Bangladesh	3	
Basic and Major Engineering	117	78%
(a) Theoretical	84	56%
(b) Laboratory	33	22%
Total	**150**	**100.00%**

iii. Language Courses:

Course Code	Course Title	Credit	Credit Hours
ENG 0002	English Fundamentals	3.00	3.00
	Total	**3.00**	**3.00**

iv. General Education Courses:

Course Code	Course Title	Credit	Credit Hours
BAN 0001	History of the Emergence of Bangladesh	3.00	3.00
ECO 1271	Engineering Economics	2.00	2.00
ACC 3271	Industrial Management and Accountancy	2.00	2.00
CSE 4105	Engineering Ethics and Environmental Protection	2.00	2.00
	Total	**9.00**	**9.00**

v. Basic Science Courses:

Course Code	Course Title	Credit	Credit Hours
PHY 1151	Basic Physics	3.00	3.00
PHY 1152	Basic Physics Lab	1.00	2.00
CHE 1161	Chemistry	2.00	2.00
	Total	**6.00**	**7.00**

vi. Mathematics Courses:

Course Code	Course Title	Credit	Credit Hours
MAT 1141	Differential and Integral Calculus	3.00	3.00
MAT 1241	Coordinate Geometry and Vector Analysis	3.00	3.00
MAT 2141	Differential Equations	3.00	3.00
MAT 2241	Linear Algebra and Complex Variables	3.00	3.00
MAT 3141	Applied Statistics and Probability	3.00	3.00
	Total	**15.00**	**15.00**

vii. Core Courses:

Course Code	Course Title	Credit	Credit Hours
CSE 1100	Computer Fundamentals Lab	1.00	2.00
CSE 1201	Structured Programming Language	3.00	3.00
CSE 1202	Structured Programming Language Lab	1.50	3.00

Course Code	Course Title	Credit	Credit Hours
CSE 1203	Discrete Mathematics	3.00	3.00
CSE 2101	Object Oriented Programming	3.00	3.00
CSE 2102	Object Oriented Programming Lab	1.50	3.00
CSE 2103	Data Structures	3.00	3.00
CSE 2104	Data Structures Lab	1.50	3.00
CSE 2105	Digital System Design	3.00	3.00
CSE 2106	Digital System Design Lab	1.00	2.00
CSE 2107	Communication Engineering	3.00	3.00
CSE 2201	Object Oriented Design and Design Patterns	3.00	3.00
CSE 2202	Object Oriented Design and Design Patterns Lab	1.50	3.00
CSE 2203	Computer Algorithms	3.00	3.00
CSE 2204	Computer Algorithms Lab	1.50	3.00
CSE 2205	Numerical Methods	3.00	3.00
CSE 2206	Numerical Methods Lab	1.00	2.00
CSE 2207	Computer Networks	3.00	3.00
CSE 2208	Computer Networks Lab	1.00	2.00
CSE 3101	Computer Graphics	3.00	3.00
CSE 3102	Computer Graphics Lab	1.00	2.00
CSE 3103	Database Management System	3.00	3.00
CSE 3104	Database Management System Lab	1.50	3.00
CSE 3105	Computer Architecture	3.00	3.00
CSE 3106	Computer Architecture Lab	1.00	2.00
CSE 3107	Theory of Computation and Compiler Design	3.00	3.00
CSE 3201	Software Engineering and System Analysis	3.00	3.00
CSE 3203	Operating System and System Programming	3.00	3.00
CSE 3204	Operating System and System Programming Lab	1.00	2.00
CSE 3205	Microprocessor and Assembly Language	3.00	3.00
CSE 3206	Microprocessor and Assembly Language Lab	1.00	2.00
CSE 3207	Digital Signal Processing	3.00	3.00
CSE 3208	Digital Signal Processing Lab	1.00	2.00
CSE 3209	E-commerce and Web Programming	3.00	3.00
CSE 3210	E-commerce and Web Programming Lab	1.50	3.00
CSE 4101	Artificial Intelligence	3.00	3.00
CSE 4102	Artificial Intelligence Lab	1.00	2.00
CSE 4103	Digital Image Processing	3.00	3.00
CSE 4104	Digital Image Processing Lab	1.00	2.00
CSE 4201	Parallel Processing and Distributed System	3.00	3.00
CSE 4202	Parallel Processing and Distributed System Lab	1.00	2.00
CSE 4203	Cryptography and Network Security	3.00	3.00
CSE 4204	Cryptography and Network Security Lab	1.00	2.00
	Total	**92.50**	**116.00**

viii. Other's Engineering Courses:

Course Code	Course Title	Credit	Credit Hours
EEE 1131	Basic Electrical Circuits	3.00	3.00
EEE 1132	Basic Electrical Circuits Lab	1.00	2.00
EEE 1231	Electronic Devices and Circuits	3.00	3.00
EEE 1232	Electronic Devices and Circuits Lab	1.00	2.00
	Total	**8.00**	**10.00**

ix. Elective Courses:

Course Code	Course Title	Credit	Credit Hours
CSE 4109	Computer Vision and Pattern Recognition	3.00	3.00
CSE 4110	Computer Vision and Pattern Recognition Lab	1.00	2.00
CSE 4111	Mobile Apps and Game Development	3.00	3.00
CSE 4112	Mobile Apps and Game Development Lab	1.00	2.00
CSE 4113	Microcontroller, Computer Peripherals and Interfacing	3.00	3.00
CSE 4114	Microcontroller, Computer Peripherals and Interfacing Lab	1.00	2.00
CSE 4205	Robotics and Automation	3.00	3.00
CSE 4206	Robotics and Automation Lab	1.00	2.00
CSE 4207	Big Data Analysis	3.00	3.00
CSE 4208	Big Data Analysis Lab	1.00	2.00
CSE 4209	Cloud Computing and IOT	3.00	3.00
CSE 4210	Cloud Computing and IOT Lab	1.00	2.00
CSE 4211	Machine Learning	3.00	3.00
CSE 4212	Machine Learning Lab	1.00	2.00
CSE 4213	UI/UX Engineering	3.00	3.00
CSE 4214	UI/UX Engineering Lab	1.00	2.00
	Total	**32.00**	**40.00**

x. Capstone course/Internship/Thesis/Project/Portfolio (as applicable for the discipline/academic program):

Course Code	Course Title	Credit	Credit Hours
CSE 3122	Technical Report Writing	0.50	1.00
CSE 4100	Project or Thesis with Seminar Part I	2.00	2.00
CSE 4120	Industrial Attachment	1.00	2.00
CSE 4200	Project or Thesis with Seminar Part II	2.00	2.00
	Total	**5.50**	**10.00**

20. **Year and semester wise distribution of courses:**

1st Year Odd Semester

Course Code	Course Title	Marks		Total	Credit
		CA*	SA*		
CSE 1100	Computer Fundamentals Lab	50	50	100	1
EEE 1131	Basic Electrical Circuits	40	60	100	3
EEE 1132	Basic Electrical Circuits Lab	50	50	100	1
MAT 1141	Differential and Integral Calculus	40	60	100	3
PHY 1151	Basic Physics	40	60	100	3
PHY 1152	Basic Physics Lab	50	50	100	1
CHE 1161	Chemistry	40	60	100	2
ENG 0002	English Fundamentals	40	60	100	3
				Total	17

- **CA** = Continuous Assessment
- **SA** = Summative Assessment
- **Odd Semester** = First semester of every academic year
- **Even Semester** = Second semester of every academic year

1st Year Even Semester

Course Code	Course Title	Marks		Total	Credit
		CA	SA		
CSE 1201	Structured Programming Language	40	60	100	3
CSE 1202	Structured Programming Language Lab	50	50	100	1.5
CSE 1203	Discrete Mathematics	40	60	100	3
EEE 1231	Electronic Devices and Circuits	40	60	100	3
EEE 1232	Electronic Devices and Circuits Lab	50	50	100	1
MAT 1241	Coordinate Geometry and Vector Analysis	40	60	100	3
BAN 0001	History of the Emergence of Bangladesh	40	60	100	3
ECO 1271	Engineering Economics	40	60	100	2
				Total	19.5

2nd Year Odd Semester

Course Code	Course Title	Marks		Total	Credit
		CA	SA		
CSE 2101	Object Oriented Programming	40	60	100	3
CSE 2102	Object Oriented Programming Lab	50	50	100	1.5
CSE 2103	Data Structures	40	60	100	3
CSE 2104	Data Structures Lab	50	50	100	1.5
CSE 2105	Digital System Design	40	60	100	3
CSE 2106	Digital System Design Lab	50	50	100	1
CSE 2107	Communication Engineering	40	60	100	3
MAT 2141	Differential Equations	40	60	100	3
				Total	19

2nd Year Even Semester

Course Code	Course Title	Marks		Total	Credit
		CA	SA		
CSE 2201	Object Oriented Design and Design Patterns	40	60	100	3
CSE 2202	Object Oriented Design and Design Patterns Lab	50	50	100	1.5
CSE 2203	Computer Algorithms	40	60	100	3
CSE 2204	Computer Algorithms Lab	50	50	100	1.5
CSE 2205	Numerical Methods	40	60	100	3
CSE 2206	Numerical Methods Lab	50	50	100	1
CSE 2207	Computer Networks	40	60	100	3
CSE 2208	Computer Networks Lab	50	50	100	1
MAT 2241	Linear Algebra and Complex Variables	40	60	100	3
				Total	20

3rd Year Odd Semester

Course Code	Course Title	Marks		Total	Credit
		CA	SA		
CSE 3101	Computer Graphics	40	60	100	3
CSE 3102	Computer Graphics Lab	50	50	100	1
CSE 3103	Database Management System	40	60	100	3
CSE 3104	Database Management System Lab	50	50	100	1.5
CSE 3105	Computer Architecture	40	60	100	3
CSE 3106	Computer Architecture Lab	50	50	100	1
CSE 3107	Theory of Computation and Compiler Design	40	60	100	3
CSE 3122	Technical Report Writing	50	50	100	0.5
MAT 3141	Applied Statistics and Probability	40	60	100	3
				Total	19

3rd Year Even Semester

Course Code	Course Title	Marks		Total	Credit
		CA	SA		
CSE 3201	Software Engineering and System Analysis	40	60	100	3
CSE 3203	Operating System and System Programming	40	60	100	3
CSE 3204	Operating System and System Programming Lab	50	50	100	1
CSE 3205	Microprocessor and Assembly Language	40	60	100	3
CSE 3206	Microprocessor and Assembly Language Lab	50	50	100	1
CSE 3207	Digital Signal Processing	40	60	100	3
CSE 3208	Digital Signal Processing Lab	50	50	100	1
CSE 3209	E-commerce and Web Programming	40	60	100	2
CSE 3210	E-commerce and Web Programming Project Lab	50	50	100	1.5
ACC 3271	Industrial Management and Accountancy	40	60	100	2
				Total	20.5

4th Year Odd Semester

Course Code	Course Title	Marks		Total	Credit
		CA	SA		
CSE 4101	Artificial Intelligence	40	60	100	3
CSE 4102	Artificial Intelligence Lab	50	50	100	1
CSE 4103	Digital Image Processing	40	60	100	3
CSE 4104	Digital Image Processing Lab	50	50	100	1
CSE 4105	Engineering Ethics and Environmental Protection	40	60	100	2
Option I (T)	Theory: Should be selected from Table-I	40	60	100	3
Option I (L)	Lab: course based on Option-I (T)	50	50	100	1
CSE 4100	Project or Thesis with Seminar Part I	50	50	100	2
CSE 4120	Industrial Attachment	50	50	100	1
				Total	17

Table-I: Option - I

Course Code	Course Title	Marks	Credit
CSE 4109	Computer Vision and Pattern Recognition	100	3
CSE 4110	Computer Vision and Pattern Recognition Lab	100	1
CSE 4111	Mobile Apps and Game Development	100	3
CSE 4112	Mobile Apps and Game Development Lab	100	1
CSE 4113	Microcontroller, Computer Peripherals and Interfacing	100	3
CSE 4114	Microcontroller, Computer Peripherals and Interfacing Lab	100	1

4th Year Even Semester

Course Code	Course Title	Marks		Total	Credit
		CA	SA		
CSE 4201	Parallel Processing and Distributed System	40	60	100	3
CSE 4202	Parallel Processing and Distributed System Lab	50	50	100	1
CSE 4203	Cryptography and Network Security	40	60	100	3
CSE 4204	Cryptography and Network Security Lab	50	50	100	1
Option II (T)	Theory: Should be selected from Table-II	40	60	100	3
Option II (L)	Lab course based on Option-II (T)	50	50	100	1
Option II (T)	Theory: Should be selected from Table-II	40	60	100	3
Option II (L)	Lab course based on Option-II (T)	50	50	100	1
CSE 4200	Project or Thesis with Seminar Part II	50	50	100	2
				Total	18

Table-II: Option - II

Course Code	Course Title	Marks	Credit
CSE 4205	Robotics and Automation	100	3
CSE 4206	Robotics and Automation Lab	100	1
CSE 4207	Big Data Analysis	100	3
CSE 4208	Big Data Analysis Lab	100	1
CSE 4209	Cloud Computing and IOT	100	3
CSE 4210	Cloud Computing and IOT Lab	100	1
CSE 4211	Machine Learning	100	3
CSE 4212	Machine Learning Lab	100	1
CSE 4213	UI/UX Engineering	100	3
CSE 4214	UI/UX Engineering Lab	100	1

CURRICULUM
(Effective from Spring 2026)

Part C

1st year
(Odd Semester)

Course Code: CSE 1100	**Course Title:** Computer Fundamentals Lab	
Course Type: Lab	**Credit Hour: 2**	**Total Marks:** 100
Pre-requisite: None		

Rationale: This course aims to equip students with practical skills in operating computer systems, managing hardware and software troubleshooting, and utilizing essential applications such as MS Office, modern communication tools, and cloud platforms. Additionally, it introduces the basics of programming through algorithms, flowcharts, and C programming to develop foundational coding skills and problem-solving abilities

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Apply the Office Applications Tools, Documents/Spreadsheet processing.	Cognitive/ Apply	5	2			Hands-on	Lab Test
CO2	Describe and interpret hardware components and their functionalities,	Cognitive/ Understand	1	1			Hands-on/ Lecture	Presentation
CO3	Apply basic concepts of data types and variables of C programming to write simple programs	Cognitive/ Apply	1	1			Hands-on/ Lecture	Lab Test

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1					√							
CO2	√											
CO3	√											

Course Content	Duration (Weeks)	COs
Introduction to Computer Systems	1	1
Interacting with Operating Systems and the Internet	1	
Introduction to MS Word and it's features	2	2
Introduction to MS Power points and it's features	2	3
Introduction to MS Excel and it's features	2	
Modern Tools for Collaboration and Productivity	1	
Introduction to Programming Concepts. Setting Up an IDE	2	4
Data Types and Variables in C, Writing Basic C Programs	2	4
Final Lab Test	1	

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Lab Participation	10%	50%
	Continuous Assessment (Experiment, Report, Viva)	40%	
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva)		50%
	Total	**100%**	

Recommended Books:

1. Dr. Mohammad Lutfor Rahman , Dr. M. Alamgir Hossain : **Computer Fundamentals,** *Systech Publications Ltd.*
2. P.K. Sinha and Priti Sinha : **Computer Fundamentals,** *BPB Publications (India*)

Course Code: EEE 1131	**Course Title:** Basic Electrical Circuits	
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: None		

Rationale: This course focuses on basic electrical circuit analysis including direct current and alternating current. Basic concept of measuring unit, voltage, current, resistance and power. Laws of electrical circuits and methods of network analysis; Network theorem, KCL, KVL superposition theorem, Thevenin's theorem, Norton theorem, Max Power transfer theorem Introduction to magnetic circuits, instantaneous and r.m.s. current, voltage and power, average power for various combinations of R, L and C circuits, phasor representation of sinusoidal quantities which will make strong background to analysis and solve electrical circuits.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Discuss different components of electrical circuits.	Cognitive/ Understand	1	1			Lecture, Practice and Discussion	Class Test, Assignment
CO2	Apply various network theorems for circuit analysis.	Cognitive/ Apply	2	3			Lecture, Practice and Discussion	Class Test, Midterm Exam
CO3	Analyze the characteristics of different combinations of R, L and C circuits.	Cognitive/ Analyze	1	3			Lecture, Practice and Discussion	Assignment, Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3	√											

Course Content	Duration (Weeks)	COs
Fundamental electrical concepts and measuring units. Direct current: voltage, current, resistance and power. Laws of electrical circuits and methods of network analysis; Network theorem, KCL, KVL superposition theorem, Thevenin's theorem, Norton theorem, Max Power transfer theorem Introduction to magnetic circuits.	8	1,2
Alternating current: instantaneous and r.m.s. current, voltage and power, average power for various combinations of R, L and C circuits, phasor representation of sinusoidal quantities.	6	3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Robert L. Boylestad: : **Introductory Circuit Analysis [Text Book],** *Prentice Hall*
2. Charles K. Alexander, Matthew N.O. Sadiku: : **Fundamentals of Electric Circuits,** *McGraw Hill Education*
3. Richard C. Dorf, James,A. Svoboda: : **Introduction to Electric Circuits,** *Wiley*
4. L. Theraja, A.K. Theraja: : **A Text Book of Electrical Technology,** *S. Chand Limited*

Course Code: EEE 1132	**Course Title:** Basic Electrical Circuits Lab	
Course Type: Lab	**Credit Hour:** 2.0	**Total Marks:** 100
Pre-requisite: None		

Rationale: This course provides the hand in experiences on basic electrical circuit design and testing of DC network theorem, such as KCL, KVL, superposition theorem, Thevenin's theorem, Norton theorem, Max Power transfer theorem and RLC circuit for determining resonance frequency. After doing this course student will be able to start learning basic electronic circuit design.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Operate different types of instruments for circuit analysis.	Psychomotor/ Practice	4	3				
CO2	Demonstrate the analysis of network theorems.	Psychomotor/ Precision	2	2				
CO3	Examine the characteristics of RLC circuits.	Affective/ Responding	4	8				

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1				√								
CO2		√										
CO3				√								

Course Content	Duration (Weeks)	COs
Verification of Kirchoff's law (Current) Verification of Kirchoff's law (Voltage) Verification of Superposition theorem. Verification of Thevenin's theorem. Verification of Maximum Power transfer theorem.	12	1,2
Verification of resonance of a series RLC circuit.	2	3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. Robert L. Boylestad: : **Introductory Circuit Analysis [Text Book],** *Prentice Hall*
2. Charles K. Alexander, Matthew N.O. Sadiku: : **Fundamentals of Electric Circuits,** *McGraw Hill Education*
3. Richard C. Dorf, James,A. Svoboda: : **Introduction to Electric Circuits,** *Wiley*
4. L. Theraja, A.K. Theraja: : **A Text Book of Electrical Technology,** *S. Chand Limited*

Course Code: MAT 1141	**Course Title:** Differential and Integral Calculus	
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: None		

Rationale: This course is designed to progress the topics of differential and integral calculus for students with a view to familiarizing with functions, limits, continuity, ordinary derivatives, and expansions of functions, maxima- minima of function of one variable, partial derivatives, infinite integrals, definite integrals and multiple integrals. Upon completion, students should be able to select and use appropriate techniques for finding solutions through differentiation and integration related problems in computer science such as data mining, scientific computing, image processing, and creating the graphics and video games, including the 3D visuals for simulations.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Describe the concept of functions or limits or continuity	Cognitive/ Understand	1	1			Lecture, Practice and Discussion	Class Test, Midterm Exam
CO2	Solve problem of derivatives	Cognitive/ Analyze	2	1			Lecture, Practice and Discussion	Class Test, Midterm Exam
CO3	Assess indefinite or definite integral	Cognitive/ Evaluate	4	8			Lecture, Practice and Discussion	Assignment, Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3				√								

Course Content	Duration (Weeks)	COs
Functions: Domain, Range, Inverse function and graphs of functions, Composition of function, Limits, Continuity, Indeterminate form, asymptotes.	4	1
Ordinary Differentiation: Differentiability, Differentiation, Successive differentiation, and Leibnitz theorem. **Expansions of functions**: Rolle's Theorem, Mean value theorem, Taylor's and Maclaurin's formulae, Power series. **Maximum and minimum of functions of one variable.** **Partial Differentiation**: Partial differentiation, successive partial differentiations, differentiation of implicit functions, total differential coefficient, exact differential, Euler's theorem **Tangents and normal:** Equation of tangents, equation of normal, angle of intersection of two curves, subtangent and subnormal.	6	2
Indefinite Integrals: Method of substitution, Integration by parts, Special trigonometric functions and rational fractions. **Definite Integrals:** Fundamental theorem, General properties, Evaluations of definite integrals and reduction formulas. **Multiple Integrals:** Determination of lengths, Areas and Volumes.	4	3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Frank Ayres, Jr. and Elliott Mendelson : **Calculus,** *Schum's outline, 6th Edition, McGraw-Hill [Text Book]*
2. B. C. Das and B.N. Mukherjee : **Differential Calculus,** *U.N. Dhur and Sons and Pvt. Ltd., 51th Edition, India, 2009*
3. B. C. Das and B.N. Mukherjee : **Integral calculus including differential equations**. *U.N. Dhur and Sons and Pvt. Ltd., 54th Edition, India, 2008*
4. Joseph Edwards : **Differential Calculus,** *Kessinger Publishing*
5. Md. Abdul Latif and S.Bhattacharjee : **Differential Calculus**, *Chandaapure, Chittagong*
6. E. W. Swokowshi, M. Olinick and D, Pence : **Calculus of Several Variables,** *PWS Publishing Company, India, 1995*
7. H. Anton, I. C. Bivens and S. Davis. : **Calculus Late Transcendentals**, *John Willey and Sons Inc., 10th Edition, US, 2012*

Course Code: PHY 1151	**Course Title:** Basic Physics
Course Type: Theory	**Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: None	

Rationale: Studying physics strengthens quantitative reasoning and problem-solving skills that are valuable in Computer Science and Engineering. This course focuses on basic studies in electrostatic and steady electric current, magnetic field and its interaction, electromagnetic induction, waves, interference, diffraction and polarization of light. Physics and engineering physics are great preparation for almost any career, because they teach students how to analyze complex problems and they give students a strong quantitative background that can be applied in any technical field.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Describe the conception electrostatics, magnetism, and electromagnetic induction	Cognitive/ Understand	1	1			Lecture, Practice and Discussion	Class Test, Assignment
CO2	Explain wave related different phenomenon	Cognitive/ Understand	1	1			Lecture, Practice and Discussion	Class Test, Midterm Exam
CO3	Apply different laws electric and magnetic fields	Cognitive/ Apply	1	2			Lecture, Practice and Discussion	Assignment, Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2	√											
CO3	√											

Course Content	Duration (Weeks)	COs
Columb's law, Gauss's Law and its application; Electric field in dielectric media, Energy in an electrostatic field, Electrostatic force, Electromotive force. Magnetic induction, Magnetic force on a charge, Lorenz force, Magnetic field of a current, Torque on a current Loop, Moving coil galvanometer, Biot-Savart law and its applications, Ampere's law, Hall effect. Faraday's induction law, Lenz's law, induced current and voltage, Self-inductance and mutual inductance, Inductor, Ideal transformer, Energy stored in a magnetic field.	8	1,3

Types of waves, Equation of Waves, Velocity and Energy, Complex waves, Standing waves, Resonance, Beats, Sound waves, the Doppler Effect. Huygen's principle, Interference phenomena, Young's experiment, Michaelson interferometer, Interference involving multiple reflections, Newton's ring, Holography. Fraunhoffer and Fresnel diffraction, Diffraction by single slit; Diffraction gratings and its resolving power, Polarization of light	6	2

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Halliday, Resnick and Walker **:** **Fundamentals of Physics. [Text Book],** *Wiley*
2. Dr. Giasuddin Ahmad, Hafiz **:** **Physics for Engineers, Part-1 & Part-2 (4th Edition),** *Hafiz Book Centre*
3. N. Subrahmanyam Brij Lal, M.N. Avadhanulu **:** **A Text Book of Optics,** *S. Chand Limited*
4. Feyman, Leighton, Sands **:** **The Feymman Lecture on Physics,** *Addison–Wesley*

Course Code: PHY 1152 **Course Title:** Basic Physics Lab
Course Type: Lab **Credit Hour:** 2.0 **Total Marks:** 100
Pre-requisite: None

Rationale: This course explains the very fundamental requirements for scientific experiments, e.g., use of graph papers (Linear–linear, Linear-log and Log-log), error calculations and use of different electronic equipment's like Multi-meter, Oscilloscope and Signal Generator etc.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Demonstration of the experiment on electrostatic and magnetism.	Psychomotor/ Manipulates	1	1			Lecture and Demonstration	Lab Test, Lab Report
CO2	Demonstration of the experiment on electromagnetic induction wave	Psychomotor/ Precision	1	2			Lecture and Demonstration	Quiz, Lab Report

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO3	Demonstration of the experiment on optics.	Psychomotor/ Precision	2	2			Lecture and Demonstration	Quiz, Lab Report

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2	√											
CO3		√										

Course Content	Duration (Weeks)	COs
Measurement of Coulombs force between charges.	2	1
Verification of Biot-savart law for straight and circular wire.	2	1
Verification of Faraday's law of electromagnetic induction.	3	2
Measurement of the frequency, wavelength, and speed of standing waves on a string	2	2
Use of Michelson interferometer to measure the wavelength of a HeNe laser and to measure the refractive index of air and investigate its dependence on pressure.	3	3
Franhoffer single slit diffraction.	2	3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. Halliday, Resnick and Walker : **Fundamentals of Physics. [Text Book],** *Wiley*
2. Dr. Giasuddin Ahmad, Hafiz : **Physics for Engineers, Part-1 & Part-2 (4th Edition),** *Hafiz Book Centre*
3. N. Subrahmanyam Brij Lal, M.N. Avadhanulu : **A Text Book of Optics,** *S. Chand Limited*
4. Feyman, Leighton, Sands : **The Feymman Lecture on Physics,** *Addison–Wesley*

Course Code: CHE 1161 **Course Title:** Chemistry
Course Type: Theory **Credit Hour:** 2.0 **Total Marks:** 100
Pre-requisite: None

Rationale: This course introduces the basic concepts of chemical bond and solutions. The covered topics also include Phase rule and phase diagram of mono-component system, Electro-chemistry, Chemical kinetics and chemical equilibrium.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Explain the structure, bonding, properties and reactions of organic and inorganic molecules	Cognitive/ Understand	1	1			Lecture, Practice and Discussion	Class Test, Midterm Exam
CO2	Describe the characteristics of different types of liquid systems.	Cognitive/ Understand	1	1			Lecture, Practice and Discussion	Class Test, Final Exam
CO3	Interpret the kinetics and mechanism of chemical interactions.	Cognitive/ Analyze	2	1			Lecture, Practice and Discussion	Assignment, Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2	√											
CO3		√										

Course Content	Duration (Weeks)	COs
Chemical Bond: Different types of chemical bonds, Properties of Ionic and Covalent Compound, and Modern Approaches of Covalent Bond.	2	1
Solution: Types of Solution, Factors Influencing the Solubility of Substance. Mechanism of Dissolution; Solution of Gases in Liquids, Different Units of Concentration, Distribution Law and its Application; Properties of Dilute Solution, Raoult's Law - its Application, Elevation of Boiling Point, Depression of Freezing Point and Osmotic Pressure.	4	2
Materials Chemistry: Semiconductors: Doping, band gap theory, and applications in microchips. Polymers: Conducting polymers, optical fibers and biodegradable materials.	2	2
Electro-chemistry: Electrolytes, Mechanism of Electrolytic Conduction, Transport Number and Electrolytic Conductance, Cell EMF.	2	2, 3
Chemical kinetics and chemical equilibrium: Rate of a Reaction, Factors Determining the Rate, Law of Mass Action, Evaluation and Characteristics of Equilibrium Constant of Reaction; The Lechatclier's Principle.	4	3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Bahl, B. S., & Tuli, G.D. (1960). : **Essentials of Physical Chemistry**. *S Chand And Co.; Delhi; Jullundur; Lucknow.* **[Text Book]**
2. Huque, M. &Auni, A.(2018) : **Advanced Physical Chemistry**. *Venus Prokashoni, Bangla Bazar, Dhaka.*
3. Madan, R. D.(2006) : **Modern Inorganic Chemistry**. *S Chand & Co.; Delhi.*
4. Cotton, A. F., Wilkinson, G., Bochmann, M., & Murillo, C. A. (1999) : **Advanced Inorganic Chemistry**. *Wiley.*

Course Code: ENG 0002 **Course Title:** English Fundamentals
Course Type: Theory **Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: None

Rationale: This course covers the basics of the English language, aiming at improving the linguistic, sociolinguistic, discourse and strategic competence of the students. The course is designed to strengthen students' basic communication skills, including grammar, spelling, punctuation, and sentence construction. Emphasis is placed on increasing students' ability to read textbooks written in English, improving the writing of well-structured paragraphs and short essays, and developing students' verbal communication skill. The primary objective of this course is to enable students to understand English in the academic context, read texts written in simple English, give presentations fluently in English on any given topic, and develop their writing abilities which will help them to express their views and ideas clearly as well as logically. It will also familiarize students with common conversational and formal spoken English.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Construct grammatical knowledge in applicative activities	Cognitive/ Understand	10				Discussion, Text Book, Lecture	Class Test
CO2	Illustrate the reasoning and deduction skills from analyzing passages	Cognitive/ Apply	10				Discussion, Text Book, Lecture	Presentation, Midterm Examination

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO3	Demonstrate basic and formal communication skills in virtual situations	Cognitive/ Apply	12				Discussion, Text Book, Lecture	Presentation, Final Examination

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1										√		
CO2										√		
CO3												√

Course Content	Duration (Weeks)	COs
Parts of speech, Types of phrases, Types of clauses and sentences, Verb and Phrasal verb, Preposition and Conjunction	1	1
Transitional words and Phrases, Subject-verb agreement, Tense, Voice	1	1
Making Question (wh question, yes/no question, tag question, embedded question)	1	1
Reading Comprehension (reading for gist and detail, reference and inference, finding factual information, finding author's purpose) and High frequency academic vocabulary	2	2
Paragraph writing Techniques, Essay writing Techniques	2	2
Resume Writing, Cover Letter Preparation, Email Writing	2	3
Précis Writing, Report Writing	2	3
Common spoken discourse in formal and informal context	2	3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Houghton Mifflin : **English Grammar and Composition,** *Houghton Mifflin.*
2. Murphy, R. : **English Grammar in Use Book** (5th ed.), *Cambridge University Press*
3. Jahurul Islam : **ABC of English Grammar,** *Aligarh Library 2009.*
4. Wren and Martin : **English Grammar and Composition**. *S. Chand*
5. Jahurul Islam : **A Handbook of Paragraph Writing,** *Aligarh Library 2009.*

1st year
(Even Semester)

Course Code: CSE 1201	**Course Title:** Structured Programming Language
Course Type: Theory	**Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: None	

Rationale: This is an introductory course, and the aim of this course is to provide the complete knowledge about C programming. Topics include the basic structures of C program, basic I/O functions, identifiers and keywords, simple data types, variables, constants, operators, bitwise operators, comments, decision making statements with if- else and switch, looping structures with for, while, do-while, array, structures, union, pointes, strings, dynamic allocation, static, global, external and registrar, user defined data types, user defined function, function types, parameters, prototypes, recursive function, file handling, character and file I/O, basics of simple file I/O, ANSI Standard Libraries, pre-processor and uses of graphics functions. After completion of this course students will able to analyze, design and implement programs to solve mathematical and analytical problem.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Understand and apply the fundamentals of C programming.	Cognitive/ Apply	1	4			Lecture/ Slides	Midterm Exam
CO2	Apply decision-making and iterative statements in C programming to solve well-defined problems.	Cognitive/ Apply	2	4			Lecture/ Slides	Assignment
CO3	Develop C programs using modular programming principles to solve structured problems efficiently.	Cognitive/ Create	3	5			Lecture/ Slides	Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3			√									

Course Content	Duration (Weeks)	COs
Basic Overview of Computer Programming Languages, Structure of A C Program, Basic Concepts of Compiler, Interpreter, Algorithm and Flowchart.	1	1
C Tokens, Variables, Operators, Expressions and Data Types.	1	1
Decision Making: Simple If, If-Else, Nested If-Else, Else-If Ladder, Switch Case,	2	2
For Loop, While, Do-While Loop, Infinite Loop	3	2
Array, String, Enum and Pointers	2	2

Course Content	Duration (Weeks)	COs
User-Defined Function, Return Type, Parameter, Call by Value and Call by Reference	2	3
Structure, Union, File and Dynamic Memory Allocation	3	3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. H. Schildt : **Teach yourself C,** *McGraw-Hill Publishers* **[Text Book]**
2. E. Balagurusamy : **Programming with ANSI C**, Tata McGraw Hill
3. Gotfreid : **Programming with C**, Schaum's Outline Series, Tata McGraw Hill
4. D.E. Knuth : **The Art of Computer Programming**, Addison-Wesley Professional
5. Kernighan and Ritchie : **The C Programming Language**, Prentice Hall

Course Code: CSE 1202 **Course Title:** Structured Programming Language Lab
Course Type: Lab **Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: None

Rationale: To provide the fundamental of C language to write a program to solve mathematical and logical problems. The lab exercises are designed to introduce the ability of the students to design, write and implement programs and enhance their analyzing and problem-solving skills.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Solve simple programming problems leading to specific applications.	Cognitive/ Apply	1	4			Hands-on	Lab Test
CO2	Apply modular programming principles to develop structured C programs.	Cognitive/ Create	3	5			Hands-on	Lab Report
CO3	Evaluate mathematical	Cognitive –	2	4			Hands-on	Lab Test

	operations using arrays in C programming	Apply						

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2			√									
CO3		√										

Course Contents	Duration (Weeks)	COs
Simple Programs in C.	1	1
Variable, operators, data types	1	1
Simple if, if-else, nested if-else, else-if ladder, Switch-case, nested switch-case.	2	1
For loop, while loop, do-while loop, Nested for loop	3	1
Functions: call by value, call by reference. Recursive function.	2	2
One dimensional array, two-dimensional array	2	3
String, Structure, union, pointer. File Handling	3	2, 3

COs	Teaching-Learning strategy	Assessment strategy
CO1	Lab Manual, Hands on Practice	Continuous Assessment, Lab Test, Quiz
CO2	Lab Manual, Hands on Practice	Continuous Assessment, Lab Test, Quiz
CO3	Lab Manual, Hands on Practice	Final Lab Test, Quiz
CO4	Lab Manual, Hands on Practice	Final Lab Test, Quiz

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1 H. Schildt : **Teach yourself C,** *McGraw-Hill Publishers* **[Text Book]**
2 E. Balagurusamy : **Programming with ANSI C**, Tata McGraw Hill
3 Gotfreid : **Programming with C**, Schaum's Outline Series, Tata McGraw Hill
4 D.E. Knuth : **The Art of Computer Programming**, Addison-Wesley Professional
5 Kernighan and Ritchie : **The C Programming Language**, Prentice Hall

Course Code: CSE 1203	**Course Title:** Discrete Mathematics
Course Type: Theory	**Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: None	

Rationale: This course will introduce students with basic elements of Discrete Mathematics which provide a foundation for an understanding of algorithms and data structures used in computing. Topics include propositional Logics, Mathematical Reasoning and Proof, Set Theory, Functions, Relations, Combinatorics, Probabilities and Graph Theory. This course is designed to provide students with a basic understanding of logic, mathematical reasoning skills, and the ability to apply these skills in problem-solving.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Demonstrate the ability to use mathematical logic to solve problem.	Cognitive/ Apply	1	2			Discussion, Text Book, Practice and Lecture	Class Test
CO2	Demonstrate the ability to use a problem-solving approach in applying counting techniques to determine probabilities.	Cognitive/ Apply	2	2			Discussion, Text Book, Practice and Lecture	Midterm Exam
CO3	Demonstrate the ability to use a problem-solving approach to model practical problems using graphs	Cognitive/ Apply	2	3			Discussion, Text Book, Practice and Lecture	Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3		√										

Course Content	Duration (Weeks)	COs
Introduction: Logic and Proofs, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Sets and Set Operations, Mathematical Inductions, Functions, Relation and it's properties.	4	1
Counting: Basic Counting Principles, Inclusion- Exclusion Principle, Permutations and Combinations, Sequences, Binomial Theorem, Fibonacci, and Pascal's triangle. Probability: Probability of an event, Complement of an event, Conditional Probabilities, Bayes' Theorem, and its application.	5	2

Graph: Introduction to graph, graph terminology, representing graph and graph isomorphism, paths, reach ability, connectivity, Euler and Hamilton path, shortest path problems, graph coloring, memory representation of graph.	3	3
Trees: Introduction of trees, application of trees, tree traversal, labeling trees, spanning trees, minimal spanning tree.	2	3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Kenneth H. Rosen : **Discrete Mathematics and Its Applications**, ***McGraw-Hill*.** [Text Book]
2. J. P. Tremblay and R. Manohar : **Discrete Mathematics structures with applications to Computer Science**, *Mc-Graw Hill*
3. C.L. Liu : **Elements of Discrete Mathematics**, *McGraw-Hill*.
4. Seymour Lipschutz : **Theory and Problems of Discrete Mathematics, Schaum's Outline Series**, *McGraw-Hill*
5. Bernard Kolman, Robert Busby, Sharon C. Ross : **Discrete Mathematical Structures**, *Prentice Hall*

Course Code: EEE 1231 **Course Title:** Electronic Devices and Circuits
Course Type: Theory **Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: PHY-1151, EEE-1131

Rationale: This course familiarizes the basic concepts of semiconductor physics and the applied fields of it. It introduces the PN Junction diode, transistors, field effect transistors, Operational amplifier, and switching circuits. This course will help the students to understand the basics of electronics and application of electronic circuits operations. After learning this course, they will be able to start digital logic circuits.
Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Describe the basic semiconductor devices and their characteristics.	Cognitive/ Understand	1	4			Lecture/ Slides	Mid-Term
CO2	Demonstrate the operational principles and applications of Transistors	Cognitive/ Apply	1	3			Lecture/ Slides	Final
CO3	Implement various circuits using operational amplifiers	Cognitive/	3	5			Lecture/ Slides	Class Test

		Apply						

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2	√											
CO3			√									

Course Content	Duration	COs
Introduction to semiconductors, p-type and n-type semiconductors; p-n junction diode characteristics; Diode applications: half and full wave rectifiers, clipping and clamping circuits, regulated power supply using Zener diode.	4	1
Introduction to semiconductors, p-type and n-type semiconductors; p-n junction diode characteristics; Diode applications: half and full wave rectifiers, clipping and clamping circuits, regulated power supply using Zener diode.	4	2
Field Effect Transistor: principle of operation of JFET and MOSFET; Depletion and enhancement type NMOS and PMOS; biasing of FETs; Low and high frequency models of FETs, switching circuits using FETs; CMOS.	3	3
Operational Amplifiers: linear applications of OPAMPs, gain, input and output impedances, active filters, frequency response and noise. Introduction to feedback, Oscillators, Silicon Controlled Rectifiers (SCR), TRIAC, DIAC and UJT: characteristics and applications; Introduction to IC fabrication processes.	3	4

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Robert L. Boylestad: : **Electronic Devices and Circuit Theory**, *Pearson* **[Text Book]**
2. Mehta, Rohit, V K Mehta : **Principles of Electronics**, *S. Chad Publications*
3. Sedra / Smith : **Microelectronics Circuits**, *Oxford University Press*
4. A. Mottershead : **ElectronicDevicesandCircuits**,*Prentice-HallofIndiaPvt. Limited, 1973.*

Course Code: EEE 1232	**Course Title:** Electronic Devices and Circuits Lab
Course Type: Lab	**Credit Hour:** 2.0 **Total Marks:** 100
Pre-requisite: PHY-1152, EEE-1132	

Rationale: To provide hand-on experience in implementing basic Electronic Circuits. The laboratory exercises are designed to give students ability to design, understand, and implement electronic circuits using semiconductor devices. Laboratory assignments progress from investigation of the properties of PN junction diodes and transistors and the design of clipper clampers and transistor circuits.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Observe the characteristics of semiconductor diodes	Psychomotor/ Perception	1	3			Hands-on	Lab Final
CO2	Design rectifier circuits using semiconductor devices	Psychomotor/ organization	3	5			Hands-on	Assessment

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2			√									

Course Contents	Duration (Weeks)	COs
VI- Characteristics of PN junction and Transistors	3	1
Design of rectifier circuits and voltage regulation Half wave (AC to DC conversion) with efficiency Full wave (AC to DC Conversion) With efficiency Implementation of Zener Diode for voltage/load current regulation	5	2
Design Clipper and clamper circuits and Amplifier Circuits Wave shape change usingdiodes Signal amplification using single stage BJT	6	2,3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. Robert L. Boylestad: : **Electronic Devices and Circuit Theory**, *Pearson*
2. Mehta, Rohit, V K Mehta : **Principles of Electronics**, *S. Chad Publications*
3. Sedra / Smith : **Microelectronics Circuits**, *Oxford University Press*
4. A. Mottershead : **Electronic Devices and Circuits**, *Prentice-HallofIndiaPvt. Limited, 1973.*

Course Code: MAT 1241	**Course Title:** Coordinate Geometry and Vector Analysis
Course Type: Theory	**Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: MAT 1141	

Rationale: An elementary course in coordinating geometry & vector analysis designed to prepare students for solving engineering problems. It is needed to connect algebra and geometry with the use of graphs of lines and curves. It is an essential branch of math and usually assists us in locating points in a plane. Moreover, it also has many uses in fields of trigonometry, dimensional geometry, graphics and image processing etc.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Describe the coordinate system or straight lines	Cognitive/ Understand	1	1			Lecture, Practice and Discussion	Class Test, Midterm Exam
CO2	Illustrate the problems with the system of circles or vectors.	Cognitive/ Analyze	1	1			Lecture, Practice and Discussion	Class Test, Final Exam
CO3	Apply the various theorems of calculus vector.	Cognitive/ Apply	1	2			Lecture, Practice and Discussion	Assignment, Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2	√											
CO3	√											

Course Content	Duration (Weeks)	COs
Co-ordinate Geometry: Co-ordinates, Polar co-ordinates, the straight line, Change of axes, Pair of straight lines, Circles, system of circles, Parabola, Ellipse, and Hyperbola.	4	1

Course Content	Duration (Weeks)	COs
Co-ordinate geometry of three dimensions: System of co-ordinates, transformation of co-ordinates, distance between two points, section formula, projection, direction cosines, equations of planes and lines.	6	1,2
Vector Analysis: Vector algebra; scalar and vector product; Scalar and vector fields, Application of vectors in geometry, Calculus of vector valued function, Differentiation of vectors, Gradient, Divergence and curl of a vectors and their physical significance, Directional derivatives, vector Integration, Green's theorem, Stocke's theorem, Divergence theorem with example.	4	2,3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1 Henry Burchard Fine and Henry, Dallas Thompson : **Coordinate Geometry***, Macmillan Company, New York*. **[Text Book]**

2 M. R. Spiegel,S.Lipschutz: and D.Spellman : **Vector Analysis and An Introduction to Tensor Analysis**, *McGraw-Hill* **[Text Book]**

3 R. J. T.Bell: : **An Elementary Treatise on Coordinate Geometry of Three Dimension**. *Macmillan Publishers India Limited, 2000*

4 L. S.Loney : **The Elements of Coordinate Geometry**, *Macmillan Company, New York.*

Course Code: BAN 0001	**Course Title: :** History of the Emergence of Bangladesh
Course Type: Theory	**Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: None	

Rationale: This course intends to give an understanding to the students about historical roots of Bangladesh as an independent state. Course will explore in great depth political, social cultural vicissitude which led to the manifestation of provincial autonomy and finally to independence. The Course will help students to know the various development and the heroic efforts of the political and student leaders preceding independence and finally on the valiant efforts of the Freedom Fighters of the Liberation War of 1971. At the end of the course, students will be able to understand the inner significance of the emergence of Bangladesh as a nation. Thus, this course will allow the students to appreciate the significance of the birth of Bangladesh and make them patriotic nationals.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Develop their understanding about the history of Bangladesh;	Cognitive/ Remember	4	8			Lecture, Practice and Discussion	Class Test, Midterm Exam
CO2	Research on the history of liberation war.	Cognitive/ Understand	8	7			Lecture, Practice and Discussion	Class Test, Final Exam
CO3	Compare between the expectation and achievement of our liberation	Cognitive/ Apply	12				Lecture, Practice and Discussion	Assignment, Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1				√								
CO2								√				
CO3												√

Course Content	Duration (Weeks)	COs
Partition of India in 1947 Lahore conference; United Bangla plan; Two nation theory; Creation of Pakistan and India; Displacement crisis.	1	1,3
Language Movement of 1952 Primary discussion on Bangla and Urdhu language; early stage of movement; Agitation of 1948, 21 February of 1952; Constitutional status of Bangla language. Disparity Between Two Wings of Pakistan Economic disparity; Administrative disparity; Political disparity.	2	1,2
Military Rule of Ayub Khan and Six Point Movement. Commander-in-Chief of the Pakistan Army; President of the Pakistan; Constitutional and legal reforms; Background of Six-point movement; Six-point movement; Result of six point movement. Mass Upsurge of 1969 and Yahiya Khan, General Election of 1970 Shorbodolio Chatro Shongram Porishad (All Party Student Action Committee); Democratic Action Committee. Withdrawal of Agartala conspiracy case; Election campaign in East Pakistan, Political condition of west Pakistan.	3	1,3
Result of the election and aftermath condition of election.	1	1,3
Historic Speech of 7 March, Non-cooperation Movement. Genocide of 25 March, Declaration of Independence and Proclamation of Independence.	2	1

Course Content	Duration (Weeks)	COs
Mujibnagar Government. Contribution of different countries to independence, 14th December Tragedy, 16th December Victory. Government of Bangabandhu Sheikh Mujibur Rahman.	3	1,2
4th November and 15th August tragedy.	1	1
Liberation War: Expectation and Achievement: A Study	1	3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. K. B.Sayeed : **Political System of Pakistan**, *Peace Publications*
2. ডা. মো: মাহবুবর রহমান : **বাংলাদেশের ইতিহাস**, **১৯৪৭-১৯৭১**, *সময় প্রকাশন*
3. বশির আল হেলাল : **ভাষা আন্দোলনের ইতিহাস,** *আগামী প্রকাশনী*
4. আতিউর রহমান : **মুক্তিযুদ্ধের প্রস্তুতি পর্ব : অসহযোগের দিনগুলি,** *সাহিত্য প্রকাশ*
5. আবুলমালআব্দুলমুহিত **বাংলাদেশ: জাতিরাষ্টের উদ্ভব,** *সাহিত্য প্রকাশ*
6. William Schendel **A History of Bangladesh**, *Cambridge University Press*

Course Code: ECO 1271		**Course Title:** Engineering Economics
Course Type: Theory	**Credit Hour:** 2.0	**Total Marks:** 100
Pre-requisite: None		

Rationale: Engineering economics is a field that addresses the dynamic environment of economic calculations and principles through the prism of engineering. It is a fundamental skill that all successful engineering firms employ in order to retain competitive advantage and market share. Engineering economics studies various financial and economic problems pervasive to engineers in a variety of industries. Like all engineering courses, economics-based engineering courses have a strong quantitative component; however, unlike the more traditional courses, studying engineering economics requires extreme elasticity in the learning style that is conducive to understanding interdisciplinary material.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Illustrate the various concepts of cost & demand in simulated practical situations.	Cognitive/ Understand	11				Discussion, Text Book, Lecture	Class Test
CO2	Construct and demonstrate the knowledge of Macroeconomics.	Cognitive/ Understand	11				Discussion, Text Book, Lecture	Midterm Exam
CO3	Correlate the concept of various sections of national income with the budgets of Bangladesh.	Cognitive/ Apply	7	7			Discussion, Text Book, Lecture	Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1											√	
CO2											√	
CO3							√					

Course Content	Duration (Weeks)	COs
Basic Concepts of Economics: Definition and subject matter of Economics; Microeconomics vs macroeconomics; Law of Economics; Central economic problems of every society; Different economic systems; Economics and Engineering.	2	1,2
Theory of Demand, Supply and Consumer Behavior: Law of Demand; Demand schedule and demand curve; Supply law, Supply schedule and supply curve; Shift in demand and supply; Equilibrium in the market; Elasticity of demand and supply.	2	1
Production and Costs and Theory of the Firm: Meaning of production; Factors of production; Concepts of total, average and marginal costs, fixed and variable costs.	1	1
Theory of the Firm: Perfect competition and monopoly; Total, average and marginal revenue of a firm; Average and marginal revenue under perfect competition and monopoly; Firm's Equilibrium; Equilibrium of firm under perfect competition.	2	2
The Input-Output Analysis: Meaning of input-output analysis; Input- output analysis model; balance equation; coefficient matrix; Determination of final demand vector.	1	2
Concepts of Macroeconomics: Growth; Unemployment; Inflation; Philips Curve, Business cycle; Circular flow of economics; Two, three and four sector economics.	1	2
National Income accounting and determination: Concepts of GNP, GDP and national income; Methods of national income accounting; Problems of national income accounting; Keynesian model of national income determination; The multiplier; Effect of fiscal policy in the Keynesian model.	2	3
Budgets of Bangladesh: The revenue at the capital budget; Income, expenditure of	1	

the government; direct and indirect taxes.		3
Development Planning in Bangladesh: Need for planning in Bangladesh; Various five-year plans in Bangladesh; Development strategies in the five-year plans of Bangladesh.	2	3

Assessment Detail:

Assessment Tools		**Marks (%)**	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1.	K. K. Dewett	:	**Modern Economics Theory,** *S. Chand Publishers* **[Text Book]**
2.	H.L Ahujaaa	:	**Advanced Economic Theory**, *S. Chand Publishers*
3.	A. Koutsoyiannis	:	**Modern Microeconomics**, *Palgrave Macmillan*

2nd year

(Odd Semester)

Course Code: CSE 2101		**Course Title:** Object Oriented Programming
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: CSE 1201		

Rationale: This course is designed to provide knowledge about Object-Oriented Programming (OOP) principles and techniques using C++. The covered topics include overview of C++, classes and objects, overloading, data abstraction, encapsulation, inheritance, polymorphism, file processing, templates and exceptions. After completing the course, the students will be able to solve problems by applying OOP techniques and utilizing C++ in an Integrated Development Environment.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Describe the basic object-oriented programming principles in problem-solving.	Cognitive/ Understand	1	3			Lecture, Practice and Discussion	Class Test, Midterm Exam
CO2	Interpret the application of operator and function overloading.	Cognitive/ Apply	2	4			Lecture, Practice and Discussion	Class Test, Midterm Exam
CO3	Apply the exception-handling mechanism.	Cognitive/ Apply	2	4			Lecture, Practice and Discussion	Assignment, Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3		√										

Course Content	Duration (Weeks)	COs
Introduction: Object oriented programming and procedural oriented programming, encapsulation, inheritance, polymorphism, data abstraction, data binding, static and dynamic binding, message passing. Variable declaration and constants, expression and statements, data types, operators, Functions.	1	1
Classes: Structure of classless, public, private and protected members, array of object, argumented and non-argumented member functions, nested member class and their object, static class member, Friend function, friend class.	3	2
Inheritance: Mode of inheritance, classifications of inheritance, virtual inheritance. Array of objects of derived class.	2	1
Constructor and Destructor: Default constructor, argumented constructor, copy	2	1,2

Course Content	Duration (Weeks)	COs
constructor, dynamic constructor, constructor function for derived class and their order of execution, destructor.		
C++ data file: C++ file stream classes, input and output file, mode of files, file pointer, random file accessing.	2	1
Operator and Function Overloading: Unary and binary operator overloading, run-time and compile time polymorphism, object pointer and pointer to an object, virtual function, dynamic binding.	2	2
Template and Exception handling: Function template and class template, Exception Handling.	2	3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. H. Schidt : C++: The Complete Reference, *McGraw Hill* [Text Book]
2. H. Schidt : C++: A Beginner's Guide, *McGraw Hill*
3. N. Barkakati : Object Oriented Programming with C++, *Prentice Hall India*
4. B. Stroustrap : The C++ Programming Language*, Addison Wesley*

Course Code: CSE 2102 **Course Title:** Object Oriented Programming Lab
Course Type: Lab **Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: CSE 1201, CSE 1202

Rationale: This course equips the students with the practice on problem solving techniques using the object-oriented approach. It emphasizes on the implementation of the OOP concepts including class, object, encapsulation, polymorphism, abstraction, inheritance and dynamic binding. At the end of this course, students should be able to apply the OOP techniques to solve problems using C++.

Course Outcomes (COs): At the end of the Lab Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Demonstrate the concept of OOP in programming problems.	Cognitive/ Apply	1	3			Lab Manual, Hands on Practice	Continuous Assessment, Lab Test, Quiz

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO2	Illustrate the usage of special class functions in real-world problem solving.	Cognitive/ Apply	3	5			Lab Manual, Hands on Practice	Continuous Assessment, Lab Test, Quiz
CO3	Interpret the concept of relationship between different classes.	Cognitive/ Apply	3	5			Lab Manual, Hands on Practice	Final Lab Exam, Quiz

Mapping of Lab Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2			√									
CO3			√									

Course Content	Duration (Weeks)	COs
The basic on how to create C++ program and implement simple logics in C++, problem for: basic class and object creation, member functions with different access specifiers, enumeration, inline function, function overloading, operator overloading, friend function and class, file processing.	7	1
Problem for: Constructor, Destructor, copy constructor, constructor in derived class.	3	2
Problem for: different types of inheritance, virtual base class, function overriding, Dynamic binding, abstract class, templates and exceptions.	4	3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. H. Schidt : **C++: A Beginner's Guide,** *McGraw Hill* **[Text Book]**
2. H. Schidt : **C++: The Complete Reference**, *McGraw Hill*
3. N. Barkakati : **Object Oriented Programming with C++,** *Prentice Hall India*
4. B. Stroustrap : **The C++ Programming Language,** *Addison Wesley*

Course Code: CSE 2103		**Course Title:** Data Structures
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: CSE 1201		

Rationale: This course will introduce students with fundamental concept of data structures and emphasize the importance of data structures in developing and implementing efficient algorithms. Students will gain knowledge about several types of linear and non-linear data structures such as array, linked list, stack, queue, graph, and trees. So, studying data structures helps students deal with different ways of arranging, processing, and storing data.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Illustrate the concept of data structure.	Cognitive/ Understand	1	2			Lectures	Class Test
CO2	Demonstrate the usage of linear data structure.	Cognitive/ Apply	2	2			Lectures	Mid term
CO3	Investigate non-linear data structure in programming problem.	Cognitive/ Apply	3	5			Lectures	Final

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3			√									

Course Content	Duration (Weeks)	COs
Data representation: Internal data representation, Abstract data types, Ideas on linear and non-linear data structures, Elementary data structures.	1	1
Arrays: Maximization, ordered lists, sparse matrices, representation of arrays. Stacks, Queues and Recursion: Different types of stacks and queues: Circular, dequeues, etc; evaluation of expressions, multiple stacks and queues. Recursion: Direct and indirect recursion, depth of recursion, Simulation of Recursion, Removal of recursion; Towers of Hanoi. Linked Lists: singly linked lists, linked stacks and queues, the storage pool, polynomial addition, equivalence relations, sparse matrices, doubly linked lists and dynamic storage management, generalized lists, garbage collection and compaction.	6	2
Trees: Basic terminology, binary trees, binary tree representations, binary tree traversal; Extended binary trees: 2-trees, internal and external path lengths, Huffman codes/algorithms; threaded binary trees, binary tree representation of trees; Application of Trees: Heap tree, Max Heap, Min Heap, Heap sort, decision	7	3

Course Content	Duration (Weeks)	COs
trees, games trees: Counting binary trees. Graphs: Introduction & its storing techniques in memory, traversing algorithm: BFS & DFS, spanning tree & algorithm for Minimal Spanning tree using Kruskal & Prims methods. Symbol Tables: static tree tables, dynamic tree tables; Hash Tables: Hashing functions overflow handling, theoretical evaluation of overflow techniques. Files: file, queries and sequential organizations: Indexing Techniques: Cylinder-surface indexing hashed indexes, tree indexing-B-trees; Tree indexing.		

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Seymour Lipschutz : **Data Structures [Text Book],** *McGraw-Hill*
2. Robert Lafore : **Data Structures and Algorithms in Java,** *Sams*
3. Donald E. Knuth : **The Art of Computer Programming,** *Addison-Wesley*
4. J A Storer and John C Cherniavsky : **An Introduction to Data Structures and Algorithms,** *Birkhäuser*

Course Code: CSE 2104 **Course Title:** Data Structures Lab
Course Type: Lab **Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: CSE 2103, CSE 1201

Rationale: This lab complements the data structures (CSE 2103) course. The aim of this course is to teach students various data structures and to explain them algorithms for performing various operations on these data structures. Students will gain practical knowledge by writing and executing programs in C/C++ using various linear and non- linear data structures such as arrays, linked lists, stacks, queues, trees, graphs and search trees.

Course Outcomes (COs): At the end of the Lab Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Solve programming problems by selecting and implementing linear data structures	Cognitive/ Evaluate	2	2			Hands on Class	Continuous Assessment
CO2	Implement the applications of non-linear data structures	Cognitive/ Apply	3	5	1,2,3	1,3	Hands on Class	Lab Final

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1		√										
CO2			√									

Course Content	Duration (Weeks)	COs
Overview of data structure and algorithm, Solve different algorithm for data structure Problem for Basic array operation Insertion and deletion in an array	2	1
Problem for Linear search Binary search	1	2
Problem for Singly link list Doubly link list Basic operations on linked list	5	2
Problem for manipulating stacks and queues Complete binary tree and binary search trees		
Problem for Tree traversals, insertions, deletions Complete binary tree and binary search trees	3	3
Problem for Graphs as adjacency matrix, adjacency list. Searching technique - Breadth First Search and Depth First Search lab Quiz test (20 minutes)	3	3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. Seymour Lipschutz : **Data Structures [Text Book],** *McGraw-Hill*
2. Robert Lafore : **Data Structures and Algorithms in Java,** *Sams*
3. Donald E. Knuth : **The Art of Computer Programming,** *Addison-Wesley*
4. J A Storer and John C Cherniavsky : **An Introduction to Data Structures and Algorithms,** *Birkhäuser*

Course Code: CSE 2105		**Course Title:** Digital System Design
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: CSE 1203		

Rationale: Fundamentals of Digital Logic System: Number Systems, error detection code, Binary addition and subtraction, 2's compliment methods. Logic Gates and Boolean Algebra & Logic Gates, Boolean Functions, Canonical & Standard Forms. Multilevel NAND& NOR circuits, exclusive-OR & equivalence functions. Boolean function representation and minimization techniques: Boolean Algebraic Simplification and Karnaugh Map Method. Combinational and sequential Circuit Design.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Apply the fundamental concepts and techniques in digital electronics.	Cognitive/ Apply	1	1			Lecture, Discussion	Class Test, Assignment
CO2	Describe different techniques for binary logic circuits simplification.	Cognitive/ Understand	2	2			Lecture, Discussion, Practice	Mid-term, Class Test
CO3	Design combinational and sequential logic circuits.	Cognitive/ Create	3	5			Lecture, Discussion, Practice	Final, Class Test

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3			√									

Course Content	Duration (Weeks)	COs
Number Systems, error detection code, Binary addition and subtraction, 2's compliment methods, Boolean Algebra & Logic Gates, Boolean Functions, Switching circuit design, Input-output (binary) signals for gates.	2	1
Postulates of Boolean algebraic structures, Basic theorem & properties of Boolean Algebra, Boolean functions (Complement, Duality), Canonical & Standard Forms, Boolean Expression Simplification using Boolean Algebraic rules, Karnaugh Map and Reed Muller Methods.	4	2
Combinational Circuit: Design procedure, analysis procedure, multilevel NAND& NOR circuits, exclusive-OR & equivalence functions, Binary parallel adder, Half Adder, Full Adder, Half Subtractor, Full Subtractor, Full adder using half adder, Encoder, Decoder, Adder using Decoder, Multiplexer.	4	3
Sequential Circuit: Transistor, Latch, Clock signals and Clocked FFs: Clocked SR,	4	3

Course Content	Duration (Weeks)	COs
JK and D Flip-Flops, timing diagram of different FFs, Edge-triggered and Level triggered timing diagram, design procedure & design of different shift registers, Memory devices and their applications.		

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. M. Morris Mano : **Digital Logic and Computer Design, Prentice** *Hall* **[Text Book]**
2. Ronald J. Tocci : **Digital Systems: Principles and Applications**, *Prentice Hall*
3. V. K. Jain : **An Introduction to Switching Theory and Digital Electronics**, *Khanna Publishers, New Delhi*
4. William H. Gothmann : **Digital Electronics**, *Prentice Hall*
5. A. Mottershead : **Electronic Devices and Circuits An Introduction**, *Goodyear Pub*
6. Mehta, Rohit, V K Mehta : **Principles of Electronics**, *S. Chand Group*

Course Code: CSE 2106 **Course Title:** Digital System Design Lab
Course Type: Lab **Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: CSE 2105, CSE 1203

Rationale: To provide hand-on experience in designing and implementing basic logic circuits, combinational and sequential circuits. The laboratory exercises are designed to give students ability to design, build, and implement digital circuits. Laboratory assignments progress from investigation of the properties of basic logic gates and flip- flops to the design of combinational and sequential circuits.

Course Outcomes (COs): At the end of the Lab Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Identify the Logic gates and its application.	Cognitive/ Understand	1	3			Discussion, Lab Manual, Hands on	Continuous Assessment
CO2	Implement combinational and sequential logic circuits.	Psychomotor/ Manipulation	3	5				Lab Test

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO3	Construct combinational logic circuit to perform binary operation.	Psychomotor/ Articulation	3	5			Practice	Quiz

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2			√									
CO3			√									

Course Contents	Duration (Week)	COs
Implementation of basic gates: AND, OR, NOT using ICs	2	1
Implementation of Boolean expression after simplification (using Boolean theorem & K-map)	2	1
Proof of Universality using NAND & NOR ICs	2	1
Design combinational circuits Adder, subtractor, Encoder, Decoder Circuits using NAND, NOR gates only	3	2
Design sequential circuits Truth table verification of Flip-Flops: SR, JK, D- Type, T- Type. Shift-registers	5	2,3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
	Total	**100%**	

Recommended Books:

1. Ronald J. Tocci : **Digital Systems: Principles and Applications**, *Prentice Hall* **[Text book]**
2. V. K. Jain : **An Introduction to Switching Theory and Digital Electronics**, *Khanna Publishers, New Delhi*
3. M. Morris Mano : **Digital Logic and Computer Design,** *Prentice Hall*
4. William H. Gothmann : **Digital Electronics**, *Prentice Hall*

Course Code: CSE 2107		**Course Title:** Communication Engineering
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: CSE 2207		

Rationale: This course contains the basics of analogue communication and digital communication, optical fiber communication, satellite communication and cellular communication, 5G technologies. After finishing this course, students will be able to understand the current trends of communication technologies and will be able to implement the knowledge for further research purposes.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Describe the necessary terminologies of Communication Engineering.	Cognitive/ Understand	1	2			Lecture, Practice, Discussion	Class Test, Midterm Exam
CO2	Analyze the analog and the digital modulation techniques. Discuss digital communication system including source, channel and receiver.	Cognitive/ Apply	2	3			Lecture, Practice, Discussion	Assignment, Final Exam
CO3	Explain optical fiber communication with source and transmission. Satellite and cellular communication with 5G technologies.	Cognitive/ Understand	1	4			Lecture, Practice, Discussion	Class Test, Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3	√											

Course Content	Duration (Weeks)	COs
Communication Engineering Fundamentals, Waveforms Spectra, Elements of basic communication systems, Periodic and nonperiodic waveforms and their properties, Fourier series, Noise and its different types.	2	1
Analogue Communication: Amplitude modulation, Amplitude modulation index, Frequency spectrum for sinusoidal AM, Frequency Modulation: Frequency Modulation, Sinusoidal FM, Frequency spectrum for Sinusoidal FM, Phase Modulation. Pulse Modulation, Pulse Codes Modulation (PCM), Quantization, Compression, PCM Receiver, Differential PCM, Delta Modulation, Sigma-Delta A/D conversion, Pulse Modulation. Analog Multiplexing	10	2

Course Content	Duration (Weeks)	COs
Digital Communication: Basic Digital Communication System, Synchronization, Asynchronous Transmission, Probability of Bit Error in Base band Transmission, Matched Filter, Eye Diagrams, Digital Carrier Systems, Amplitude Shift keying, Frequency Shift Keying, Phase Shift Keying, Carrier Recovery Circuits, Quadrature Phase Shift Keying, Error Control Coding, Block Control, Repetition Encoding, Parity Encoding, Convolution Encoding. Digital Multiplexing.		
Satellite Communication: Satellite Communication, Kepler's First and Second Law, Orbits, Geostationary Orbits, Power System. 5G technologies. **Fiber Optic Communication:** Fiber Optic Communication, Propagation within a Fiber, Modes of Propagation, Losses in Fibers, Light sources for Fiber optics, Photo detectors.	2	3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Behrouz A. Forouzan : **Data Communication and Networking,** *Tata McGraw-Hill Edition* **[Text Book]**
2. George Kennedy, Bernard Davis : **Electronic communication System**, *Tata McGraw-Hill Edition* **[Text Book]**
3. John M. Senior : **Optical Fiber Communication**, *Prentice-Hall of India Pvt Ltd*
4. William Stallings : **Data and computer Communication**, *Addison Wesly*
5. Theodore S. Rappaport : **Wireless Communication,** *Prentice-Hall of India Pvt Ltd*

Course Code: MAT 2141 **Course Title:** Differential Equations
Course Type: Theory **Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: MAT 1141

Rationale: This is an elementary course in differential Equations to solve and apply engineering problems. It is an essential tool for describing the nature of the physical universe and naturally also an essential part of models for computer graphics and vision. The students will learn the solution of Ordinary Differential Equations (ODE), Partial Differential Equations (PDE) and basics of special function.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Create ODE from any equation of two variables	Cognitive/ Create	1	1			Lecture, Practice and Discussion	Class Test, Midterm Exam
CO2	Solve the differential equations of first degree first order with various methods or the nth order Linear differential equation with constant coefficient	Cognitive/ Analyze	1	1			Lecture, Practice and Discussion	Class Test, Final Exam
CO3	Apply the special function to solve various ODE or PDE equations	Cognitive/ Apply	1	2			Lecture, Practice and Discussion	Assignment, Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2	√											
CO3	√											

Course Content	Duration	COs
Introduction: Degree and order of ordinary differential equations, formation of ODE from any equation of two variables.	2	1
Differential Equation: Solution of the ordinary differential equation of 1^{st} order differential equation with variable separable, exact differential equation, linear differential equation, homogeneous differential equation, solution of n^{th} order linear differential equation with constant coefficient. **Partial Differential Equations**: Introduction. Solutions of linear and nonlinear partial differential equations of first order. Linear equations of higher order. Equations of the second order with variable coefficients.	6	2
The special functions: Introduction, the factorial function, Beta Gamma function, reduction formula for Gamma of n and factorial of n, transformation of Gamma function, relation between Beta and Gamma functions, example. **Fourier series and Fourier Integral**: periodic function, even function, odd function, Fourier series, determining the co-efficient, Fourier sine and co-sign series and Fourier Integral. **Legendre's differential equation**: Define Legendre's differential equation, solution of Legendre's differential equations, Legendre's polynomials, Rodrigue's formula, orthogonality of Legendre's polynomials, Laplace's first definite integral for Legendre's polynomials, Laplace's second definite integral for Legendre's	6	3

Course Content	Duration	COs
polynomials. **Bessel's differential Equation:** Define Bessel's differential equation, solution of Bessel's differential equations, Legendre's functions, orthogonality of Bessel's functions, recurrence formulae for Bessel's functions.		

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Erwin Kreyszig : **Advanced Engineering Mathematics**, *10th Edition* **[Text Book]**
2. Dr. B. D. Sharma : **Differential Equations,** *Kedar Nath Ram Nath Publisher, New Delhi.*
3. Prof. Md. Abdur Rahaman : **Mathematical Methods: Special Functions & Vector Analysis,** *Nahar Book Depot & Publications, Volume One, 3rd Edition-2009.*
4. H. T. H. Piaggio : **Differential Equations**. *Hayne Press, Us, 2008.*
5. M.D. Raisinghania : **Ordinary and Partial Differential Equations**, *S. Chand and Company, 15th Revised Edition, India, 2013.*

2nd year
(Even Semester)

Course Code: CSE 2201	**Course Title:** Object Oriented Design and Design Patterns	
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: CSE 2101		

Rationale: This course is designed to provide knowledge about Object-Oriented Programming (OOP) principles and techniques using Java. The covered topics include overview of Java, classes and objects, Unified Modelling Language (UML) design, encapsulation, inheritance, polymorphism, data abstraction and exceptions. After completing the course, the students will be able to solve problems by applying OOP techniques and utilizing Java in an Integrated Development Environment.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Describe design pattern techniques and discuss the impact on developing and maintaining programs.	Cognitive/ Understand	1	3			Lecture, Practice, Discussion	Class Test
CO2	Illustrate the OOP based problem solving techniques.	Cognitive/ Apply	2	4			Lecture, Practice, Discussion	Midterm Exam
CO3	Develop interactive GUI with OOP and Exception handling mechanism.	Cognitive/ Create	2	4			Lecture, Practice, Discussion	Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3		√										

Course Content	Duration (Weeks)	COs
OOP Concepts: Modularity, reusability, functional decomposition, and object- based decomposition, abstract data types. Classes and uniform type system, objects and references, memory management, inheritance techniques, generic classes and templates, exception handling.	4	1
Software Design with UML: Introduction to UML. Overview of the design process using UML Rational Unified Process. Structured description of system usage and function, requirements capture techniques, identification of scenarios and UML use case diagrams. Description of scenario elements in terms of CRC models - classes, responsibilities and collaborators. Systematic definition of classes, data and system structure. Abstraction, modularization and UML class diagrams. Combining top-down refinement with bottom-up construction. Object interaction, behavior and state. Different varieties of UML interaction diagram. Recognizing coupling between	6	2

Course Content	Duration (Weeks)	COs
modules and responsibility-driven design. Structuring source code as a design model. Recognition of variable roles. Defensive programming methods including recognition of pre- and post- conditions, invariants, composition and assertions. Rapid and agile prototyping strategies, optimization and debugging techniques		
Design Patterns: Introduction, creational patterns - abstract factory, builder, factory method, prototype, singleton; structural patterns - adapter, bridge, composite, decoder, proxy, facade, flyweight; behavioral patterns- chain, command, interpreter, iterator, mediator, memento, observer, state, strategy, visitor, and template method	4	**3**

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Herbert Schildt : **Java the Complete Reference,** *Mc Graw Hill [Text Book]*
2. H. M. Deitel, P. J. Deitel : **Java how to Program,** *Prentice Hall*
3. Cay S. Horstmann : **Java SE8 for the Really Impatient,** *Addison-Wesley Professional*
4. Barry Burd : **Beginning Programming with Java for Dummies,** *For Dummies*

Course Code: CSE 2202 **Course Title:** Object Oriented Design and Design Patterns Lab
Course Type: Lab **Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: CSE 2101, CSE 2201

Rationale: This course equips the students with the practice on problem solving techniques using the object-oriented approach. It emphasizes on the implementation of the OOP concepts including class, object, encapsulation, polymorphism, abstraction, inheritance. At the end of this course, students should be able to apply the OOP techniques to solve problems using Java.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Implementing OOP based Design Pattern Techniques.	Cognitive/ Apply	1	3			Discussion, manual and hands on practice in lab	Continuous Assessment

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO2	Develop interactive GUI application	Cognitive/ Analyze	9				Discussion, manual and hands on practice in lab	Continuous Assessment, Quiz
CO3	Analyze exception-handling mechanisms in Java programming language.	Affective/ Responding	4	8			Discussion, manual and hands on practice in lab	Final Lab Exam, Lab Report/Project

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2									√			
CO3				√								

Course Content	Duration (Weeks)	COs
Overview of software, review the basic how to create Java Projects and files, Basic input and output related problems. Arithmetic operations and conversion of number to character number format	2	1
Perform different operations: factorial of a given number, multiplication of numbers and print number in sorting order Check Armstrong number, find the Roots of a Quadratic Equation, print the Fibonacci series Print the Prime Numbers, check Palindrome string, sort the given list of names	6	2
Create multiple threads, create pie charts design in own interface, draw the line, rectangle Design a simple calculator using Grid layout to arrange buttons for the digits and +, -, * % operations. Implements the client/server application	6	3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. Herbert Schildt : **Java the Complete Reference,** *Mc Graw Hill [Text Book]*
2. H. M. Deitel, P. J. Deitel : **Java how to Program,** *Prentice Hall*
3. Cay S. Horstmann : **Java SE8 for the Really Impatient,** *Addison-Wesley Professional*
4. Barry Burd : **Beginning Programming with Java for Dummies,** *For Dummies*

Course Code: CSE 2203 **Course Title:** Computer Algorithms
Course Type: Theory **Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: CSE 2101, CSE 1203, CSE 2103

Rationale: This course aims to develop students' ability to design efficient solutions for emerging algorithmic problems in computer science as well as to apply well-known algorithms properly to real-world problems. It also aims to enhance their ability to analyze newly designed algorithms and select appropriate ones based on runtime and memory complexity. Students will learn to solve a variety of graph and combinatorial optimization problems commonly encountered in operations research. Additionally, the course introduces students to computational complexity, enabling them to assess the difficulty of algorithmic problems.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Analyze algorithmic time/ space complexity	Cognitive/ Apply	1	2			Lecture/ Practice	Mid-Term
CO2	Design necessary algorithms to solve problems in real life.	Cognitive/ Creating	3	5			Lecture/ Slides/ Discussion	Final
CO3	Classify problems based on computational complexity	Cognitive/ Analyze	2	4			Lecture/ Slides/ Discussion	Presentation

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2			√									
CO3		√										

Course Content	Duration (Weeks)	COs
Basics of Algorithms: Analyzing algorithms, different design techniques, asymptotic notations, best case, worst case and average case time complexity analysis	1	1
Sorting Algorithms: Algorithm and complexity for bubble sort, insertion sort, radix sort, quick sort, merge sort, Topological sort.	2	1
Divide and Conquer Design: Definition, general technique, recurrence relations, and polynomial multiplication, maximum sub array sum problem, analysis of divide and conquer algorithms.	2	2
Dynamic Programming: general principles, difference between divide and conquer and dynamic programming, rod cutting problem, memoization vs. caching, discrete knapsack, longest common subsequence, weighted activity scheduling problem	2	2
Greedy Design: General principles, difference between dynamic programming and greedy, unweighted activity scheduling, fractional knapsack, Huffman coding and their analysis.	2	2
Graph Theory: Single source shortest path for general weight case, and all pair shortest path problem: Floyd Warshall algorithm, network flow problem: Edmond-Karp's algorithm. Matching problem.	2	2
String Processing: Naïve string matching and its pitfalls, KMP algorithm, Trie, Aho-Korasick algorithm, Boye-Moore algorithm.	1	2
Computational Complexity: Definition, polynomial, pseudo polynomial and exponential class, P vs. NP, encoding, reductions, approach to proving NP-completeness, approximation techniques.	2	3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Thomas Cormen, Charles Leiserson, Ronald, Rivest, Clifford Stein : **Introduction to Algorithms,** *MIT Press* ***[Text Book]***
2. Jon Kleinberg, Eva Tardos : **Algorithm Design,** *Pearson*
3. Sartaj Sahni, Ellis Horrowitz,: Rajasekara **Fundamentals of Computer Algorithms,** *Universities Press (India) Private Limited*

Course Code: CSE 2204		**Course Title:** Computer Algorithms Lab
Course Type: Lab	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: CSE 2102, CSE 2104		

Rationale: The objective of this course is to provide hands-on experience in implementing various algorithms and utilizing previously learned data structures to improve algorithmic efficiency. It emphasizes the application of algorithm design techniques to analyze and solve new problems. Students will examine the trade-offs involved in choosing different data structures for algorithm implementation and gain an understanding of the strengths and limitations of various algorithms in solving computational problems. Additionally, students will learn to adapt good coding practices while implementing sophisticated algorithms.

Course Outcomes (COs): At the end of the Lab Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Apply linear/non-linear data structures in solving algorithmic problems.	Cognitive/ Apply	1	3			Demonstration/ Implementation	Mid Assessment
CO2	Analyze the stepwise execution of algorithms.	Cognitive/ Analyze	2	2			Demonstration/ Implementation	Report
CO3	Solve real life problems using the knowledge of algorithms.	Cognitive/ Apply	3	5	1,2, 3	1, 2	Demonstration/ Implementation	Final

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3			√									

Course Contents	Duration (Weeks)	COs
Introduction to standard data structure libraries in the selected programming language.	1	1
Practice problems on basic data structures (arrays, stacks, queues, linked lists) using built-in library routines.	1	1
Implementation and analysis of basic searching and sorting algorithms.	2	2
Implementation of recursive and divide-and-conquer algorithms with step-by-step debugging to trace recursive calls.	2	2
Solving problems using dynamic programming techniques to understand their design principles and internal execution flow.	2	2
Implementation of greedy algorithms with a focus on decision-making strategies and performance trade-offs.	2	3
Development of graph algorithms (e.g., traversal, shortest path, spanning tree) using existing data structure libraries.	2	3
Application-based problems combining multiple algorithmic techniques for integrated problem solving.	2	3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. Thomas Cormen, Charles Leiserson, Ronald, Rivest, Clifford Stein : **Introduction to Algorithms,** *MIT Press* ***[Text Book]***
2. Jon Kleinberg, Eva Tardos : **Algorithm Design,** *Pearson*
3. Sartaj Sahni, Ellis Horrowitz,: Rajasekara **Fundamentals of Computer Algorithms,** *Universities Press (India) Private Limited*

Course Code: CSE 2205 **Course Title:** Numerical Methods
Course Type: Theory **Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: MAT 1141, MAT 2141

Rationale: This course introduces the basic concepts and methodologies of numerical methods. The covered topics include Floating-point arithmetic, Error analysis, Root finding, Systems of linear algebraic equations, Matrix eigenvalue problems, Curve Fitting, Numerical Differentiation and Integration and ordinary differential equations. It also familiarizes techniques and concepts of numerical methods. The motivation of the course is to develop basics knowledge on numerical methods.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Explain the concept of error analysis, root finding methods and techniques for solving systems of linear equation	Cognitive/ Understand	2	2			Lecture/Slides	Mid Term
CO2	Apply appropriate techniques for approximating functions	Cognitive/ Apply	3	5			Lecture/Slides	Class Test/
CO3	Analyze and evaluate the performance of numerical integration methods and techniques to solving ordinary differential equations	Cognitive/ Analyze	1	2			Lecture/Slides	Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1		√										
CO2			√									
CO3	√											

Course Content	Duration (weeks)	COs
Floating-point representations, General properties, Floating- point exception handling, Rounding methods, Floating-point operations (+, -, ×, /), Accuracy and Precision, Error Definitions, Round-Off Errors, Truncation Errors.	2	1
Graphical Methods, The Bisection Method, The False- Position Method, Simple One-Point Iteration, The Newton- Raphson Method, The Ramanujan's Method, The Secant Method. Gauss Elimination, Solving Small Numbers of Equations, Naive Gauss Elimination, Pitfalls of Elimination Methods, Matrix Inversion and Gauss – Seidel, The Matrix Inverse. Singular Value Decomposition	4	2
Polynomial Interpolation, Newton's Interpolation, Gauss's central interpolation, Lagrange interpolation. Linear Regression, Polynomial Regression, Multiple Linear Regression, least square curve fitting procedure, Weighted least square approximation.	4	3
The Trapezoidal Rule, Simpson's Rules, Integration with Unequal Segments, High-Accuracy Differentiation Formulas, Derivatives of Unequally Spaced Data, Ordinary and partial differential equations, Numerical solution techniques for ordinary differential equation, error analysis of the ODE solution.	4	4

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Steven C. Chapra, Raymond P. Canale : **Numerical Methods for Engineers,** *McGraw-Hill* **[Text Book]**
2. S. S. Kuo : **Computer Applications of Numerical Methods**, *Addison-Wesley* **[Text Book]**
3. S. S. Sastry : **Introductory Methods of Numerical Analysis**, *Prentice-Hall of India Pvt. Ltd.*
4. Cantrell : **Modern Mathematical Methods for Physicists and Engineers**, *Cambridge University Press.*
5. Press, Teukolsky, Vetterling and Flannery : **Numerical Recipes in C: The Art of Scientific Computing,** Cambridge University Press.
6. V. Rajaraman : **Computer Oriented Numerical Method**, *Prentice-Hall of India Pvt. Ltd.*

Course Code: CSE 2206 **Course Title:** Numerical Methods Lab
Course Type: Lab **Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: CSE 1201

Rationale: Rationale: This course is designed to provide the students with a hands-on experience of implementing basic root finding methods, algorithms for numerical linear algebra, interpolation, regression analysis, numerical differentiation and integration and differential equation solving algorithms. The laboratory exercises are designed to give students ability to implement different problem solving using numerical methods. Laboratory assignments are based on investigation of the various techniques of numerical methods to solve real-world problems.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Apply error analysis and implement different root finding methods	Cognitive/ Apply	1	2			Hands-on	Mid-term
CO2	Implement function-approximation and numerical integration.	Cognitive/ Apply	3	5			Hands-on	Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2			√									

Course Content	Duration (Weeks)	COs
Introduction to the Python programming language and analyzing different types of errors from mathematical operations.	4	1
Implementing the Bisection Method, The False- Position Method, Simple One-Point Iteration, The Newton- Raphson Method, The Ramanujan's Method, The Secant Method. Gauss Elimination, Solving Small Numbers of Equations, Naive Gauss Elimination, Pitfalls of Elimination Methods, Matrix Inversion and Gauss – Seidel, The Matrix Inverse. Singular Value Decomposition	4	2
Implementing polynomial Interpolation, Newton's Interpolation, Gauss's central interpolation, Lagrange interpolation. Linear Regression, Polynomial Regression, Multiple Linear Regression, least square curve fitting procedure, Weighted least square approximation.	6	3

COs	Teaching-Learning strategy	Assessment strategy
CO1	Lecture and practice	Midterm, class test
CO2	Lecture and practice	Class test, Midterm
CO3	Lecture and practice	Assignment, class test

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. Steven C. Chapra, Raymond P. Canale : **Numerical Methods for Engineers,** *McGraw-Hill* **[Text Book]**
2. S. S. Kuo : **Computer Applications of Numerical Methods**, *Addison-Wesley*
3. S. S. Sastry : **Introductory Methods of Numerical Analysis**, *Prentice-Hall of India Pvt. Ltd.* **[Text Book]**
4. Cantrell : **Modern Mathematical Methods for Physicists and Engineers**, *Cambridge University Press.*
5. Press, Teukolsky, Vetterling and Flannery : **Numerical Recipes in C: The Art of Scientific Computing,** Cambridge University Press.
6. V. Rajaraman : **Computer Oriented Numerical Method**, *Prentice-Hall of India Pvt. Ltd.*

Course Code: CSE 2207		**Course Title:** Computer Networks
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: None		

Rationale: This course introduces the basic concepts and methodologies of computer networking. This course will provide a comprehensive introduction to computer network, network architecture and protocols. It also familiarizes networking tools and techniques of computer networking. The motivation of the course is to develop basics knowledge on computer networks. After completing the course, the students will be able to diagnose network issues and design various types of computer networks.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Describe various network reference models.	Cognitive/ Understand	1	4			Lecture/Slides	Mid-Term
CO2	Identify various standard protocols in computer networking	Cognitive/ Analyze	2	4			Lecture/Slides	Assignment /Presentation
CO3	Design and validate a standards-compliant IP network	Cognitive/ Create	3	5			Lecture/Slides	Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3			√									

Course Content	Duration (Weeks)	COs
Introduction: Computer Networks and Applications, OSI reference model, TCP/IP model and terminology, Connectionless and Connection Oriented services, Service primitives, The ARPANET	2	1
Physical Layer: Circuit switching and Packet switching, X-25 protocol, Frame relay and Cell relay, ATM reference model; Medium Access Sub layer: Pure and slotted ALOHA, Persistent and Non persistent CSMA, CSMA with collision detection and collision free protocols, IEEE standard 802.3 and Ethernet; Data Link Layer: Types of errors, framing, error detection & correction methods; Flow control, Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ, HDLC	3	1
Network Layer: Internet address, classful address, subnetting, static vs. dynamic routing, shortest path algorithm, flooding, distance vector routing, link state routing, ARP, RARP, IP, ICMP;	3	3
Transport Layer: UDP, TCP, Connection management, Addressing, Establishing and Releasing Connection, Congestion control algorithm, Flow control and		

Course Content	Duration (Weeks)	COs
Buffering, Multiplexing; Presentation Layer: Data Compression techniques, Frequency Dependent Coding, Context Dependent Encoding; Application Layer: Internet and intranets, Internet services and goals, DNS, SMTP, FTP, Telnet, HTTP, World Wide Web (WWW), DHCP and BOOTP;	3	2
Networking in Practice: Designing LAN, Cabling, Establishing Client- Server network, Configuring: Directory Server, Proxy server, FTP server, E-mail server, web server, DB server, Firewall, Network troubleshooting, network maintenance, network monitoring, Network programming	3	2

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Andrew S. Tanenbaum : **Computer Networks,** *Prentice Hall* **[Text Book]**
2. Behrouz A. Forouzan : **Data Communications and Networking,** *McGraw-Hill*
3. Behrouz A. Forouzan : **TCP/IP Protocol Suite,** *McGraw-Hill*
4. William Stallings : **Data and Computer Communications,** *Prentice Hall*

Course Code: CSE 2208 **Course Title:** Computer Networks Lab
Course Type: Lab **Credit Hour:** 2.0 **Total Marks:** 100
Pre-requisite: None

Rationale: To provide hand-on experience in understanding and designing various computer networks. The laboratory exercises are designed to give students ability to analyze, design, build, and implement networks. The Laboratory works are designed to effectively implement managing and configuring various network devices such as switches and routers, and various networking technologies.

Course Outcomes (COs): At the end of the Lab Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Understanding various networking devices and tools.	Cognitive/ Understand	1	4			Hands-on	Report/ Quiz
CO2	Design and implement a standards-compliant IP network	Cognitive/ Create	3	5	1,2, 3	1,2	Hands-on	Final

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2			√									

Course Contents	Duration (Weeks)	COs
Study of different types of Network cables and practically implement the cross-wired cable and straight through cable using clamping tool.	1	1
Install and configure Network Devices: HUB, Switch and Routers.	1	1
Study of network IP, LAN connection, network topology	2	2
Study of basic network command and network configuration commands.	1	2
Configure a Network topology using packet tracer software	1	2
Configuration of multiple networks using router	2	3
Static routing configuration of multiple networks using multiple routers	2	3
RIP routing configuration of multiple networks using multiple routers	1	3
DHCP and DNS configuration	1	3
HTTP, FTP and SMTP configuration	2	3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. Andrew S. Tanenbaum : **Computer Networks,** *Prentice Hall* **[Text Book]**
2. Behrouz A. Forouzan : **Data Communications and Networking,** *McGraw-Hill*
3. Behrouz A. Forouzan : **TCP/IP Protocol Suite,** *McGraw-Hill*
4. William Stallings : **Data and Computer Communications,** *Prentice Hall*

Course Code: MAT 2241	**Course Title:** Linear Algebra and Complex Variables	
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: MAT 1141		

Rationale: This is an elementary course in Linear Algebra and Complex Variables designed for students to become familiar with the fundamental operations of linear algebra and complex variables with application to computer engineering problems. Linear algebra provides concepts that are crucial to many areas of computer science, including graphics, image processing, cryptography, machine learning, computer vision, optimization, graph algorithms. In the other hand, complex variables are especially useful in electronics, optics, quantum theory for describing waves and any periodic phenomena, Fourier transforms use complex variables and are the key to working with wave functions, designing filters signal integrity in digital electronics radio astronomy.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Inspect the terms of matrix algebra or solving a general system of linear equations.	Cognitive/ Analyze	1	1			Lectures, Practice and Discussion	Class Test, Midterm Exam
CO2	Solve the mathematical problems of functions or limits or continuity for complex variables.	Cognitive/ Analyze	1	2			Lectures, Practice and Discussion	Class Test, Final Exam
CO3	Solve the derivatives or integrals for complex variables.	Cognitive/ Analyze	1	2			Lectures, Practice and Discussion	Assignment, Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2	√											
CO3	√											

Course Content	Duration (Weeks)	COs
Linear Algebra: Determinants, Matrices, Inverse of a Matrices, Rank of a Matrix, Solution of system of linear equations by Cramer's rule and by Matrix inversion, System of linear equation, Linear Transformation, Eigen values and Eigen vectors, Matrix Decomposition Techniques, Matrix Valued Function Differentiation. Indeterminate form.	6	1
Complex Variables: Complex number, Complex function, Hyperbolic functions, Euler's formula, Exponential and polar forms, De Mover's theorem, Limit and continuity of a complex function, Complex differentiation and Cauchy-Riemann equations,	4	2

Course Content	Duration (Weeks)	COs
Analytic functions**,** Complex integration and Cauchy's theorem; Cauchy's integral formula and related theorems, Infinite series, Taylor's and Laurent's series, Residues and residue theorem.	4	3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Seymour Lipschutz, Marc Lipson : **Linear Algebra,** *Schaum's Outline Series, McGraw-Hill Education.* **[Text Book]**
2. MR Spiegel : **Complex Variables**, *McGraw-Hill Education* **[Text Book]**
3. Howard Anton, Chris Rorres : **Linear Algebra with Application**
4. M. Abdur Rahman : **College Linear Algebra**, *Nahar Book Depot & Publications, Dhaka, 7th Edition.*

3rd year

(Odd Semester)

Course Code: CSE 3101		**Course Title:** Computer Graphics
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: MAT 1241, MAT 2241		

Rationale: From this course, students will be able to gather proper knowledge about visualization and image processing, RGB color model, direct coding, various kinds of graphics display. They can learn points plotting techniques, line drawing & circle drawing algorithms and using these primitive shapes they can create complex shapes. Polygon Filling, 2D and 3D transformation, viewing and clipping are also learned. They can also learn about curves, surfaces, curve fitting from this course.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Describe algorithmic interpretation for scan conversion of basic shapes.	Cognitive/ Understand	1	2			Lectures/ Slides	Mid Term
CO2	Apply mathematical formulation of 2D and 3D transformation.	Cognitive/ Apply	2	4			Lectures/ Slides	Final
CO3	Compare the efficiency of different curve drawing algorithms.	Cognitive/ Evaluate	3	5			Lectures/ Slides	Class Test

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3				√								

Course Content	Duration (Weeks)	COs
Scan Conversion: Points plotting techniques, Line drawing algorithms: Horizontal and vertical line drawing algorithm, Direct Line drawing algorithm, DDA algorithm, Bresenham's algorithm. Circle Drawing algorithms: Direct method, Mid-point circle drawing algorithm. Ellipse generating algorithm.	4	1
Polygon Filling: Scan line polygon fill algorithm, Boundary fill algorithm and Flood fill algorithm.	2	1
2D and 3D transformation: Basic transformations (2D and 3D): Translation, Scaling, Rotation, Other transformations (2D and 3D): Reflection, Reflection through an arbitrary plane, Rotation about an arbitrary axis in space, shearing. Matrix representations and Homogeneous coordinates, General parallel projection Transformation.	4	2
Viewing and Clipping: Viewing pipeline, Window to viewport coordinate transformation, 3D viewing, View port clipping, clipping operations: point clipping, line clipping, polygon clipping etc.	2	2,3
Curves: Curve representation, Surfaces design, Hermit curves, Bezier curves, B-spline curves, End conditions for periodic B-spline curves, Rational B-spline curves.	2	3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Donald Hearn and M. Pauline Barker : **Computer Graphics,** *Prentice Hall* **[Text Book]**
2. Steven Harrington : **Computer Graphics: A Programming Approach,** *McGraw-Hill College*
3. F.S. Hill : **Fundamentals of Computer Graphics,** *Prentice Hall*

Course Code: CSE 3102 **Course Title:** Computer Graphics Lab
Course Type: Lab **Credit Hour: 2** **Total Marks:** 100
Pre-requisite: MAT 1241, MAT 2241

Rationale: From this course, students will be able to create shapes, complex shapes and their transformations. They can implement animation. Using this knowledge, they can make animation games, projects etc. Laboratory assignments progress from investigation of the properties of basic algorithms and OpenGL library functions to the design of combinational and sequential shapes and animations.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Practice of primitive shape drawing algorithms	Cognitive/ Apply	2	3,4	1,2, 3	1,2	Implementation	Lab Test
CO2	Design and implement the algorithm for moving arbitrary object on 2D screen.	Cognitive/ Create	3	5			Implementation	Lab Test

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1		√										
CO2			√									

Course Content	Duration (Weeks)	COs
Using different primitives and drawing scenery using shapes	2	1
Implementation of line, circle, ellipse drawing algorithms in drawing primitive shapes.	2	2
Apply Different kind of geometric transformations, Coordinate transformations, Composite transformations in both 2D and 3D objects.	2	3
Practice Clipping algorithms: Line, Polygon clipping	2	2
Implementation of animation on 2D screen	2	2,3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. Donald Hearn and M. Pauline Barker : **Computer Graphics,** *Prentice Hall* **[Text Book]**
2. Steven Harrington : **Computer Graphics: A Programming Approach,** *McGraw-Hill College*
3. F.S. Hill : **Fundamentals of Computer Graphics,** *Prentice Hall*

Course Code: CSE 3103		**Course Title:** Database Management System
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: None		

Rationale: Concepts and implementation of Database Management System (DBMS) using Data manipulation Language (DML), Data Definition Language (DDL), Data Control language (DCL), Designing E-R diagram and performing different types of integrity constraints. design RDBMS using SQL. From this course, students also gather knowledge about the storage and file structure of DBMS and DBMS transaction processing systems and so on.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Describe the basic terminologies of database management system.	Cognitive/ Understand	1	1			Lecture/ Slides	Class Test
CO2	Construct a database schema utilizing the principles of Entity–Relationship diagrams	Cognitive/ Create	3	5			Lecture/ Slides	Mid Term
CO3	Investigate and apply normalization methods to minimize data redundancy in relational database design	Cognitive/ Analyze	2	2			Lecture/ Slides	Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2			√									
CO3		√										

Course Content	Duration (Weeks)	COs
Introduction: Data and information, Purpose of Database Systems, View of Data, Database Languages DDL, DML, DCL. **Database Design and the E-R Diagram:** Entity and attributes, Entity-Relationship Model, Entity-Relationship Diagrams, convert E-R model into tables. **Relational Data Model:** Structure of Relational Databases, Database Schema, Keys, Schema, Diagrams, Relational Query Languages, Relational Database Design, Normalizing database up to 3rd normal form, BCNF.	5	1,2
SQL: Overview of the SQL Query, Language, SQL Data Definition, Basic Structure of SQL, Queries, Aggregate Functions, Modification of the Database, Join Expressions, Views, Transactions, Integrity Constraints, Functions and Procedures, Triggers, Recursive Queries, Advanced Aggregation Features.	4	1,3

Course Content	Duration (Weeks)	COs
Storage and File Structure: Overview of Physical Storage Media, Magnetic Disk and Flash Storage, RAID, Tertiary Storage, File Organization, Organization of Records in Files, Data-Dictionary Storage, Database Buffer. **Transactions:** Transaction Concept, A Simple Transaction Model, Storage Structure, Transaction Atomicity and Durability, Transaction Isolation, Transaction Isolation and Atomicity, Transaction Isolation Levels, Implementation of Isolation Levels, Transactions as SQL Statements, Lock-Based Protocols, Deadlock Handling, Multiple Granularity, Timestamp-Based Protocols, Validation-Based Protocols. Database-System Architectures: Centralized and Client–Server Architectures, Server System Architectures, Parallel Systems, Design and types of Parallel Systems, Distributed Systems architecture and its application.	5	1

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. A. Silberschatz : **Database System Concepts**, *McGraw-Hill* **[Text Book]**
2. Raghu Ramakrishnan, Johannes Gehrke : **Database Management System**, *McGraw Hill Higher Education*
3. James Martin : **Principles of Database Management**, *Prentice-Hall of India Pvt Ltd*
4. Ullman : **Database Management systems**, *Prentice-Hall Publication*

Course Code: CSE 3104		**Course Title:** Database Management System Lab
Course Type: Lab	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: None		

Rationale: Designing relational DBMS, performing different types of DDL and DML commands. The laboratory exercises are designed to give students ability to perform any indexing operation, hashing operation and cascading operation and so on. Using integrity constraints like normalization on a database, remove all kinds of anomalies and redesign the database.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Utilize SQL commands to perform basic database tasks	Cognitive/ Apply	1	4			Hands-on	Lab Test
CO2	Develop database solutions for efficient, redundancy-free, and reliable data management	Cognitive/ Create	3	5	1,2, 3	1,2	Hands-on	Lab Test

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2			√									

Course Content	Duration	COs
Create a relational database for a domain like an organization and discuss how the schema is effective for that organization. Design an E-R diagram and mapping a relational model from that E-R diagram for a given scenario.	5	1
Practice intermediate and advanced SQL operation for a given relation. Intermediate SQL: Join Expressions, Views etc. Advanced SQL: Trigger, Stored procedure, sub query etc.	5	2
Practice cascading operation using keys for the given relations. Removing insertion, deletion and update anomalies using normalization technique and redesign the database schema.	4	3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. A. Silberschatz : **Database System Concepts**, *McGraw-Hill* **[Text Book]**
2. James Martin : **Principles of Database Management**, *Prentice-Hall of India Pvt Ltd*
3. Ullman : **Database Management systems**, *Prentice-Hall Publication*
4. Abey : **Oracle 8i a Beginners Guide**, *McGraw-Hill*

Course Code: CSE 3105		**Course Title:** Computer Architecture
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: CSE 2105		

Rationale: This course provides students with a solid understanding of fundamental architectural techniques used to build today's high-performance processors and systems. Course topics include pipelining, superscalar, out of order execution, multithreading, caches, virtual memory, and multiprocessors. Some emphasis will be placed on hardware/software interaction to achieve performance. Issues affecting the nexus of architecture, compilers and operating systems will be briefly touched upon. Significant challenges face today's computer hardware industry. At the forefront of these challenges is the multi-core revolution. The transition from single processor designs to multi- core design requires hardware and software designers knowledgeable about a range of issues in parallel computing including hardware.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Illustrate hardware-software interaction to run the computer system.	Cognitive/ Apply	3	5			Lecture, Tutorial	Class Test
CO2	Designing of Arithmetic Logic Unit (ALU)	Cognitive/ Create	2	4			Problem-based, Assignment	Final Exam
CO3	Illustrate detail functionality and connection architecture of different types of memories leading to high performance computing.	Cognitive/ Apply	1	4			Lecture, Discussion	Midterm Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1			√									
CO2		√										
CO3	√											

Course Content	Duration (Weeks)	COs
Basic Concept: Introduction to Computer Architecture, Computer Design and Computer Organization. Interaction of hardware with the system and application software, basic hardware components of computer system and bus structure, concept and analysis of performance.	2	1
Machine Instruction: Concept of machine instruction, different parts of machine instruction, memory model maps for instruction, micro-operation, registers, addressing modes, I/O registers and instruction, program control status bits.	2	1
Processing Unit: Components of processing units and their functions, general	2	2

Course Content	Duration (Weeks)	COs
register organization for micro-operation, control word, pipelining, instruction pipelining and performance of pipelining.		
I/O Organization: Peripheral devices, I/O Interface, I/O bus module, synchronous data transfer and its different types, asynchronous data transfer, different modes of transfer, interrupt processing, direct memory access (DMA), I/O processor (IOP).	3	2
Memory Organization: Concept of memory, memory hierarchy, main memory, functions of RAM and ROM, memory address map, memory connection with CPU, Cache memory and its performance, secondary storage, virtual memory.	3	3
Composite Architecture: Multiprocessor and its different types, multicomputer, CISC and RISC processors, parallel processing, parallelism in multiprocessor, Flynn's classification.	2	3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky : **Computer Organization**, *McGraw-Hill.* **[Text Book]**
2. Patterson, David A. and John L. Hennessy : **Computer Organization and Design: The Hardware/Software Interface**, Third edition.
3. William Stallings : **Computer Organization and Architecture: Designing for Performance**, *Prentice Hall*.

Course Code: CSE 3106		**Course Title:** Computer Architecture Lab
Course Type: Lab	**Credit Hour: 2**	**Total Marks:** 100
Pre-requisite: None		

Rationale: This course provides students with a solid understanding of fundamental architectural techniques used to build today's high-performance processors and systems. Course topics include pipelining, superscalar, out of order execution, multithreading, caches, virtual memory, and multiprocessors. Some emphasis will be placed on hardware/software interaction to achieve performance. Issues affecting the nexus of architecture, compilers and operating systems will be briefly touched upon. Significant challenges face today's computer hardware industry. At the forefront of these challenges is the multi-core revolution. The transition from single processor designs to multi- core design requires hardware and software designers knowledgeable about a range of issues in parallel computing including hardware.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Design different types of counters	Cognitive/ Create	3	5			Demo/ Hands-on	Mid Term
CO2	Demonstrate data shifting operations using appropriate shift register.	Cognitive/ Apply	1	4			Experiment	Quiz
CO3	Design and implement arithmetic circuits (ALU)	Cognitive/ Create	2	4			Mini-project, Teamwork	Final

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1			√									
CO2	√											
CO3		√										

Course Content	Duration (Weeks)	COs
Design asynchronous counters using J-K flip-flop, Design synchronous counters to count the sequence using J-K flipflop	7	1
Design 8-bit Serial In/ Parallel Out shift register using 74LS164, Design 8 bit Parallel In/ Serial Out shift register using 74LS165	4	2
Design memory read/write operation using IDT 6116 Static RAM	3	3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky : **Computer Organization**, *McGraw-Hill.* **[Text Book]**
2. Patterson, David A. and John L. Hennessy : **Computer Organization and Design: The Hardware/Software Interface**, Third edition.
3. William Stallings : **Computer Organization and Architecture: Designing for Performance**, *Prentice Hall*.

Course Code: CSE 3107	**Course Title:** Theory of Computation and Compiler Design	
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: CSE 1203		

Rationale: Concepts and application of languages and automata models, regular languages and expression. Get knowledge about computational models and decision problems. In this course, students also gather knowledge about compiler and interpreter, parsing technique, code optimizing, and error handling and so on.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Describe finite automata and its application to decision making.	Cognitive/ Understand	1	2			Book, Lecture sheet, Design Practice, discussion	Midterm Exam
CO2	Apply appropriate automata in regular language and expression.	Cognitive/ Apply	2	3				Class Test
CO3	Discuss different phases of a compiler.	Cognitive/ Understand	1	4				Final Exam
CO4	Analyze the code optimization scheme for efficient compiler design.	Cognitive/ Analyze	2	4				Class Test

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3	√											
CO4		√										

Course Content	Duration (Weeks)	COs
Languages and Grammars: Finite Automata - accepting languages, strings, string search algorithm, distinguishing strings, integers, lexical analysis, decision problems and languages, minimizing finite automata.	4	1
Regular languages and Expression: Non-deterministic finite automata, Kleene's theorem. Context-free languages, regular languages and grammars. Simplified forms and normal forms. Push-Down Automata- deterministic PDA and non-deterministic PDA, top-down and bottom-up PDA, Parsing - top down and bottom-up parsers. Decision problems and CFL. **Computational Models:** Computational tasks - search and decision problems,	5	2

Course Content	Duration (Weeks)	COs
General model of computation, Turing Machines. **Decision Problems:** Undecidable problems, reduction and halting problem, context-free languages. Decision trees. Satisfiability problem.		
Introduction: Introduction to compiler, compiler and translator, the structure of a compiler. **Parsing:** Basic parsing technique, parsers, shift reduce parsing, operator procedure parsing, top-down parsing, bottom-up parsing, predictive parsing. **Syntax:** Syntax directed translation, intermediate code generation, polish notation, parse tree and syntax trees, quadruples, triples, Boolean expression. **Symbol Table:** Perspective and motivation of symbol table. Symbol table content, operation on symbol table, organization of symbol table.	3	3
Code Optimization: Code optimization, sources of optimization, basic blocks, folding, loop optimization, flowgraph, induction variable elimination, reduction in strength, code motion. Code generation, object programs, problems in code generation, a machine model, a simple code generator, register allocation.	2	4

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. John C. Martin : **Introduction to Languages and The Theory of Computation**. *McGraw Hill.* **[Text Book]**
2. Sanjeev Arora and Boaz Barak : **Computational Complexity: A Modern Approach [Text Book]**
3. Oded Goldreich : **Complexity of Algorithms – A Conceptual Perspective**
4. Peter Gacs and Laszlo Lovasz : **Complexity Algorithms**
5. Alfred V. Aho and Jeffrey D. Ullman : **Principles of Compiler Design**, *Addison Wesley Publication*.
6. A.J. Holub : **Compiler design in C**, *Prentice-Hall of India*
7. Trembly and Sorensen : **Theory and Practices of Compiler Writing,** *McGraw-Hill*

Course Code: CSE 3122		**Course Title:** Technical Report Writing
Course Type: Lab	**Credit Hour:** 0.5	**Total Marks:** 100
Pre-requisite: ENG 0002		

Rationale: This is a laboratory course for students to become familiar with the fundamentals of report writing process. This course provides essential understanding of various writing tools those are needed for a complete writing process. It will also cover basic topics such as oral presentation, proofing and presentation tools.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Understand the stages of the writing process and apply them.	Cognitive/ Understand	2	2			Lecture, Discussion	Experiment, Report, Viva
CO2	Apply and operate various tools and software for the writing process.	Cognitive/ Understand	1	2			Practice, Discussion	Experiment, Report, Viva
CO3	Demonstrate communication ability through report and presentation.	Cognitive/ Apply	10				Discussion, Hands on practice	Lab Test, Quiz, Viva, Project

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1		√										
CO2	√											
CO3										√		

Course Content	Duration (Weeks)	COs
Introduction: Issues of Technical Writing and Effective Oral Presentation in Computer Science and Engineering,	3	1
Writing Issues: Writing Styles of Definitions, Propositions, Theorems and Proofs; Preparation of Reports, Research Papers, plagiarism & plagiarism detection.	5	2
Writing and Presentation Tools: LATEX; Diagram Drawing Software; Presentation Tools	6	3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. Eunson B, John Wiley : **Writing and presenting reports,** *Wiley* **[Text Book]**
2. Roy Peter Clark : **Writing Tools: 50 Essential Strategies for Every,** *Writer, Little, Brown and Company*
3. Lutz Hering, Heike Hering : **How to Write Technical Reports: Understandable Structure, Good Design, Convincing Presentation,** *Springer*
4. Leslie Lamport : **LaTeX: A Document Preparation System**

Course Code: MAT 3141	**Course Title:** Applied Statistics and Probability
Course Type: Theory	**Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: MAT 1141, MAT 2241	

Rationale: This is an introductory course in Basic Statistics and Probability designed for students to become familiar with the fundamentals of statistics and their application to computer engineering problems. It provides essential tools that are needed from engineering professionals to analyze statistical data and construct graphical representation. It will cover basic concepts of statistics and probability including measure of central tendency, measure of dispersion, correlation, regression, sampling techniques and probability distribution.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Apply central tendency or dispersion.	Cognitive/ Analyze	1	1			Lecture, Practice, Discussion	Class Test, Midterm Exam
CO2	Construct a frequency distribution table or construct statistical charts.	Psychomotor/ Practicing	2	2			Lecture, Practice, Discussion	Assignment, Final Exam
CO3	Solve the problem of correlation or regression or probability.	Cognitive/ Analyze	2	3			Lecture, Practice, Discussion	Class Test, Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3		√										

Course Content	Duration (Weeks)	COs
An introduction: Definition of Statistics, Uses and importance, Variables, Measurement level of variables, Sample and Population. **Measures of central tendency:** Introduction, the arithmetic mean, Geometric mean, Harmonic mean, Median, mode, computing of means for grouped data and ungrouped data, Advantages, and disadvantages, and Uses of all measures. **Measures of dispersion:** Introduction of dispersion, Absolute and Relative measures, Range, mean deviation, Standard deviation, Variance, Quartile deviation, Coefficient of Variation, Advantages, disadvantages and uses of all measures.	5	1
Data representation: Classification, Types of classification, Tabular representation, Graphical representation, Pie chart, Histogram, Bar chart, Frequency curve, Frequency Polygon and Ogive curve.	2	2
Correlation and Regression: Correlation, Types, Importance and uses of correlation, Properties of correlation, Rank correlation, Regression, Differences between regression line and regression model, Simple linear Regression, Importance of regression analysis, Comparison of regression and correlation. **Probability:** Concept of probability, Sample Space, Events, Union and Intersection of Events, Probability of events, Laws of probability, Conditional probabilities, Bayes' theorem, Chebyshev's Inequality and Practical examples. **Random variables and probability Distribution:** Basic concepts, Discrete and continuous random variables, Probability Mass Function (PMF), Probability Density Function (PDF), Cumulative Distribution Function (CDF), Mathematical expectation and variance, Joint, marginal and conditional density functions, Conditional Expectation and conditional variance, Probability generating function, Characteristic function, Binomial distribution, Poisson distribution, and Normal distribution with Practical examples. **Sampling design and Statistical test:** Sampling Design, Simple random sampling, Systematic sampling, Stratified sampling; Cluster sampling, Judgment sampling, Chi-squared test, Z test, t-test and F-test.	7	3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Murray R. Spiegel and Larry J. Stephens : **Schaum's Outlines of Statistic**s, *the McGraw-Hill*
2. Mr. Nurul Islam : **Statistics & Probability**
3. J. B. Anderson : **Interpreting Data**, *Chapman and Hall, London*
4. H. Cramer : **The Elements of Probability Theory**, *Wiley, N. Y*
5. P. Hoel : **Introductory Statistics, Wiley and Sons**, *N. Y*
6. Lind, Marchal, Mason : **Statistical Techniques in Business & Economics**, *Irwin/McGraw-Hill, USA, Fourteen Editions.*

3rd year
(Even Semester)

Course Code: CSE 3201	**Course Title:** Software Engineering and System Analysis	
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: None		

Rationale: This course introduces the basics of software engineering, software development life-cycles. SDLC models, design of solution of a problem partition are also learned. They can learn about testing and software project management. They can estimate the cost using techniques, schedule a project, and manage the risks. They can also learn about system concepts and the information system environment, the role of system analyst, analysis information Gathering, cost/benefit analysis. They can design system design and implement with testing and quality assurance.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Interpret the various industry standard software development models and utilize different design techniques	Cognitive/ Understand	1	4			Lecture, PowerPoint Slides, Discussion	Class Test, Assignment
CO2	Demonstrate various software testing methods.	Cognitive/ Apply	2	4			Lecture, PowerPoint Slides, Discussion	Midterm Exam
CO3	Demonstrate end-to-end software project management using system analysis and design artifacts to produce a candidate system.	Cognitive/ Apply	11	8			Lecture, PowerPoint Slides, Discussion	Class Test, Assignment

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3											√	

Course Content	Duration (weeks)	COs
Software Development Life-Cycle: Requirement analysis, Software design, Coding, Testing and Maintenance, SDLC models like Water fall model, Incremental model, Spiral model, Agile model and their role of management in software development.	1	1
Design: Problem partitioning, Top-down and bottom-up design, Functional versus object-oriented approach, Component-level design, User-system interaction, Data visualization etc.	1	1
Software Project Management: Cost estimation and techniques, Project scheduling, Risk management, Role of matrices and measurement.	2	3
Software Reliability: Reliability growth modelling, ISO 9000 certification for	2	3

software industry, SEI capability maturity model, Comparison between ISO & SEI CMM.		
Testing: Verification and validation, testing strategies, Unit testing, Integration testing, Top-down and bottom-up testing, Alpha and Beta testing, System testing and debugging.	2	2
Overview: System concepts and the information system environment, The system development life cycle, The role of systems analyst and the concepts of MIS.	2	3
System Analysis: Information Gathering, The tools of structured analysis, Cost/benefit analysis.	2	3
System Design and Implementation: The process and stages of system design, Input/output and forms design, System testing and quality assurance.	2	3

Assessment Detail:

Assessment Tools		**Marks (%)**	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. E.M. Awad : **System Analysis and Design**, *Galgotia Publication Ltd* **[Text Book]**
2. P. Edwards : **System Analysis & Design**, *McGraw-Hill*
3. Roger S. Pressman : **Software Engineering**, *A practitioner's Approach, McGraw-Hill*
4. Ian Sommerville : **Software Engineering,** Pearson Education.

Course Code: CSE 3203	**Course Title:** Operating System and System Programming	
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: CSE 1201		

Rationale: This course introduces operating system concepts for operating system design, implementations and functions for single-user and multi-user systems. Topics include computer system structure, computer system operation, operating system services, storage structure, caching, how a modern computer works, operating system structure, user interface, system calls and their implementation, system call parameter passing method, operating system design and implementation, virtual machine and virtualization, process concepts, context switching, IPC (Inter Process Communication), CPU scheduling, process synchronizations, deadlock, hardware address protection, swapping, file and memory management system. Upon completion, students should be able to perform operating systems functions at the support level in a single and multi-user environment.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Explain the fundamental structure and functions of operating systems	Cognitive/ Understand	1	3			Lectures/Students centered learning	Class Test
CO2	Apply process management and CPU scheduling algorithms to solve scheduling problems	Cognitive/ Apply	3	5			Lectures/Students centered learning	Mid term
CO3	Analyze and implement solutions for concurrency, deadlock, and memory management problem	Cognitive/ Analyze	5	2			Lectures/Students centered learning	Final

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2			√									
CO3					√							

Course Content	Duration (Weeks)	COs
Introduction to Operating system functions, Different types of OS, Computer System Structure, operating system structure (simple, layered, modular), virtual machine, O/S services, system calls and API, Process Management	4	1
CPU scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, RR, priority), algorithm evaluation, multi-processor scheduling (Processor affinity, Load Balancing)	2	2
Critical section problem, race condition, synchronization hardware, classical problems of synchronization, semaphores, monitors. Deadlocks: system model, necessary conditions for deadlock, resource allocation graph, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.	4	3
Base and limit register, logical vs. physical address space, swapping, contiguous memory allocation (first-fit, best-fit, worst-fit algorithm), paging technique, segmentation, segmentation with paging.	4	4

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. A. Silberschatz and Peter Baer Galvin : **Operating System Concepts**, *Wiley Publisher* **[Text Book]**
2. Tanenbaum : **Operating Systems**, *Prentice Hall*
3. Madnick and J. Donovan : **Operating Systems**, *McGraw-Hill*
4. B. Hausen : **Operating System Principles,** *Prentice Hall of India*
5. Donovan : **Systems Programming,** *Prentice Hall*
6. M. MilenKovic : **Operating System Concept and Design**, *Tata McGraw Hill*
7. Terrence : **Unix System Programming in C++,** *Prentice Hall*

Course Code: CSE 3204 **Course Title:** Operating System and System Programming Lab
Course Type: Lab **Credit Hour: 2** **Total Marks:** 100
Pre-requisite: CSE 1201

Rationale: This course introduces how to work with virtual machine to learn and design open-source operating system (Ubuntu). Also introduces how to work at Ubuntu using terminal (commands), system call, create own system calls, create processes, practice and implement CPU scheduling algorithms like First Come First Serve (FCFS), Shortest Job First Scheduling (SJF) (Pre-emptive/Non-pre-emptive), Round Robin, Priority Scheduling and kernel compilation.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Execute basic Linux commands for file management, process control, and system monitoring	Psychomotor/ Manipulation	2	2			Hands on Class	Continuous Assessment
CO2	Evaluate the performance of different process scheduling algorithms and memory management techniques through implementation and analysis	Cognitive/ Evaluate	5	2	1,2, 3	1,3	Hands on Class	Lab Final

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1		√										
CO2					√							

Course Content	Duration (Weeks)	COs
Discussion and installation process of VMware/virtual box and ubuntu operating system on pc.	2	1
Practice Linux commands	3	1
Process Creation: Parent, child, Process Identifier	2	1
Code implementation using fork() and execlp()	2	2
Implementation of FCFS algorithm	2	2
Implementation of SJF algorithm	1	2
Implementation of Priority Scheduling algorithm	1	2
Implementation of Round Robin algorithm	1	2

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. A. Silberschatz and Peter Baer Galvin : **Operating System Concepts**, *Wiley Publishe*r **[Text Book]**
2. Tanenbaum : **Operating Systems**, *Prentice Hall*
3. Madnick and J. Donovan : **Operating Systems**, *McGraw-Hill*
4. B. Hausen : **Operating System Principles,** *Prentice Hall of India*
5. Donovan : **Systems Programming,** *Prentice Hall*
6. M. MilenKovic : **Operating System Concept and Design**, *Tata McGraw Hill*
7. Terrence : **Unix System Programming in C++,** *Prentice Hall*

Course Code: CSE 3205	**Course Title:** Microprocessor and Assembly Language	
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: CSE 3105		

Rationale: This course introduces the students to the Microprocessor and its Assembly Language programming. The course is designed based on the popular Intel 8086 microprocessor and provides a good understanding of the microprocessor operation at the address, data, and control level.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Describe Intel 8086 microprocessor Organization and Instruction sets.	Cognitive/ Understand	1	4			Lecture, Practice, Discussion	Midterm Exam
CO2	Discuss memory addressing modes.	Cognitive/ Understand	1	4			Lecture, Practice, Discussion	Final Exam
CO3	Use of flow control instructions, shift, rotation instructions.	Cognitive/ Apply	1	3			Lecture, Practice, Discussion	Class Test
CO4	Solve problems using logic operations in assembly language.	Cognitive/ Analyze	2	2			Lecture, Practice, Discussion	Assignment

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2	√											
CO3	√											
CO4		√										

Course Content	Duration (Weeks)	COs
Introduction to IMB PC Assembly Language, Assembly Language syntax. A few basic Instructions, program structure, memory models Input/output instruction, running program, Program Segment Prefix The processor status and the Flag register	2	1, 4
Multiplication and Division Instructions, signed versus unsigned multiplications	2	4
Overflow condition, debugging a program. Flow control instructions, High-level language structures: branching and looping structures	2	3, 4
Divide overflow, Arrays and related addressing modes, DUP operator. Register	2	2

Course Content	Duration (Weeks)	COs
indirect modes, Based, and Indexed addressing modes. The string instructions, director flag, moving a string, storing a string Loading a string, scanning a string, comparing strings, substring operation.		

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Ytha Yu and Charles Marut : **Assembly Language Programming and Organization of the IBM PC**, *McGraw-Hill* **[Text Book]**
2. Rafiquzzaman : **Microprocessor and Microcomputer based System Design,** *Crc Press Publication*
3. D. V. Hall : **Microprocessors and Interfacing,** *McGraw-Hill*

Course Code: CSE 3206 **Course Title:** Microprocessor and Assembly Language Lab
Course Type: Lab **Credit Hour: 2** **Total Marks:** 100
Pre-requisite: CSE 3106

Rationale: The course covers the software part through the teaching of assembly language programming techniques. Microprocessor Interface hardware and support chips are also examined in detail.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Demonstrate basic input/output operations with 8086 microprocessors.	Psychomotor/ Precision	5	6			Discussion, manual and hands on practice in lab	Continuous Assessment
CO2	Solve problems using decision making instructions.	Cognitive/ Apply	2	3				Viva
CO3	Solve problems using logic operations.	Cognitive/ Apply	2	4				Lab Report
CO4	Practice arithmetic operations to solve problems.	Cognitive/ Understand	3	5				Quiz

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1					√							
CO2		√										
CO3		√										
CO4			√									

Course Content	Duration (Weeks)	COs
Practice writing simple programs to take input characters and print them afterward Implement basic string printing operations	1	1
Implement the concept of compare operation by solving various basic condition related problems	3	2
Execute various types of Jumps in a wide range of practical scenarios. Include programs that have both of: Signed and Unsigned jumps	4	3
Implement the logic operations (AND, OR, XOR) and solve relating problems. Using Shift and rotate operation build the concept of manipulating bit-wise operation Using the DUP operator and various addressing modes work with basic array operations.	6	4

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. Ytha Yu and Charles Marut : **Assembly Language Programming and Organization of the IBM PC**, *McGraw-Hill* **[Text Book]**
2. Rafiquzzaman : **Microprocessor and Microcomputer based System Design,** *Crc Press Publication*
3. D. V. Hall : **Microprocessors and Interfacing,** *McGraw-Hill*

Course Code: CSE 3207		**Course Title:** Digital Signal Processing
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: CSE 2205, MAT 2141		

Rationale: This course introduces the basic concepts and methodologies of digital signal processing. The covered topics include signals, systems and signal processing, The z-transform, frequency analysis of signals and systems, the Discrete Fourier Transform: The DFT and Digital Filters: Design of FIR and IIR filters. It also familiarizes signal analysis techniques and concepts. The motivation of the course is to develop basics knowledge on Digital Signal Processing.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Describe concepts of signal and its discretization process.	Cognitive/ Understand	1	2			Lecture, Practice, Discussion	Class Test, Midterm Exam
CO2	Analyze the response of linear time invariant (LTI) systems to any input signal.	Cognitive/ Analyze	2	4			Lecture, Practice, Discussion	Assignment, Midterm Exam
CO3	Illustrate the concept and application of frequency domain signal processing	Cognitive/ Understand	2	4			Lecture, Practice, Discussion	Class Test, Final Exam
CO4	Apply Fourier transform to implement frequency domain filtering.	Cognitive/ Apply	3	5			Lecture, Practice, Discussion	Assignment, Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3		√										
CO4			√									

Course Content	Duration (Weeks)	COs
Introduction to Digital signal processing – Motivation: the importance and different applications of DSP in real time system. Overview: Basic concepts, Classifications of signals, Analog and discrete signal. Different types of discrete time signals, applications of discrete time signals, different operations of Signals. Analog to Digital Conversion, Sampling, Quantization. Digital to Analog Conversion.	3	1
Discrete time signals and systems: Discrete time signals, discrete time systems, analysis of discrete-time linear time- invariant systems. Discrete time systems	4	2

described by difference equations, implementation of discrete time systems, correlation and convolution of discrete time signals.		
The Discrete Fourier Transform: The DFT, Properties of the DFT, Filtering method based on the DFT, Frequency analysis of signals using the DFT	3	3
Fast Fourier Transform Algorithms: FFT algorithms, applications of FFT algorithm. Digital Filters: Design of FIR and IIR filters. Adaptive filters: Adaptive system, Kalman filters, RLS adaptive filters, the steepest-descent method, the LMS filters.	4	4

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Monson H. Haye:s : **Digital Signal Processing (**Schaum's Outlines) **[Text Book]**
2. John G. Proakis, Dimitris G. Manolakis : **Digital Signal Processing,** *Pearson*
3. David J. Defatta : **Digital Signal Processing,** *Wiley*

Course Code: CSE 3208 **Course Title:** Digital Signal Processing Lab
Course Type: Lab **Credit Hour: 2** **Total Marks:** 100
Pre-requisite: CSE 2206

Rationale: To provide implementation of signal processing techniques for analog and digital signals. The laboratory exercises are designed to give students ability to implement different problem-solving using signal processing techniques. Laboratory assignments progress from investigation of the various techniques of signal processing to solve real-world problems.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Demonstrate amplitude and time modification on discrete signal.	Cognitive/ Apply	1	3			Discussion, manual and hands on practice in lab	Continuous Assessment
CO2	Compute statistical features of a real-world signal.	Cognitive/ Analyze	2	2				Continuous Assessment
CO3	Operate frequency domain	Cognitive/	4	8				Quiz, Lab

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
	transformation and filtering on a discrete signal.	Apply						Test

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3				√								

Course Content	Duration (Weeks)	COs
Overview of software, how to generate a waveform, amplitude, frequency. generate some basic signals Continuous and discrete signals Signal Addition, Multiplication, Shifting operation Folding or Time reversed	7	1
Problem for different types of operations on signals Change of shape with noise for real world signals Finding features of a signal	4	2
How to generate: Fourier Transform Convolution	3	3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. Monson H. Hayes : **Digital Signal Processing (**Schaum's Outlines) **[Text Book]**
2. Rafiquzzaman : **Microprocessor and Microcomputer based System Design,** *Crc Press Publication*
3. D. V. Hall : **Microprocessors and Interfacing,** *McGraw-Hill*

Course Code: CSE 3209	**Course Title:** E-commerce and Web Programming
Course Type: Theory	**Credit Hour:** 2.0 **Total Marks:** 100
Pre-requisite: CSE 1201	

Rationale: This course is designed to grow concepts and skills for the strategic use of e-commerce and related information technology from three perspectives: business to consumers, business-to-business, and intra- organizational. Examination of e-commerce in altering the structure of entire industries, and how it affects business processes including electronic transactions, supply chains, decision making and organizational performance. This course will help students to demonstrate and understand the importance of E-Commerce, analyze the impact of E- commerce on business models and strategy, and describe the infrastructure for E-commerce. This course also offers the student foundational programming knowledge and skills for application development on the Internet.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Describe basic terminologies and concept of E-commerce.	Cognitive/ Understand	1	1			Lectures Slide	Mid-term
CO2	Apply payment processing system to enhance the e-commerce applications	Cognitive/ Understand	1	2			Lectures Slides	Final
CO3	Design web programming concept in developing e-commerce system.	Cognitive/ Create	5	6			Lectures Slides, Hands-on work	Assignment

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2	√											
CO3					√							

Course Content	Duration (Weeks)	COs
E-Commerce Definition, E-Commerce business models, E-Commerce Challenges, E-Commerce Opportunities. Internet Access Requirements, Web Hosting Requirements, Storefront and Template Services, E- Commerce Software Packages, E-Commerce Developers, E-Business Solutions	3	1
Web Site Goals, Planning Stages, Resource Allocation, Content Development, Web Site Design Principles, Web Site Design Tools, Web Page, Programming Tools, Data-Processing Tools. Navigation Aids, Web Site Search Tools, Search Engines,	3	1, 3

Course Content	Duration (Weeks)	COs
Web Site Monitoring, Forms, Shopping Carts, Checkout Procedures, Shipping Options.		
Electronic Payment Issues, E-Cash, Credit Card Issues, Merchant Accounts, Online Payment Services, Transaction Processing. Security Issues and Threats, Security Procedures, Encryption, Digital Certificates, SSL and SET Technologies, Authentication and Identification, Security Providers, Privacy Policies.	3	2
HTML tags, formatting text, creating links, adding images, lists, tables, frames, forms, Cascading Style Sheets (CSS), graphics; Adding Multimedia – Audio, Video, Graphics. Introduction to JavaScript, JavaScript syntax, variables, functions, events, jQuery, Ajax	5	3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Elias M. Awad : **Electronic Commerce: From Vision to Fulfilment**, *Prentice-Hall Inc.* **[Text Book]**
2. Jeffrey F., Rayport, Bernard J. Jaworsk : **E-Commerce,** *McGraw-Hill*
3. David Kosiur : **Understanding Electronic Commerce**, *Microsoft Press*.
4. Jeffrey F. Rayport, et al. **Introduction to E-Commerce**, *McGraw-Hill.*
5. Debra Cameron : **E-Commerce Security Strategies: Protection the Enterprise**, *Computer Technology Research Corp*
6. Charles Trepper : **E-Commerce Strategies**, Phi Learning Pvt. Ltd
7. Dave W. Mercer, Steven D. Nowicki : **Beginning PHP 5**, *Wrox publication*.

Course Code: CSE 3210 **Course Title:** E-commerce and Web Programming Lab
Course Type: Lab **Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: CSE 1201, CSE 3103

Rationale: This course is designed to provide the student with foundational programming knowledge and skills for application development on the Internet. The student will learn about the Web as a development platform through the use of popular representative languages (such as PHP). The student will learn to plan, design, construct, and integrate basic server-side components of modern web applications including databases and scripts.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Design web pages with well-structured, easily maintainable, standards-compliant with accessible HTML code.	Cognitive/ Create	3	5			Hands-on Practice	Lab Test
CO2	Develop dynamic website with user interactive interface using server-side scripting and MySQL database.	Cognitive/ Create	5	6	1,2, 3	1,3	Hands-on Practice	Assignment

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1			√									
CO2					√							

Course Content	Duration (Weeks)	COs
HTML tags, formatting text, creating links, adding images, lists, tables, frames, forms, Cascading Style Sheets (CSS), graphics; Adding Multimedia – Audio, Video, Graphics.	5	1
Introduction to JavaScript, JavaScript syntax,	2	1, 2
variables, functions, events, jQuery, Ajax	1	
PHP basics, processing forms, sessions, cookies, back-end database support, database interface in PHP, searching in web applications.	3	2, 2
PHP and MySQL CRUD	4	2

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. Elias M. Awad : **Electronic Commerce: From Vision to Fulfilment**, *Prentice-Hall Inc.* **[Text Book]**
2. Jeffrey F., Rayport, Bernard J. Jaworsk : **E-Commerce,** *McGraw-Hill*
3. David Kosiur : **Understanding Electronic Commerce**, *Microsoft Press*.
4. Jeffrey F. Rayport, et al. **Introduction to E-Commerce**, *McGraw-Hill.*
5. Debra Cameron : **E-Commerce Security Strategies: Protection the Enterprise**, *Computer Technology Research Corp*
6. Charles Trepper : **E-Commerce Strategies**, Phi Learning Pvt. Ltd
7. Dave W. Mercer, Steven D. Nowicki : **Beginning PHP 5**, *Wrox publication*.

Course Code: ACC 3271	**Course Title:** Industrial Management and Accountancy	
Course Type: Theory	**Credit Hour:** 2.0	**Total Marks:** 100
Pre-requisite: None		

Rationale: This course introduces the basic concepts about industries and how the business be formed. Students can learn about management and the role of a manager. They can gather proper knowledge about plant layout and utility. They basic accounting principles and transaction methods are learned. They can prepare journal, ledger and trial Balance, work sheet etc. They can learn about cost terms and classifications.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Illustrate industries and the ways of business formation.	Cognitive/ Apply	1	2			Lecture, Text Book	Class test, Assignment
CO2	Interpret the knowledge of management, plant layout and utility	Cognitive/ Apply	2	4			Lecture, Practice, Text Book	Assignment, Midterm Exam
CO3	Practice the accounting terms like journals, ledgers, work sheet etc. in real life problem.	Cognitive/ Understand	5	6			Lecture, Practice, Text Book	Class Test, Final exam
CO4	Describe the cost terms with classifications.	Cognitive/ Understand	2	3			Lecture, Practice, Text Book	Assignment, final exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3					√							
CO4		√										

Course Content	Duration (Weeks)	COs
Industry: Commerce-Industry: Meaning & Characteristics of Industry, Types of Industry. Business: Meaning & Objectives of Business, Types of Business- Sole Proprietorship, Partnership, Joint Stock Company, State Enterprise and Cooperative Society.	1	1
Fundamentals of Management: Meaning of Management, Principles of Management, Functions of Management, Levels of Management, Roles of Management, Management skills, Scientific Management, Consultative Management, and Participative Management. Factory Location, Plant Location and Utility, Factors Determining Location of Factory, Steps in Location.	2	2
Plant Layout and Utility: Definition, Types of Layouts, Problems of Layout, Plant Utility, Problem Solving, Linear Programming EOQ, Lead Time, Safety Stock, Re-Order Point, Lighting, Ventilation, Air- conditioning, Sanitation and Noise Control.	1	2
Accountings: Basic Accounting Principles, Objectives of Accounting, Information and Uses.	1	3
Transactions: Meaning and Classification of Account, Accounting Equation, Double Entry System, Rules for Determining Debit and Credit, Accounting Cycles.	2	3
Journal, Ledger and Trial Balance: Meaning, Features, Necessity, Rules, Double and Triple Column Cash Book and Practical Problems. **Work Sheet:** Meaning, Purpose, Adjustment Entries and 10 Columns Work Sheet.	5	3
Cost Terms, Concepts and Classification: Meaning of Cost, Manufacturing and Non-Manufacturing Costs, Periodic and Product Costs, Fixed and Variable Costs, Direct and Indirect Costs, Preparation of Cost Sheet, Cost Volume Profit (CVP) Analysis, Standard Costing, Process Costing.	2	4

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. M. C. Shukla : **Business Organization and Management**, *S. Chand Publisher* **[Text Book]**
2. Harold Koontz and Heinz Weihrich : **Management,** *Tata McGraw-Hill*
3. Krajewski and Ritzman : **Operation Management**, Addison-Wesley Publishing Company
4. Jeffrey F. Rayport, et al. **Introduction to E-Commerce**, McGraw-Hill.
5. David A. Decenzo and Stephen P. Robbins : **Human Resource Management**, *John Wiley & Sons Publisher*.
6. Hermanson Etar : **Accounting Principles**, *Business Publications*
7. Ray H. Garrison : **Managerial Accounting**, *Irwin Professional Publishing*

4th year
(Odd Semester)

Course Code: CSE 4101		**Course Title:** Artificial Intelligence
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: MAT 3141		

Rationale: To realize the intelligent human behaviors on a computer. The ultimate goal of AI is to make a computer that can learn, plan, and solve problems autonomously. In this course, we will study the most fundamental knowledge for understanding AI. We will introduce Fundamental of Artificial Intelligence, some basic search algorithms for problem solving, knowledge representation and reasoning, Uncertainty, Fuzzy logic, Expert System, Robotics, Natural language processing and neural networks.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Discuss about the Artificial Intelligence (AI) problem space and related searching algorithms.	Cognitive/ Understand	1	3			Lecture and Discussion using Power Point and Textbook.	Assignment
CO2	Use the concept of knowledge representation with its application in AI implementation.	Cognitive/ Apply	2	3				Midterm Exam
CO3	Analyze the learning approaches to achieve the AI system.	Cognitive/ Analyze	4	8				Class Test
CO4	Design artificial neural network (ANN) suitable for pattern classification.	Cognitive/ Create	9					Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3				√								
CO4									√			

Course Content	Duration (Weeks)	COs
Fundamental of Artificial Intelligence: Definition of Al, Historical Development of Al, Application of Al, Intelligent agents – Structure of agents and its functions, Problem spaces and Search Algorithms- Breadth First Search, Depth First Search, Iterative Deepening Search, Hill Climbing, Heuristic Search, A* Algorithm, Greedy Best First Search, the Minimax Algorithm, Constraint Satisfaction Problems.	4	1
Knowledge Representation: Approaches and issues in knowledge representation- Knowledge - Based Agent- Propositional Logic – Predicate logic – Unification –	3	2

Course Content	Duration (Weeks)	COs
Resolution - Weak slot - filler structure – Strong slot - filler structure.		
Reasoning under Uncertainty: Bayesian Reasoning, Naive Bayes Probability Theory, Dempster-Shafer Theory, Algorithm, Fuzzy Logic, Fuzzy Set Theory.	3	3
Introduction to selected topics in AI: Expert Systems. Robotics, Natural Language Processing., Neural Networks, Forms of learning - inductive learning - Reinforcement Learning - learning decision trees - Neural Net learning and Genetic learning. Features of Al Programming Languages, Major Al Programming Languages: Python and Prolog, Implementation of AI Algorithms Through Python and Prolog.	4	4

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Elaine Rich, Kevin Knight and S.B. Nair : **Artificial Intelligence,** *McGraw-Hill* **[Text Book]**,
2. Stuart J. Russell and Peter Norvig : **Artificial Intelligence: A Modern Approach**, *Pearson*
3. D.W. Patterson : **Introduction to Artificial Intelligence and Expert Systems**, *Prentice Hall*
4. Patrick Henry Winston : **Artificial Intelligence**, *Addison-Wesley*
5. N. P. Padhy : **Artificial Intelligence and Intelligent Systems**, *Oxford University Press*
6. Ivan Bratko : **Prolog Programming for Artificial Intelligence**, *Addison-Wesley*
7. Prateek Joshi : **Artificial Intelligence with Python**, *Packt Publishing*

Course Code: CSE 4102 **Course Title:** Artificial Intelligence Lab
Course Type: Lab **Credit Hour: 2** **Total Marks:** 100
Pre-requisite: MAT 3141

Rationale: To provide hands-on experience in designing and implementing Artificial Intelligence systems through Prolog and Python Language. The laboratory exercises are designed to give students the ability to implement different real-life problems, machine learning and deep learning algorithms.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Understand the informed and uninformed problem types and apply search strategies to solve them	Cognitive/ Apply	1	3			Discussion and hands on practice in lab	Continuous Assessment
CO2	Apply difficult real-life problems in a state space representation so as to solve them using Machine Learning techniques	Cognitive/ Understand	5	6			Discussion and hands on practice in lab	Continuous Assessment
CO3	Model the solution of real-life problems using Deep Learning techniques.	Cognitive/ Analyze	3	4			Discussion and hands on practice in lab	Final Lab Test

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2					√							
CO3						√						

Course Content	Duration (Weeks)	COs
Basics of Turbo Prolog, Intro to Prolog programming, Running a simple program. An Introduction to Python Programming Performance of a Machine Learning Algorithm. (Accuracy, Precision, Sensitivity, Specificity)	2	1
The Family relations Prolog Problem The Jungle Problem: Different Arithmetic Programs using Prolog and Python	4	2
Medical Diagnosis system.	3	3
Implementation of KNN Algorithm. Implementation of Support Vector Machine (SVM)	5	4

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. Ivan Bratko : **Prolog Programming for Artificial Intelligence,** *Addison-Wesley* **[Text Book]**
2. Carl Townsend : **Introduction to Turbo Prolog**, *BPB Publications*
3. Prateek Joshi : **Artificial Intelligence with Python**, *Packt Publishing*

Course Code: CSE 4103		**Course Title:** Digital Image Processing
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: CSE 3207		

Rationale: This course introduces the basic concepts and methodologies of digital image processing. The covered topics include image representation and storage, image enhancement, high-dimensional spectral analysis, spatial and frequency domain image filtering, binary image processing, edge detection, image segmentation, feature extraction and image compression. It also familiarizes image analysis techniques and concepts. The motivation of the course is to develop basic knowledge on Digital Image Processing. After completing the course, the students will be able to start working on computer vision.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Describe the concept of digital image representation and enhancement.	Cognitive/ Remember	1	2			Lectures, Practice, Discussion	Class Test, Assignment
CO2	Understanding the improvement of image quality by filtering and restoration.	Cognitive/ Understand	2	4			Lectures, Practice, Discussion	Midterm, Assignment
CO3	Apply image processing algorithms in relevant applications.	Cognitive/ Apply	12				Lectures, Practice, Discussion	Class test, Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3												√

Course Content	Duration (weeks)	COs
Introduction and Image Representation: Introduction to digital image and digital image processing, history of digital image processing, state of the art examples of digital image processing, key stages in digital image processing, digital image representation, image sampling and quantization, image resolution.	2	1
Image Enhancement: Concept of image enhancement, Different kinds of image enhancement, histogram processing, point processing, neighborhood operations. Some point processing includes Point Processing: concept on point processing.	2	1
Enhancement by Spatial Filtering: Defining point processing, Negative images, Thresholding, Logarithmic transformation, Power law transforms, Grey level slicing, Bit plane slicing, Neighborhood operations, spatial filtering, Smoothing operations, Correlation and convolution, sharpening filter, combining filtering techniques.	2	2
Frequency Domain Filtering: Concept of Fourier transform (FT), 2D implementation of FT and image processing in frequency domain, different frequency domain filters for image smoothing and sharpening, comparison of spatial and frequency domain filtering	2	2
Image Restoration: Introduction to image restoration, noise and images, different noise models, noise removal using spatial domain filtering, dealing with periodic noise, different types of mean filters, noise removal using frequency domain filtering.	1	2
Image Segmentation: The segmentation problem, finding points, lines and edges, derivative based edge detection, effects of noise in derivative-based edge detection, common spatial filters for edge detection, thresholding- based image segmentation, simple thresholding, global thresholding, adaptive thresholding.	2	3
Morphological image processing: Morphology and its application in image processing, structuring element and basic morphological operations, compound operations, opening, closing, boundary extraction, other morphological algorithms used in image processing.	2	3
Image Compression: Image compression, lossy and lossless compression, compression ratio and data redundancy, different types of data redundancy, information and entropy, image compression model, concept of different methods.	1	3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Rafael C. Gonzalez and Richard E. Woods : **Digital Image Processing,** 4th Edition. **[Text Book]**
2. David Vernon : **Machine Vision: Automated Visual Inspection and Robot Vision,** *Prentice Hall, 1991*
3. Pratt William K : **Digital Image Processing,** PIKS Scientific Inside, 4th Edition**,** *John Wiley*
4. Pitas Ioannis : **Digital Image Processing Algorithms and Applications,** *John Wiley*

Course Code: CSE 4104	**Course Title:** Digital Image Processing Lab	
Course Type: Lab	**Credit Hour: 2**	**Total Marks:** 100
Pre-requisite: CSE 3208		

Rationale: The course aims to provide hands-on experience in basic concepts and methodologies of digital image processing. The laboratory tasks are aimed to teach students how to implement image processing techniques to solve a variety of problems. At the end of this course, students should be able to apply various image processing approaches that lead to the solution of real-world problems in laboratory tasks.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Demonstrate basic image manipulation techniques	Cognitive/ Apply	1	3			Discussion and hands on practice in lab	Continuous Assessment
CO2	Interpret image filtering and enhancement techniques in spatial and frequency domain	Cognitive/ Understand	3	5			Discussion and hands on practice in lab	Continuous Assessment
CO3	Examine the performance midlevel image analysis techniques	Cognitive/ Analyze	4	8			Discussion and hands on practice in lab	Final Lab Test

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2			√									
CO3				√								

Course Content	Duration (weeks)	COs
Apply basic image conversion: RGB to Gray, BW, Colour channel separation. Gray level transformation: Thresholding, negative, log, inverse log	2	1
Gray level transformation: power law: nth power, nth root, gray level slicing, bit plane slicing, scaling, rotation, histogram, histogram equalization. Different arithmetic operations on images.	3	1
Analyze different filtering techniques of Smoothing and Sharpening in Spatial domain.	2	2
Analyze different point processing techniques: point detection, line detection, edge detection	3	2
Implement different filtering techniques of image restoration and compare.	2	3
Implement basic operations, compound operations of morphological operation. Implement algorithms of morphological operation.	2	3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz/Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. Rafael C. Gonzalez and Richard E. Woods : **Digital Image Processing**, 4th Edition. [**Text Book**]
2. David Vernon : **Machine Vision: Automated Visual Inspection and Robot Vision,** *Prentice Hall*, *1991*
3. Pratt William K : **Digital Image Processing**, PIKS Scientific Inside, 4th Edition, *John Wiley*
4. Pitas Ioannis : **Digital Image Processing Algorithms and Applications**, *John Wiley*

Course Code: CSE 4105 **Course Title:** Engineering Ethics and Environmental Protection
Course Type: Theory **Credit Hour:** 2.0 **Total Marks:** 100
Pre-requisite: None

Rationale: The course aims to provide an understanding of the principles of Engineering Ethics and Environmental Protection. As an Engineer, it is one of the utmost duties is maintain a strong morality so that the things they create are not used for harmful purpose, and also ensure that the inventions or products made do not have a bad impact on the environment.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Correlate between the attributes of engineers with ethical conundrums	Cognitive/ Analyze	8	7			Lectures, Textbook	Midterm Exam
CO2	Illustrate and demonstrate the responsibilities towards the society and the environment	Cognitive/ Apply	7	7			Lectures, Textbook	Final Exam
CO3	Apply ethical knowledge of engineers in the protection of the environment	Cognitive/ Apply	7	7			Lectures, Textbook	Class Test, Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1								√				
CO2							√					
CO3							√					

Course Content	Duration (Weeks)	COs
Engineering Ethics **Introduction to Engineering ethics and professionalism:** What is engineering ethics? Why study engineering ethics? Responsible Professionals, Professions, and Corporations, The Origins of Ethical Thought, Ethics and the Law, Moral Reasoning and Codes of Ethics: Ethical decision-making strategies, Ethical dilemmas, Codes of ethics, Case studies **Moral Frameworks for Engineering Ethics:** Ethical theories, Personal commitments, and professional life **Ethical Problem-Solving Techniques:** Analysis of Issues in Ethical Problems, An Application of Problem-Solving Methods, Engineering as Social Experimentation: Engineering as Experimentation, Engineers as Responsible Experimenters, Risk, Safety, and Accidents: Assessment of safety and risk, Design considerations, uncertainty, Risk-benefit analysis, safe-exit and fail- safe systems	5	1
Engineer's Responsibilities and Rights: Employee/employer rights and responsibilities, Confidentiality and conflict of interest, Whistleblowing, Case studies on whistleblowing **Honesty and Research Integrity:** Truthfulness, Trustworthiness, Research Integrity, Protecting Research Subjects **Computer Ethics:** The Internet and Free Speech, Power Relationships, Property, Privacy, Additional Issues **Environmental Ethics:** Engineering, ecology, economics, Sustainable development, Ethical frameworks	5	2

Course Content	Duration (Weeks)	COs
Global Issues: Multinational corporations, globalization of engineering, Technology transfer, appropriate technology **Cautious Optimism and Moral Leadership:** Cautious optimism as a technology development attitude, Moral leadership in engineering **Cyber Law:** Definition Nature, Scope, Utility of Cyber Law, Origin and Development of Cyber Law and Internet **ICT Policy in Bangladesh;** Internet Service Providers (ISP)- Domain Name, Present Legal Basis of ISP in Bangladesh; e- Readiness in Bangladesh- e-Commerce in Bangladesh, e-Governance in Bangladesh, e-Learning/Education in Bangladesh, e-Journal in Bangladesh, e-Voting in Bangladesh; Electronic Evidence- Digital Signature, The Evidence Act of 1872 Vs. ICT Act-2006, Electronic Evidence in Bangladesh, Legal Effects of Electronic Evidence, UNCITRAL Model Law on Electronic Evidence; **Cyber Crime:** Jurisdiction and Cyber Crime, Criminal Justice in Bangladesh and Implications on Cyber Crime; Cyber vandalism, Hacking, Malicious Spreading in Viruses, Password fraud, Cheating, Cyber Pornography, Child Pornography, Protection of Copyrights and Intellectual Property right, Invasion of Privacy, Constitutional basis of Privacy, Unsolicited E-Mail, Defamation, Harassment and e-Mail Abuse, Present Legal Protection; **Human Rights Violation and Internet;** The Information and Communication Technology Act, 2006- Objectives, Strengths & Weaknesses of the ICT Law, Regulation of Cryptography;		
Environmental Protection **Environmental Laws of Bangladesh:** The Environment Conservation Act 1995, The Environment Court Act 2010, The Forest Act 1927, The Wildlife (Conservation and Security) Act 2012, The Brick Manufacturing and Brick Kilns Establishment (Control) Act 2013, The Bangladesh Biodiversity Act 2017 **International Environment Law:** International Environment Law and its effects and regulations on the computer technology industry.	3	3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Charles B. Fleddermann : **Engineering Ethics.** *Pearson, 4th Edition, 2011* [**Text Book**]
2. Mike W. Martin, Roland Schinzinger : **Introduction to Engineering Ethics,** *McGraw-Hill, 2nd Edition, 2010*
3. Vivck Sood : **Cyber Law Simplified,** *Tata McGraw Hill Publications*
4. V. D. Dudej : **Information Technology & Cyber Laws,** *Commonwealth Publishers*
5. I.Brownlie : **Principles of Public International Law,** *(4th Ed.) 1990*
6. John Strawson : **Public International Law,** *London, 1996*

Course Code: CSE 4100 **Course Title:** Project or Thesis with Seminar Part I
Course Type: Final Year Design Project (FYDP) 1 **Credit Hour:** 4.0 **Total Marks:** 100
Pre-requisite: Completion of course works relevant to the proposed project/thesis work.

Time frame: Each student is required to complete a project over the combined duration of two semesters in 4th year. In the odd semester, as part of the course CSE 4100 (Part-I), students must present and defend a project proposal along with initial outcomes at the end of the semester. The project or thesis is then to be completed with full outcomes and a dissertation in the continuation course, CSE 4200 (Part-II), during the even semester of 4th year.

Rationale: This course is designed to help students develop the skills needed to function effectively both as individuals and as members or leaders of diverse teams in multidisciplinary settings. The student will identify an engineering and/or computing problem and apply their knowledge and skills to solve it using systematic methods and modern engineering tools.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Use principles of mathematics, science, and engineering to propose an initial conceptual approach toward solving a real-world engineering problem.	1	1, 3			Discussion, Lecture notes, Readings from books, journals, research papers	Project report, Viva, Presentations
CO2	Identify and formulate an engineering problem through literature review and analytical reasoning, applying fundamental principles of mathematics, science, and engineering to define its scope and objectives.	2	4				
CO3	Develop and justify a conceptual solution for an identified engineering problem, integrating cultural, societal, and environmental considerations into the design approach.	3	5				

COs	Description	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO4	Formulate a research plan, reviewing relevant literature, and outlining appropriate methods for experimentation, data analysis, and interpretation.	4	8				
CO5	Apply modern engineering and IT tools effectively for modeling, analysis, and prediction in their project, while recognizing the scope and limitations of the chosen techniques and resources.	5	2				
CO6	Assess the broader implications of their engineering solution by analyzing its sustainability, societal relevance, economic viability, health and safety considerations, legal compliance, and environmental impact.	6	5, 7	1, 2, 3			

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3			√									
CO4				√								
CO5					√							
CO6						√						

Course Content	Duration (Weeks)	COs
Group formation & project selection	1	9
Introduction to Final Year Project Meet the supervisor and discuss about the possible topics for the project. Document the outcome of the meeting in the log book.	1	1
Effective Literature Review Meet the supervisor and finalize the topic for the project. Document the outcome of the meeting in the log book.	1	1, 2
Research Methodologies Start the literature review process Document the outcome of the meeting in the log book.	1	3
Avoiding Plagiarism	1	8

Continue with the literature review Meet the supervisor to show the findings from literature review. Write the preliminary research objectives		
Continue the literature review Meet with the supervisor to present the key findings. Drafts the research objectives based on the supervisor's feedback	1	7
Align the research objectives with societal needs Modify and finalize the research objectives in this regard	1	6
Effective Technical Report Writing Meet the supervisor to discuss about desecration	1	10
Effective Presentation Skill Meet the supervisor to discuss about presentation.	1	10
Meet the supervisor and discuss findings from the analysis. Document the outcome of the meeting in the log book.	1	4
Improve the preliminary analysis Meet the supervisor and discuss findings from the analysis.	1	4
Finalize the analysis and document the results. Meet the supervisor and discuss results from the final analysis. Document the outcome of the meeting in the log book.	1	2
Meet the supervisor and discuss the progress for future work. Document the outcome of the meeting in the log book.	1	2
Prepare the draft version of the final report Meet the supervisor and discuss the final report. Document the outcome of the meeting in the log book. Submit the log book along with signatures to the department Execute all tasks within the time frame through effective project planning.	1	5, 10

Assessment Detail:

Assessment Tools		**Marks (%)**
Continuous Assessment (CA)	Participation	10%
	Continuous Assessment (Team Work and Individual Performance, Report)	40%
Summative Assessment (SA)	Final Examination (Presentation, Viva, Project Report)	50%
	Total	**100%**

Course Code: CSE 4120 **Course Title:** Industrial Attachment
Course Type: Internship **Credit Hour:** 2 **Total Marks:** 100
Pre-requisite: None

Rationale: This course is designed to provide experience to students through internship/Co-op works in IT/Software industry. Students will work there, prepare detailed reports and their supervisors will evaluate their work. This course aims to provide students with a professional environment and workload similar to what they would find when they join different firms after graduation.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Apply knowledge and skills gained throughout the program to work in industry.	Cognitive/ Apply	3	6			Lecture notes and handouts, Discussions, Case studies and Real-world scenario analysis	Observation/ Report Writing, Oral Presentation
CO2	Develop adaptation ability with industry environment and teamwork.	Cognitive/ Analyze	10					

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1			√									
CO2										√		

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Report)	40%
Summative Assessment (SA)	Final Examination (Presentation, Feedback form, Viva)	50%
	Total	**100%**

Option I

Course Code: CSE 4109 **Course Title:** Computer Vision and Pattern Recognition
Course Type: Theory **Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: CSE 3101, CSE 4103

Rationale: The purpose of this course is to provide the students a string theoretical grounding of computer vision and pattern recognition. Students will get to apply their previously learned image processing knowledge to computer vision applications. Students will learn different image feature extraction technique and learn their tradeoffs and will also understand different image representation techniques. The purpose of this course is also to introduce the students with computer vision techniques. The core component of the computer vision part will be convolutional neural network. The course will make students capable of choosing right architecture, hyper parameter and optimization algorithms.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Apply image feature extraction techniques	Cognitive/ Apply	2	4			Lecture notes, readings from books	Class test, midterm examination
CO2	Design convolutional neural networks	Cognitive/ Design	3	5			Lecture notes, readings from books	Assignment, midterm examination
CO3	Analyze a complete computer vision system	Cognitive/ Analyze	4	8			Lecture notes, readings from books	Class test, Final examination

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1		√										
CO2			√									
CO3				√								

Course Content	Duration (weeks)	COs
Image formation: Geometric primitives and transformation, photometric image formation, sampling and aliasing	2	1
Basic image processing technique review: point operations, correlation and convolution in spatial domain, filter masks, 2D Fourier transform, filtering in frequency domain	2	2

Course Content	Duration (weeks)	COs
Feature detection: edge detection, image segmentation, Hough transformation, active contours, split and merge, mean shift and mode finding, graph cuts and energy-based methods.	2	2
Dense motion estimation: translational alignment, parametric motion, spline-based motion, optical flow	1	2
Image based rendering: view interpolation, light fields and lumigraphs, environment matters.	1	2
Pattern recognition: Linear classifiers, loss function optimization, nonlinear classifiers, kernel methods,	1	3
Loss function optimization: Image feature optimization, gradient descent and other advanced 2^{nd} order optimization techniques.	1	3
Neural networks: multilayer perceptron, loss function of the MLP network. Convolutional neural networks: the structure of the network, convolution and pooling.	2	3
Training and hyper parameter tuning: automatic differentiation using backpropagation, activation functions, batch processing, image normalization, transfer learning, update rules, tuning learning parameters, data augmentation	2	3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Richard Sizelski : **Computer Vision: Algorithms and Application,** *Springer* **[Text Book]**
2. David Forsyth, Jean Ponce : **Computer Vision: A Modern Approach,** *Pearson*
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville : **Deep Learning,** *MIT Press*

Course Code: CSE 4110	**Course Title:** Computer Vision and Pattern Recognition Lab	
Course Type: Lab	**Credit Hour: 2**	**Total Marks:** 100
Pre-requisite: CSE 3102, CSE 4104		

Rationale: To provide hands-on experience in the field of computer vision and pattern analysis. To implement different computer vision and pattern recognition algorithms. Implement different image processing techniques and their trade-offs for computer vision applications. To implement different image feature extraction techniques to be used in the computer vision and pattern recognition pipeline. Understand the trade-offs of different cost function optimization techniques to optimize cost functions of different classifiers. Implement a complete computer vision pipeline using a convolutional neural network and understand the weaknesses and strength of different architecture and learn hyper parameters tuning process.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Identify the need of different image pre-processing and feature extraction techniques	Cognitive/ Understand	1	4			Demonstration and discussion	Continuous assessment
CO2	Analyze any computer vision problem and implement the vision and pattern analysis system	Cognitive/ Analyze	2	3			Demonstration and discussion	Continuous assessment and Final exam
CO3	Solve real world pattern recognition problems using convolutional neural networks	Cognitive/ Apply	2	4			Demonstration and discussion	Final Lab exam, Viva/Project

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2		√										
CO3		√										

Course Content	Duration (Weeks)	COs
Introduction to Open CV and other machine learning frameworks e.g. keras, scikit-learn. Implement different image filtering techniques in both spatial and frequency domains. Implement image feature extraction techniques and understand the appropriate approach for any specific applications.	5	1
Solve some real-life computer vision example problems. Implement basic pattern recognition techniques e.g support vector machines, neural	5	2

Course Content	Duration (Weeks)	COs
networks, and apply them to computer vision applications Implement different cost function optimization algorithms for application in pattern recognition problems algorithms		
Design and implement complete convolutional neural network and understand the strengths and weaknesses of different architectures. Understand the appropriate hyper parameter technique for the problem at hand and implement them for application in the convolutional neural network. Map the practical relationship between the performance of convolutional neural networks and different image feature extraction techniques by implementing and analyzing the performance.	4	3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. Adrian Kehler, Gary Rost Bradski : **Learning OpenCV**, *O'Reilly* **[Text Book]**
2. Richard Szeliski : **Computer Vision: Algorithms and Applications**, *Springer.*
3. Aurelien Geron : **Hands on Machine Learning with Scikit-Learn, Keras and Tensorflow,** *O'Reilly*

Course Code: CSE 4111 **Course Title:** Mobile Apps and Game Development
Course Type: Theory **Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: CSE 2101, CSE 2201, CSE 2203, CSE 3101, CSE 3103

Rationale: Mobile Apps and Game Development will foster student creativity and innovation by presenting students with opportunities to design, implement, and present meaningful programs through a variety of media and using mobile computing devices. Through data analysis, students will include the identification of task requirements, plan search strategies, and use programming concepts to access, analyze, and evaluate information needed to design games. By acquiring programming knowledge and skills that support the work of individuals and groups in solving problems, students will select the technology appropriate for the task, synthesize knowledge, create solutions, and evaluate the results.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Understand the building blocks of an application	Cognitive/ Understand	2	4			Lectures, PowerPoint Slides, Discussion	Midterm examination
CO2	Understand a game development environment	Cognitive/ Understand	5	6			Lectures, Textbook, and Practice	Assignment
CO3	Performance analysis of an application	Cognitive/ Apply	4	8			Lecture, Practice, Discussion	Class test, Final examination

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1		√										
CO2					√							
CO3				√								

Course Content	Duration (Weeks)	COs
Introduction to App Development: Introduction to Mobile Computing, Introduction to Android Development Environment, Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI Development, Android User	2	1
Intents on UIs VUIs and Mobile Apps: Text-to-Speech Techniques Designing the Right UI Multichannel and Multi Modal UIs and Services: Android Intents and Services, Characteristics of Mobile Applications, Storing and Retrieving Data, Synchronization, and Replication of Mobile Data, Android Storing and Retrieving Data, Working with a Content Provider **Communications Via Network and the Web:** State Machine, Communications Model, Android Networking, Deciding Scope of an App, Wireless Connectivity and Mobile Apps, Android Telephony, Performance and Memory Management, Android Notifications and Alarms	3	1,2
Graphics: Performance and Multithreading, Graphics and UI Performance, Android Graphics and Multimedia, Mobile Agents and Peer-to-Peer Architecture, Android Multimedia Location, Mobility and Location Based Services **Miscellaneous:** Packaging and Deploying, Performance Analysis, Active Transactions, Security measures, Testing.	3	3
Introduction to Unity and C#: prototyping using C# and Unity. We will go over general syntax and code structures in C#, how to use the Unity editor, and how to work with Unity objects through code.	2	2

Course Content	Duration (Weeks)	COs
App/Game Development: Structure: Students will work in pairs to create an original prototype. Assignments: Pair assignment due during the final exam period. Students will create a new, unique prototype. This will be based on their work throughout the semester and should both showcase all of the skills that they've learned throughout the semester and express a unique design vision.	4	2,3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. J. Paul Cardle : **Android App Development in Android Studio: Java + Android** *Createspace Independent Publishing Platform* **[Textbook]**
2. Jeff Mcherter and Scott Gowell : **Professional Mobile Application Development**
3. Raul Portales : **Mastering Android Game Development,** *Packt Publishing Limited*

Course Code: CSE 4112 **Course Title:** Mobile Apps and Game Development Lab
Course Type: Lab **Credit Hour: 2** **Total Marks:** 100
Pre-requisite: CSE 2102, CSE 2202, CSE 2204, CSE 3102, CSE 3104

Rationale: Mobile Apps and Game Development Lab will foster student creativity and innovation by presenting students with opportunities to design, implement, and present meaningful programs through a variety of media and using mobile computing devices. Through data analysis, students will include the identification of task requirements, plan search strategies, and use programming concepts to access, analyze, and evaluate information needed to design games. By acquiring programming knowledge and skills that support the work of individuals and groups in solving problems, students will select the technology appropriate for the task, synthesize knowledge, create solutions, and evaluate the results.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning	Assessment strategy

							strategy	
CO1	Design application/game Interface	Cognitive/ Apply	1	4			Demonstration and discussion	Continuous assessment
CO2	Apply the design procedures of application/game	Cognitive/ Apply	1	4			Demonstration and discussion	Continuous assessment and Final exam
CO3	Implement the approved design	Cognitive/ Create	11				Demonstration and discussion	Final Lab exam, Viva/Project

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2	√											
CO3											√	

Course Content	Duration (Weeks)	COs
UII development with XML and JavaScript Game UI design with Unity	5	1
Backend development with Java and Kotlin	5	2
Android Networking Android Data Handling App/Game Deployment	4	2,3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. J. Paul Cardle : **Android App Development in Android Studio: Java + Android Edition for Beginners,**
2. Jeff Mcherter and Scott Gowell : **Professional Mobile Application Development**
3. Raul Portales : **Mastering Android Game Development,** *Packt Publishing Limited*

Course Code: CSE 4113	**Course Title:** Microcontroller, Computer Peripherals and Interfacing	
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: CSE 1201, CSE 3205		

Rationale: The course discusses the basic concepts of microcontrollers, computer peripherals and interfacing. This course is designed based on the popular Microchip AVR microcontrollers. The covered topics include microcontroller and embedded system introduction, microcontroller I/O port programming, special features of microcontroller, peripheral features of microcontroller, I/O controller and computer peripheral components, interfacing components. After completing the course, the students will have enough knowledge regarding microcontrollers and an understanding of computer peripherals along with the interfacing techniques to work on an embedded system.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Explain the fundamental concepts of microcontrollers and embedded systems, including architectures	Cognitive/ Understand	1	3			Lecture/Slides	Mid-Term
CO2	Apply knowledge of Microcontroller peripheral features in solving real-life problems.	Cognitive/ Apply	3	5			Lecture/Slides	Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2			√									

Course Content	Duration (Weeks)	COs
Introduction to Microcontroller and Embedded System: History and Features, Classification and applications, Overview of AVR Family, and Microcontroller Structure, Memory Architecture, Instruction Set and Comparison with Microprocessor, Definition of Embedded System, PCB Design Technique, microcontroller as a prime member of embedded system; it's comparison with microprocessor and microcomputer.	3 Weeks	1
Atmega32 Microcontroller: Basic Features, Pin Configuration, Protocols, Resisters, Port Programming and Applications, General Purpose Input/Output.	2 Weeks	
Introduction to Arduino: Arduino Integrated Development Environment (IDE), Basics and programming with C/C++, interfacing with Peripherals.	1 Week	

Advanced Microcontroller Features: Timers and Counters (Introduction, applications in event counting, time delay generation, waveform generation, PWM signals.), Serial Communication (Concepts of synchronous and asynchronous communication; USART, UART protocols, SPI and I2C communication protocols; interfacing peripherals), Interrupts (Internal and external interrupts, handling techniques, priority and nested interrupts) and Analog-to-Digital Conversion (ADC).	4 Weeks	
Interfacing: Interface of ATMEL microcontroller with external devices such as LED, Seven Segment Display, LCD, Keypad Matrix, Bluetooth Module, USB-serial Module, Sonar sensor, Temperature Sensor, IR sensor, Motor Speed Control and Mini-project demonstration.	3 Weeks	2

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi : **The AVR Microcontroller and Embedded Systems using Assembly and C,** *Pearson* [**Textbook**]
2. Douglas Hall : **Microprocessors & Interfacing,** *McGraw - Hill*
3. A. K. Ray, K M Bhurchandi : **Advanced Microprocessors and Peripherals,** *McGraw-Hill*
4. John Nussey : **Arduino For Dummies**, *Wiley*

Course Code: CSE 4114 **Course Title:** Microcontroller, Computer Peripherals & Interfacing Lab
Course Type: Lab **Credit Hour: 2** **Total Marks:** 100
Pre-requisite: CSE 1202, CSE 3206

Rationale: To provide hands-on experience in implementing microcontroller-based features like interrupt, timer, ADC, button debouncing and designing embedded systems. The laboratory exercises are designed to give students the ability to construct and demonstrate embedded systems and the ability to solve problems based on microcontrollers and microcontroller-based development boards. Laboratory assignments progress from basic I/O port programming for a microcontroller to the design of embedded system with interface device.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Demonstrate the ability to program Atmega32/ Arduino for basic digital and analog I/O operations	Psychomotor/ Precision	5	6			Hands on Practice	Lab Report
CO2	Apply Microcontroller programming skills for solving real-life problem	Cognitive/ Create	3	5			Hands on Practice	Lab Test
CO3	Develop a sustainable embedded system that incorporates various interfacing devices	Psychomotor/ Articulation	6	5	1,2,3	1,3	Supervision	Project work

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1					√							√
CO2			√									
CO3						√						

Course Content	Duration (Weeks)	COs
Writing I/O Programs-Creating Hex File for the Microcontroller, Interfacing Microcontroller with Led Bar Graph Interfacing Seven Segment Display with Microcontroller and Solving Different Problems, Microcontroller Interrupt Implementation Button debouncing and Microcontroller Timer Implementation ADC Implementation and Interfacing sensors with Microcontroller	7	2,3
Introduction to Microcontroller Based Development Board Interfacing LCD display with Microcontroller Based Development Board	6	1
Interfacing different sensors with Microcontroller Based Development Board	1	3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Viva/ Project)	50%
	Total	**100%**

Recommended Books:

1. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi : **The AVR Microcontroller and Embedded Systems using Assembly and C,** *Pearson* [**Textbook**]
2. Douglas Hall : **Microprocessors & Interfacing,** *McGraw - Hill*
3. A. K. Ray, K M Bhurchandi : **Advanced Microprocessors and Peripherals,** *McGraw-Hill*
4. John Nussey : **Arduino For Dummies**, *Wiley*

4th year
(Even Semester)

Course Code: CSE 4201	**Course Title:** Parallel Processing and Distributed Systems	
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: CSE 2207, CSE 3105		

Rationale: The course aims to provide an understanding of the principles on which Internet and other distributed system based; their architecture, algorithms and how they meet demands of contemporary distributed applications. The course covers the building block for a study of distributed systems and addressing the characteristics and challenges that must be addressed in their design, scalability, heterogeneity, security and failure handling being the most significant.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Describe parallelism and distributed system architectures.	Cognitive/ Understand	1	2			Lectures, Textbook, PowerPoint Slides, Discussion	Midterm Exams
CO2	Apply parallel programming concept for faster computation.	Cognitive/ Apply	3	5				Final Exams
CO3	Compare performances of different distributed systems.	Cognitive/Evaluate	5	6				Class Test / Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2			√									
CO3					√							

Course Content	Duration (week)	COs
Introduction: Trends towards parallel processing, Parallel processing mechanism, Multiprogramming and Time sharing, Parallel Computer Structures, Parallelism and Pipelining Parallel Programming: Parallel Programming models, Parallel Languages and Compilers, Code Optimization and Scheduling, Loop Parallelization and Pipelining, Parallel Programming Environments, Shared-variable program structures, mapping programs onto Multicomputer. Distributed System: Introduction, Distributed System Architectures, Communication in Distributed Systems, Distributed Middleware, Client/Server Design Issues, Inter-process communication, RPC, Distributed Objects and Remote Invocation, Virtualization & Code Migration, Naming, Distributed Synchronization & Coordination, Consistency & Replication in Distributed	9	1

Course Content	Duration (week)	COs
Systems, Fault Tolerance, Distributed Transactions, Security, P2P Systems, Cloud Computing, Grid Computing. Distributed System Programming: Java RMI, CORBA, P2P, COM, DCOM, Multi Agent System, SOAP, Web Service. Hardware Technology: Advanced processor Technology, Superscalar and Vector processor, Shared memory organization, Design of Linear and Nonlinear Pipeline processor, Multiprocessor System Interconnects.		
Pipelining and Vector Processing: Principles of Pipelining, Classification of pipelined processors, Instruction and Arithmetic pipeline design, Vector Processing principles, Vector processing requirements, Designing Pipelined processors, Compound Vector processing, Recent Vector processors, Vectorization, and Optimization methods. Parallel processing applications, Speedup Performance Laws, Parallel Random-Access Machines (PRAM) and VLSI model.	4	2,3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Andrew S. Tanenbaum,Maarten van Steen : **Distributed Systems Principles and Paradigms,** *Prentice-Hall* **[TextBook]**
2. Kai Hwang : **Advanced Computer Architecture,** *Tata McGraw-Hill* **[Text Book]**
3. George Coulouris : **Distributed Systems Concepts and Design,** *Pearson Education*
4. Pradeep K. Sinha : **Distributed Operating Systems,** *Prentice-Hall*

Course Code: CSE 4202	**Course Title:** Parallel Processing and Distributed Systems Lab	
Course Type: Lab	**Credit Hour:** 1.0	**Total Marks:** 100
Pre-requisite: CSE 2208, CSE 3106		

Rationale: Laboratory works based on **CSE 4201.**

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Use socket programming for developing primitive communications.	Cognitive/ Apply	9				Discussion and hands on practice in lab	Continuous Assessment/ Quiz
CO2	Apply different network protocol server packages to develop distributed systems.	Cognitive/ Apply	5	6				Continuous Assessment/ Report
CO3	Demonstrate RMI and multithreading concept to implement parallel processing.	Cognitive/ Apply	12					Final Lab Exam, Quiz/Viva

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1									√			
CO2					√							
CO3												√

Course Contents	Duration (week)	COs
RPC Programming Using DCOM. Java RMI “Hello World” service implementation.	2	1,2,3
Java RMI “Calculator” service implementation.	1	2,3
Java RMI Database CRUD implementation.	2	2,3
Implement Java CORBA.	1	2
Multithreaded Service using Java sockets.	1	2,3
Mobile Agent Programming.	3	2
FTP and HTTP server implementation.	3	2

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Quiz, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Viva)	50%
	Total	**100%**

Recommended Books:

1. Andrew S. Tanenbaum, Maarten van Steen : **Distributed Systems Principles and Paradigms,** *Prentice-Hall* **[TextBook]**
2. Kai Hwang : **Advanced Computer Architecture,** *Tata McGraw-Hill* **[Text Book]**
3. George Coulouris : **Distributed Systems Concepts and Design,** *Pearson Education*
4. Pradeep K. Sinha : **Distributed Operating Systems,** *Prentice-Hall*

Course Code: CSE 4203	**Course Title:** Cryptography and Network Security
Course Type: Theory	**Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: CSE 2207	

Rationale: This course covers cryptography overview and terminologies. Symmetric Ciphers: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Steganography, Simplified DES, Block Cipher Principles, the Data Encryption Standard, the Strength of DES, Block Cipher Design Principles, Evaluation Criteria for AES, the AES Cipher, Triple DES, Key Distribution. Public- Key Encryption: Principles of Public-Key Cryptosystems, the RSA Algorithm, Key Management. Message Authentication: Authentication Requirements, Authentication Functions, Message Authentication Codes, Hash Functions, MD5 Message Digest Algorithm, Secure Hash Algorithm, Digital Signatures, Authentication Protocols. Pretty Good Privacy, S/MIME, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Web Security Considerations, Secure Socket Layer and Transport Layer Security. After completion of this course students will be able to secure a message over insecure channel by various means and to learn about how to maintain the Confidentiality, Integrity and Availability of data.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Describe the fundamentals of symmetric and asymmetric cryptography	Cognitive/ Understand	1	4			Lecture, Discussion, Algorithm practice	Midterm, Assignment
CO2	Discuss public key-based encryption technique with proper key management	Cognitive/ Understand	1	3				Class Test, Midterm
CO3	Apply message authentication process for network security	Cognitive/ Apply	2	4				Class Test, Final Test

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√											
CO2	√											
CO3		√										

Course Content	Duration (weeks)	COs
Overview of cryptography and network security, terminologies, Substitution, and transposition ciphers, Symmetric ciphers, classical encryption technique	2	1
Block ciphers (Block Cipher Models), Fiestel Cipher, Simplified data encryption standards, DES, Double DES, Triple DES.	2	1
Public-Key Encryption: Principles of Public-Key Cryptosystems, The RSA Algorithm, Diffie Hellman Key exchange algorithm. Key Distribution, Key Management	3	2
Message Authentication: Authentication Requirements, Authentication Functions, Message Authentication Codes, Web Security Considerations, Secure Socket Layer and Transport Layer Security.	3	3
Hash Functions, MD5 Message Digest Algorithm, Secure Hash Algorithm, Digital Signatures,	2	3
Authentication Protocols. Pretty Good Privacy, S/MIME, IP Security Architecture, Authentication Header	2	3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. W. Stallings : **Cryptography and Network Security Principles and Practice**, *Prentice Hall.***[Text Book]**
2 Behrouz Forouzan : **Cryptography and Network Security**, *McGraw-Hill*
3. Bruce Schneier : **Applied Cryptography**, *John Wiley & Sons.*
4. Dieter Gollmann : **Computer Security**, *John Wiley &Sons.*
5. Edward Amoroso : **Fundamentals of Computer Security Technology**, *Prentice Hall*.
6. E. Biham and A. Shamir : **Differential Cryptanalysis of the Data Encryption Standard,** *Springer Verlag.*
7. D. Denning : **Cryptography and Data Security,** *Addison Wesley*.
8. N. Kobliz : **A Course on Number Theory and Cryptography,** *SpringerVerlag*.

Course Code: CSE 4204	**Course Title:** Cryptography and Network Security Lab	
Course Type: Lab	**Credit Hour:** 1.0	**Total Marks:** 100
Pre-requisite: CSE 1202, CSE 2208		

Rationale: To give practical exposure on basic security attacks, encryption algorithms, authentication techniques. The laboratory exercises are designed to give students ability to analyze some basic cryptographic algorithms, Implementation of symmetric and asymmetric cryptographic algorithms.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Apply basic cryptographic algorithms	Cognitive/ Apply	2	3			Discussion and hands on practice	Continuous Assessment/ Viva
CO2	Analyze different symmetric and asymmetric cryptographic algorithms	Cognitive/ Analyze	2	4			Discussion and hands on practice	Continuous Assessment/ Viva
CO3	Apply different authentication methods	Cognitive/ Apply	3	5			Discussion and hands on practice	Final Lab Test

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		√										
CO2		√										
CO3			√									

Course Contents	Duration (weeks)	COs
Implement encryption and decryption of Caesar cipher, Cryptanalysis, Playfair cipher, Hill cipher, Monoalphabetic Cipher, Polyalphabetic Cipher	5	1
Different Transposition Cipher, Multiple transposition Implementation of SDES and DES, RSA algorithm	5	2
Implement Diffie Hellman Key exchange algorithm, Hash Function, Digital Signature algorithms	4	3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1 W. Stallings : **Cryptography and Network Security Principles and Practice,** *Prentice Hall* **[Text Book]**

2. Bruce Schneier : **Applied Cryptography**, *John Wiley & Sons.*

3. Dieter Gollmann : **Computer Security**, *John Wiley & Sons.*

4. Edward Amoroso : **Fundamentals of Computer Security Technology**, *Prentice Hall*.

5. E. Biham and A. Shamir : **Differential Cryptanalysis of the Data Encryption Standard,** *Springer Verlag.*

6. D. Denning : **Cryptography and Data Security,** *Addison Wesley*.

7. N. Kobliz : **A Course on Number Theory and Cryptography,** *SpringerVerlag*.

Option II

Course Code: CSE 4205		**Course Title:** Robotics and Automation
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: CSE 4101		

Rationale: This course provides detailed information about various parts of robots and their control mechanisms. The covered topics include basic computational concepts used in robotics, various kinematics and inverse kinematics of robots, trajectory planning of robots and the control of robots for some specific applications. The motivation of the course is to develop basic knowledge of Robotics. After completing the course, the students will be able to understand the basic concepts and theory governing the programming of robots that perform autonomous tasks such as navigation and manipulation.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Compare between the perception principles of various robot sensors that enable the robots to analyze their environment, reason and take appropriate actions toward the given goal	Cognitive/ Evaluate	4	8			Lectures, Textbook, PowerPoint Slides, Discussion	Assignment
CO2	Solve problems in robot kinematics and mapping.	Cognitive/ Analyze	2	4				Class Test, Mid Term Exam
CO3	Solve problems in robot controlling.	Cognitive/ Analyze	2	4				Class Test, Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1				√								
CO2		√										
CO3		√										

Course Content	Duration (Weeks)	COs
Introduction to Robotics: Definition, Origin & Types of Robotics, Historical development of robot, Major components of Robotic system, Robot Anatomy & Degree of Freedom, Robotics and AI	1	3
Spatial Transformations: Cartesian Co-ordinate, Reference Frame, Transformation Matrix, Homogeneous Transformation, Inverse Transformation, Graphs, Co-ordinate system overview	1	2
Power Sources and Sensors: Hydraulic, pneumatic and electric drives, determination of HP of motor and gearing ratio, variable speed arrangements, path determination, micro machines in robotics, machine vision, ranging, laser, acoustic, magnetic, fiber optic and tactile sensors.	2	1
Manipulators, Actuators, and Grippers: Manipulators, Classification, Construction of manipulators, manipulator dynamics and force control, electronic and pneumatic manipulator control, End effectors, Loads and Forces, Grippers, design considerations, Robot motion Control, Position Sensing	2	1
Robot Kinematics Basics: Forward Kinematics, Inverse Kinematics. Velocities, Static Forces, acceleration of rigid bodies and Jacobians	2	2
Robotic mapping: localization, Monte Carlo localization, multi-object localization	2	2
Robotic navigation and locomotion: motion planning, dynamics, linear control, non-linear control, Force control, Compliance	2	3
Trajectory/Path Planning: Path planning for mobile robots, path planning for industrial robots.	2	3
Robot Programming Languages and Systems, Simulation and Off-Line Programming	1	2, 3
Case Studies: Multiple robots, Machine Interface, Uncertainty, Robots in Manufacturing and not-Manufacturing Application, Robot Cell Design, Mechanical Design of robots, Selection of a Robot	1	1

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. John Craig : **Introduction to Robotics: Mechanics and Control (4th Edition),** *Pearson* [**Text Book**]
2. William Bolton : **Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering (6th Edition),** *Pearson*
3. Professor S. G. Tzafestas : **Intelligent Systems, Control and Automation: Science and Engineering**, *Springer*
4. Peter Mckinnon : **Robotics: Everything You Need to Know About Robotics from Beginner to Expert**

Course Code: CSE 4206		**Course Title:** Robotics and Automation Lab
Course Type: Lab	**Credit Hour:** 1.0	**Total Marks:** 100
Pre-requisite: CSE 4102		

Rationale: The contents of the course include experimental work with locomotion, robot kinematics, mobile robot kinematics, actuating, sensing, path planning and obstacle avoidance to provide hands on experience so that the students can learn the problem-solving techniques through competition-based applications and projects of robotics principles. The laboratory exercises are designed to give students the ability to apply the learned knowledge and skills to implement a robotic system capable of solving a real-life problem.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Construct an obstacle avoider mobile robot.	Cognitive/ Create	3	4			Discussion and hands on practice in lab	Continuous Assessment/ Quiz
CO2	Design a robotic system capable of operating in complex and interactive environments.	Cognitive/ Create	3	4			Discussion and hands on practice in lab	Continuous Assessment/ Viva
CO3	Apply the learned knowledge and skills to implement a robotic system capable of solving a real-life problem.	Cognitive/ Apply	12				Discussion and hands on practice in lab	Final Lab/Viva/Project

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1			√									
CO2			√									
CO3												√

Course Contents	Duration (Weeks)	COs
Introduction to principles of robotics, necessary software and toolkits. Programming the robot and platforms. Demonstration of Cartesian/ cylindrical/ spherical robot. Developing mobile robots using Arduino, DC motor, motor shields, chassis, jumpers, hex spacers, batteries, motor brackets, sonar sensor, servo motor, motor brackets etc.	4	1
Virtual modeling for kinematic and dynamic verification any one robotic structure using suitable software. Design, modeling and analysis of different types of grippers. Study of robotic system design.	4	2
Study and testing of power supplies and movement systems, sensing systems, end-of-arm tooling, control systems. Study and implementation of sensor integration. Demonstration of Articulated/ SCARA robot. Linear and non-linear path programming.	5	3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. John Craig : **Introduction to Robotics: Mechanics and Control (4th Edition),** *Pearson* [**Text Book**]
2. William Bolton : **Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering (6th Edition),** *Pearson*
3. Professor S. G. Tzafestas : **Intelligent Systems, Control and Automation: Science and Engineering**, *Springer*
4. Peter Mckinnon : **Robotics: Everything You Need to Know About Robotics from Beginner to Expert**

Course Code: CSE 4207		**Course Title:** Big Data Analysis
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: CSE 2103, CSE 3103, MAT 3141		

Rationale: Big data analytics is the use of advanced analytic techniques against very large, diverse data sets. This course will introduce the basic concepts and methodologies of big data. This course will provide a comprehensive introduction to big data ecosystem, analytical theory and method. It also familiarizes with big data analysis tools and technique and visualization. After completing the course, the students will be able to analyze large diverse data sets and drive meaningful information.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Understanding the background and knowledge of some contemporary topics in Big Data.	Cognitive/ Understand	1	4			Lecture, Practice and Discussion	Class Test, Midterm Exam
CO2	Explain the usage of data on different big data ecosystems	Cognitive/ Understand	4	8			Lecture, Practice and Discussion	Class Test, Final Exam
CO3	Apply analytical algorithms and theories of big data analysis in problem solving	Cognitive/ Apply	2	4			Lecture, Practice and Discussion	Assignment, Final Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2				√								
CO3		√										

Course Content	Duration (Weeks)	COs
Introduction to Big Data: Introduction of Big Data, Characteristics and size of Big Data, Analytics, Drivers of Big Data, Big Data Attributes, Data Structures, Big Data Ecosystem, Big Data Platforms and Data Storage. **Big Data Tools, Techniques, and Systems:** Exascale computing, HDFS, HBase, and NoSQL (Document Store, Graph DB, etc.), MapReduce, Spark, Oozie, Tez, Hive, Pig, etc.;	3	1
Introduction to Hadoop: History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, Hadoop 1 and Hadoop 2 (YARN), IBM Big Data Strategy	2	1
Map Reduce: Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.	3	2

Course Content	Duration (Weeks)	COs
Advanced Analytical Theory and Methods: Hadoop/Mahout, Recommendation, Clustering, Classification, Regression	4	3
Advanced Topics: Big Data Visualization, High-performance Networking for Big Data Movement, Big Data Scientific Workflow Management and Optimization	2	3

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Seema Acharya,Subhasini Chellappan: **Big Data Analytics**, *Wiley 2015* **[Text Book]**
2. TomWhite : **Hadoop: The Definitive Guide**, *McGraw-Hill*
3. JayLiebowitz : **Big Data and Business Analytics**, *Auerbach Publications, CRC press (2013)*
4. Donald Miner, AdamShook : **Map Reduce Design Pattern**, *O'Reilly, 2012*

Course Code: CSE 4208 **Course Title:** Big Data Analysis Lab
Course Type: Lab **Credit Hour:** 1.0 **Total Marks:** 100
Pre-requisite: CSE 2104, CSE 3103

Rationale: The main purpose of this laboratory course is to find and manage diverse data set to derive knowledge and to make informed decisions. The Laboratory works are designed to use various big data tools and effectively implement various analytical theories and methods such as Clustering, Classification, and Regression.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Understand and implement the basics of data structures and data warehousing.	Cognitive/ Understand	1	4			Discussion and hands on practice in lab	Continuous Assessment/ Quiz
CO2	Demonstrate the knowledge of Big Data Asssnalytics and implement different management task in Hadoop.	Cognitive/ Apply	3	4			Discussion and hands on practice in lab	Continuous Assessment/ Viva

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO3	Understand Map Reduce Paradigm and develop data applications using variety of Systems.	Cognitive/ Create	3	4			Discussion and hands on practice in lab	Final Lab/Viva/Project

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2			√									
CO3			√									

Course Contents	Duration (Weeks)	COs
Implement the following Data structures a) Linked Lists b) Stacks c) Queues d) Set e) Map	1	1
Perform setting up and Installing Hadoop in its three operating modes: Standalone, Pseudo distributed, Fully distributed Use web-based tools to monitor your Hadoop setup.	1	2
Implement the following file management tasks in Hadoop: Adding files and directories, Retrieving files, Deleting files	1	2
Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.	1	3
Write a Map Reduce program that mines weather data. Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with Map Reduce, since it is semi structured and record- oriented.	2	3
Implement Matrix Multiplication with Hadoop Map Reduce.	2	2
Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data.	2	2
Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes.	2	2
Solve some real-life big data problems.	2	3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. Seema Acharya,Subhasini Chellappan: **Big Data Analytics**, *Wiley 2015* **[Text Book]**
2. TomWhite : **Hadoop: The Definitive Guide**, *McGraw-Hill*
3. JayLiebowitz : **BigDataandBusinessAnalytics**,*AuerbachPublications,CRCpress (2013)*
4. Donald Miner, AdamShook : **Map Reduce Design Pattern**, *O'Reilly, 2012*

Course Code: CSE 4200	**Course Title:** Project or Thesis with Seminar Part II
Course Type: Final Year Design Project (FYDP) 2	**Credit Hour:** 2.0 **Total Marks:** 100
Pre-requisite: CSE 4101	

Time frame: Each student is required to complete a project over the combined duration of two semesters in 4th year. In the odd semester, as part of the course CSE 4100 (Part-I), students must present and defend a project proposal along with initial outcomes at the end of the semester. The project or thesis is then to be completed with full outcomes and a dissertation in the continuation course, CSE 4200 (Part-II), during the even semester of 4th year.

Rationale: This course is designed to help students develop the skills needed to function effectively both as individuals and as members or leaders of diverse teams in multidisciplinary settings. The student will identify an engineering and/or computing problem and apply their knowledge and skills to solve it using systematic methods and modern engineering tools.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO7	Function effectively as a responsible team member or leader by coordinating tasks, fostering inclusion, and collaborating across multidisciplinary, face-to-face, and remote environments to achieve project objectives	8	9			Technology tools, Group Discussion, Experimental & problem-solving learning	Project report, Viva, Presentations
CO8	Demonstrate ethical and professional responsibility in decision-making, documentation, and teamwork by adhering to engineering codes of conduct, national/international laws, and principles of diversity and inclusion	7	9				
CO9	Demonstrate effective and inclusive communication by preparing professional reports, design documents, and delivering engaging presentations that clearly convey their FYDP's objectives, methods, and outcomes to both technical and non-technical audiences	9	8	1, 2, 4	1, 2		
CO10	Apply engineering management principles to plan, organize, and lead their FYDP effectively, ensuring coordinated teamwork	10	6				

	and timely completion of project goals.						
CO11	Evaluate the potential of their project solution as a real-world opportunity	12	6				
CO12	Demonstrate the ability to learn independently and adapt their project to incorporate new tools, technologies, or methodologies relevant to their domain	11	8				

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO7								√				
CO8							√					
CO9									√			
CO10										√		
CO11												√
CO12											√	

Course Content	Duration (Weeks)	COs
Meet the supervisor and obtain feedback for the final report for the previous term. Document the outcome of the meeting in the log book.	1	5, 10
Modify the draft version of the report. Document the outcome of the meeting in the log book.	1	5, 10
Continue with the project work Meet the supervisor and discuss the progress from the last meeting. Document the outcome of the meeting in the log book.	1	11
Continue with the project work Meet the supervisor and discuss the progress from the last meeting. Document the outcome of the meeting in	1	11
Continue with the project work Meet the supervisor and discuss the progress from the last meeting. Document the outcome of the meeting in the log book.	1	11
Continue with the project work Meet the supervisor and discuss the progress from the last meeting. Document the outcome of the meeting in the log book.	1	11
Continue with the project work Meet the supervisor and discuss the progress from the last meeting. Document the outcome of the meeting in the log book.	1	11
Continue with the project work Meet the supervisor and discuss the progress from the last meeting. Document the outcome of the meeting in the log book.	1	11
Continue with the project work and demonstrate with the team	1	11

Course Content	Duration (Weeks)	COs
Meet the supervisor and discuss the progress from the last meeting. Document the outcome of the meeting in the log book.		
Continue with the project work and demonstrate. Meet the supervisor and discuss the progress from the last meeting. Document the outcome of the meeting in the log book.	1	11
Prepare the draft version of the final report for the semester. Meet the supervisor and discuss the draft report. Document the outcome of the meeting in the log book.	1	10
Prepare the final report considering the life-long education in the context of modern technology. Document the outcome of the meeting in the log book. Discuss future work with the supervisor, focusing on potential technological advancements and changes.	1	12
Submit the final report Meet the supervisor and discuss about the final presentation. Document the outcome of the meeting in the log book. Submit the logbook along with signatures to the department Execute all tasks within the time frame through effective project planning.	1	5, 10

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Participation	10%
	Continuous Assessment (Team Work and Individual Performance, Report)	40%
Summative Assessment (SA)	Final Examination (Presentation, Viva, Project Report)	50%
Total		**100%**

Course Code: CSE 4209 **Course Title:** Cloud Computing and IoT
Course Type: Theory **Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: CSE 2101, CSE 2207, CSE 4113

Rationale: This course gives students an insight into the basics of cloud computing along with virtualization, cloud computing is one of the fastest-growing domains for a while now. It will provide the students a basic understanding of cloud and virtualization along with how one can migrate over it. Also, students will explore various components of the Internet of Things (IoT) such as sensors, internetworking, and cyberspace. In the end, they will also be able to design and implement IoT circuits and solutions.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Understand the fundamentals of cloud architecture	Cognitive/ Understand	2	4			Discussion, Text Book, Lecture	Class Test
CO2	Apply cloud computing concept via simulation	Cognitive/ Apply	5	6			Discussion, Text Book, Lecture	Midterm Examination
CO3	Demonstrate Raspberry Pie to implement IoT architecture.	Cognitive/ Analyze	5	6			Discussion, Text Book, Lecture	Final Examination

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1		√										
CO2					√							
CO3					√							

Course Content	Duration (Weeks)	COs
Introduction to Cloud Computing: Origins of Cloud computing – Cloud components, Essential characteristics – On-demand self-service, Broad network access, Location independent resource pooling, Rapid elasticity, measured service, Comparing cloud providers with traditional IT service providers, Roots of cloud computing. **Cloud Insights:** Architectural influences – High-performance computing, Utility, and Enterprise grid computing, Cloud scenarios – Benefits: scalability, simplicity, vendors, security, Limitations – Sensitive information, Application development-security level of third party, security benefits, Regularity issues: Government policies. **Cloud Architecture- Layers and Models:** Layers in cloud architecture, Software as a Service (SaaS), features of SaaS and benefits, Platform as a Service (PaaS), features of PaaS and benefits, Infrastructure as a Service (IaaS), features of IaaS and benefits, Service providers, challenges and risks in cloud adoption. Cloud deployment model: Public clouds – Private clouds – Community clouds, Hybrid clouds, Advantages of Cloud computing.	5	1
Cloud Simulators- Cloud Sim and Green Cloud: Introduction to Simulator, understanding Cloud Sim simulator, Cloud Sim Architecture (User code, Cloud Sim, Grid Sim, Sim Java) Understanding Working platform for Cloud Sim, Introduction to Green Cloud **Introduction to VMWare Simulator:** Basics of VMWare, advantages of VMware virtualization, using VMware workstation, creating virtual machines-understanding virtual machines, create a new virtual machine on local host, cloning virtual machines, virtualize a physical machine, starting and stopping a virtual machine.	4	2
Introduction to IoT: Internet of Things, Physical Design, Logical Design- IoT Enabling Technologies, IoT Levels & Deployment Templates, Domain Specific IoTs,	5	3

IoT and M2M, IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology **IoT Architecture:** M2M high-level ETSI architecture, IETF architecture for IoT, OGC architecture, IoT reference model, Domain model, information model, functional model, communication model, IoT reference architecture **IoT Protocols:** Protocol Standardization for IoT, M2M and WSN		

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Anthony T.Velte , TobyJ. Velte Robert Elsenpeter : **Cloud Computing a Practical Approach,** *TATA McGraw-Hill*
2. DieterUckelmann,Mark Harrison, Michahelles, Florian (Eds) : **Architecting the Internet of Things**, *Springer* [Textbook]
3. Judith Hurwitz,RobinBloor, Marcia Kaufman, FernHalper : **Cloud Computing for Dummies,** *Wiley Publishing Inc.*
4. RajkumarBuyya,James Broberg, AndrzejGościński : **Cloud Computing (Principles and Paradigms),** *John Wiley & Sons,*
5. Honbo Zhou : **The Internet of Things in the Cloud: A Middleware Perspective,**
6. OlivierHersent,DavidBoswarthick, OmarElloumi : **The Internet of Things – Key Applications and Protocols,***Wiley Publishing Inc.*

Course Code: CSE 4210		**Course Title:** Cloud Computing and IOT Lab
Course Type: Lab	**Credit Hour:** 1.0	**Total Marks:** 100
Pre-requisite: CSE 2102, CSE 2208, CSE 4114		

Rationale: This course gives students an insight into the basics of cloud computing along with virtualization, cloud computing is one of the fastest-growing domains for a while now. It will provide the students a basic understanding of cloud and virtualization along with how one can migrate over it. Also, students will explore various components of the Internet of Things (IoT) such as sensors, internetworking, and cyberspace. In the end, they will also be able to design and implement IoT circuits and solutions.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Learn the design and development process involved in creating a cloud-based application	Cognitive/ Understand	3	5			Discussion and hands on practice in lab	Continuous Assessment/ Viva
CO2	Develop web applications in cloud	Cognitive/ Apply	3	5			Discussion and hands on practice in lab	Continuous Assessment/ Quiz
CO3	Use the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis.	Cognitive/ Analyze	4	8			Discussion and hands on practice in lab	Final Lab Exam, Viva/Quiz

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1			√									
CO2			√									
CO3				√								

Course Contents	Duration (Weeks)	COs
Install VirtualBox/VMware Workstation with different flavours of Linux or windows OS on top of windows7 or8. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs	5	1
Install Google App Engine. Create hello world app and other simple web applications using python/java. Use GAE launcher to launch the web applications. Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm that is not present in Cloud Sim. Find a procedure to transfer the files from one virtual machine to another virtual machine. Find a procedure to launch virtual machine using try stack (Online Open stack Demo Version) Install Hadoop single node cluster and run simple applications like word count	4	2

Course Contents	Duration (Weeks)	COs
Introduction to Arduino platform and programming Interfacing Arduino to ZigBee module Interfacing Arduino to GSM module, Interfacing Arduino to Bluetooth Module, Introduction to Raspberry PI platform and python programming. Interfacing sensors to Raspberry PI Communicate between Arduino and Raspberry PI using any wireless medium, Setup a cloud platform to log the data Log Data using Raspberry PI and upload to the cloud platform Design an IOT based system	5	3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1 Anthony T.Velte , Toby J. Velte Robert Elsenpeter : **Cloud Computing a Practical Approach,** TATA *McGraw-Hill [Textbook]*

2 Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds) : **Architecting the Internet of Things**, *Springer [Textbook]*

3 Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper : **Cloud Computing for Dummies**, *Wiley Publishing Inc.*

4 Rajkumar Buyya, James Broberg, Andrzej Gościński : **Cloud Computing (Principles and Paradigms),** *John Wiley & Sons, Inc*.

5 Honbo Zhou : **The Internet of Things in the Cloud: A Middleware Perspective**, *CRC Press*

6 Olivier Hersent, David Boswarthick, Omar Elloumi : **The Internet of Things – Key applications and Protocols,** *Wiley Publishing Inc.*

Course Code: CSE 4211		**Course Title:** Machine Learning
Course Type: Theory	**Credit Hour:** 3.0	**Total Marks:** 100
Pre-requisite: CSE 4101		

Rationale: This course introduces the basic concepts and methodologies of machine learning. The covered topics include aspects of developing a learning system, different kind of learning systems, data pre-processing techniques, supervised learning, unsupervised learning, reinforcement learning, ensemble learning, performance metrics of machine learning algorithms and basic concepts of deep learning. The course will be project-oriented, with emphasis placed on implementations of learning algorithms applied to real-world problems. After completing the course, the students will be able to understand the basic concepts of machine learning and build systems that can learn and adapt through real-world applications.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Identify the suitable problem area for application of supervised, unsupervised and reinforcement learning.	Cognitive/ Understand	2	4			Lectures, Textbook, Discussion	Class Test, Midterm
CO2	Illustrate when regularization can be used.	Cognitive/ Apply	1	4			Lectures, Textbook, PowerPoint Slides, Discussion	Final Exam
CO3	Analyze the performance of different machine learning algorithms on real data.	Cognitive/ Analyze	4	8			Lectures, Textbook, PowerPoint Slides, Discussion	Assignment

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12
CO1		√										
CO2	√											
CO3				√								

Course Content	Duration (Weeks)	COs
Fundamentals of Machine Learning: Definition and types of learning systems, Goals and applications of machine learning, Aspects of developing a learning system, Main steps in a typical machine learning project, Challenges of Machine Learning like Overfitting, Underfitting, Irrelevant Features etc.	1	1
Knowing Your Data: Different Attribute Types, Basic Statistical Descriptions of Data, Measuring Data Similarity and Dissimilarity; Machine Learning Terms: Feature, Train Data, Test Data, Validation Data, Response Variable, Labelled/ Unlabeled Data, partitioning a Dataset Depending on a Target Variable, Cross Validation Method, Optimizing a cost function	2	3
Handling and preparing Data: Data Cleaning, Data Reduction, Data Integration, How to Prepare Data for Machine Learning Algorithm, Reducing the dimensionality of the training data to fight the curse of dimensionality, dimensionality reduction algorithms, Selecting and engineering features, Selecting a model and tuning hyper parameters using cross-validation, facing the main challenges in machine learning- particularly underfitting and overfitting (the bias/variance tradeoff) , Learning by fitting a model to data, Ensemble learning.	2	2
Supervised ML: Basic Concepts of classification, Multiclass/Multilabel/Multioutput Classification, Decision Tree Induction, Bayes Classification Methods, Rule-Based Classification, Solving Real Life Problems using Supervised ML Algorithms like SVM, Decision Tree, Naïve Bayes, Linear Regression, Non-Linear Regression, Time-series Analysis.	2	1
Unsupervised ML: What is Cluster Analysis and What are the Requirements, Basic Overview of Clustering Methods like Partitioning/ Hierarchical/ Density-based/ Grid based Method; Solving Real Life Problems Using K-Means Clustering Algorithm and its challenges;	2	1
Performance Metrics of Supervised and Unsupervised ML Algorithms: R-Squared Value, Confusion Matrix, Accuracy, Precision, Recall, F1 measure, Specificity, ROC curve**,** Elbow Method	2	3
Introduction to Deep Learning: Neural nets and for what they are good for, The most important neural net architectures: feedforward neural nets, convolutional nets, recurrent nets, long short-term memory (LSTM) nets, and autoencoders, Techniques for training deep neural nets, Reinforcement learning	2	1

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
Total		**100%**	

Recommended Books:

1. Aurélien Géron : **Hands-On Machine Learning with Scikit-Learn and TensorFlow Concepts, Tools and Techniques to Build Intelligent Systems,** *O'REILLY* **[Textbook]**
2. Noah Gift : **Pragmatic AI: An Introduction to Cloud-Based Machine Learning,** *Adison Wesley*
3. Oliver Theobald : **Machine Learning for Absolute Beginners (2nd Edition)**
4. Jiawei Han, Micheline Kamber, Jian Pei : **Data Mining Concepts and Techniques,** *Elsevier Publisher*

Course Code: CSE 4212		**Course Title:** Machine Learning Lab
Course Type: Lab	**Credit Hour:** 1.0	**Total Marks:** 100
Pre-requisite: CSE 4102		

Rationale: To provide hands on experience in implementing data analysis, data pre-processing techniques and developing machine learning models capable of providing solutions to real life problems. The laboratory assignments progress from investigation of the basic properties of machine learning to the development and evaluation of machine learning models.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Apply the dimensionality reduction techniques properly.	Cognitive/ Apply	1	4			Discussion and hands on practice in lab	Continuous Assessment, Viva
CO2	Develop a machine learning model to solve a real-life problem.	Affective/ Receiving	3	5			Discussion and hands on practice in lab	Continuous Assessment, Quiz
CO3	Evaluate the efficiency of different machine learning algorithms on real data.	Cognitive/ Evaluate	4	8			Discussion and hands on practice in lab	Final Lab Exam, Viva/ Project

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	√											
CO2			√									
CO3				√								

Course Contents	Duration (Weeks)	COs
Implementing the methods of missing values ratio, low variance filter, high correlation filter, backward feature elimination, forward feature construction. Implementation of principle component analysis, linear discriminant analysis and generalized discriminant analysis.	4	1
Implementation of different classification, regression and clustering types of machine learning algorithms.	4	2
Determining the performance metrics for machine learning algorithms: R-Squared value for regression type algorithms; confusion matrix, accuracy, precision, recall, specificity, F1 measure, ROC curve for classification type algorithms; applying elbow method for clustering algorithms.	5	3

Assessment Detail:

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

Recommended Books:

1. Aurélien Géron : **Hands-On Machine Learning with Scikit-Learn and TensorFlow Concepts, Tools and Techniques to Build Intelligent Systems,** *O'REILLY* **[Textbook]**
2. Noah Gift : **Pragmatic AI: An Introduction to Cloud-Based Machine Learning,** *Adison Wesley*
3. Oliver Theobald : **Machine Learning for Absolute Beginners (2nd Edition)**
4. Jiawei Han, : **Data Mining Concepts and Techniques,** *Elsevier Publisher*

Course Code: CSE 4213 **Course Title:** UI/UX Engineering
Course Type: Theory **Credit Hour:** 3.0 **Total Marks:** 100
Pre-requisite: None

Rationale: The course introduces the novice to a cycle of discovery and evaluation and a set of techniques that meet the user's needs. The course mantra is that "Design is a systematic and data driven process." Students will gain an understanding of the critical importance of user interface and user experience design. They will also learn industry-standard methods for how to approach the design of a user interface and user experience along with key theories and frameworks that underlie the design of most interfaces you use today. This course will demonstrate how the costs of bad design can often be severe (in user experience, money, and even human lives).

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Creating new designs from scratch.	Cognitive/ Apply	5	6			Lecture, Practice and Discussion	Class Test, Midterm Exam
CO2	Analyzing existing design and suggest improvements	Cognitive/ Understand	2	3			Lecture, Practice and Discussion	Class Test, Midterm Exam

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12
CO1					√							
CO2		√										

Course Content	Duration (Weeks)	COs
Course Introduction and Importance of UI Design	1	1
Understanding the UI Design Process, Usability and Design-Centered Approaches	2	2
Psychology and Human Factors in Design, Core Design Principles	2	2
High-Level Interaction Models, User Experience Design Overview	2	2
Requirement Gathering, Design Goals and Alternatives	2	2
Prototyping, Evaluation Techniques	2	1
Iterative Design and Feedback, Advanced Topics in UI/UX, Project Presentation and Course Wrap-Up	3	2

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
	Total	**100%**	

Recommended Books:

1. Donald A. Norman : **The Design of Everyday Things,** *MIT Press*
2. Jesse James Garret : **The Elements of User Experience,** *New Riders*
3. Jenifer Tidwell : **Designing Interfaces: Patterns for Effective Interaction Design,** *O'Reilly Media*

Course Code: CSE 4214		**Course Title:** UI/UX Engineering Lab
Course Type: Lab	**Credit Hour:** 1.0	**Total Marks:** 100
Pre-requisite: None		

Rationale: The course introduces the novice to a cycle of discovery and evaluation and a set of techniques that meet the user's needs. The course mantra is that "Design is a systematic and data driven process." Students will gain an understanding of the critical importance of user interface and user experience design and practically demonstrate them. They will also work on industry-standard methods for how to approach the design of a user interface and user experience along with key theories and frameworks that underlie the design of most interfaces you use today.

Course Outcomes (COs): At the end of the Course, students will be able to:

COs	Description	Taxonomy domain/level	POs	WK	WP	EA	Teaching-Learning strategy	Assessment strategy
CO1	Creating new UI design from scratch.	Cognitive/ Understand	5	6			Lecture, practical discussion	Continuous Assessment, Lab Test, Quiz
CO2	Gain practical experience in UX Design	Cognitive/ Understand	2	3			Lecture, practical discussion	Final Lab Test, Quiz

Mapping of Course Outcomes (COs) and Program Outcomes (POs):

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO10	PO11	PO12
CO1					√							
CO2		√										

Course Content	Duration (Weeks)	COs
Introduction to UI/UX Lab tools and objectives	1	1
Case Study Analysis - UI Disasters	1	2
Case Study - Citibank ATM, Microsoft Office 2007 Ribbon, International Children's Digital Library, Taxes and Tickets	5	2
Comparative Study - Airbnb vs. Couchsurfing	1	2
User Research Techniques	1	1
Ideation Techniques	1	1
Prototyping Session I	2	1
Evaluation and Testing	1	1
Final Lab Test		

Assessment Detail:

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Lab Participation	10%	50%
	Continuous Assessment (Experiment, Report, Viva)	40%	
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva)		50%
	Total	**100%**	

Recommended Books:

1. Donald A. Norman : **The Design of Everyday Things,** *MIT Press*
2. Jesse James Garret : **The Elements of User Experience,** *New Riders*
3. Jenifer Tidwell : **Designing Interfaces: Patterns for Effective Interaction Design,** *O'Reilly Media*

CURRICULUM
(Effective from Spring 2026)

Part D

Grading/Evaluation:

Evaluation of students' performance will be based on **Continuous Assessment (CA)** and **Summative Assessment (SA).** SA includes midterm examination and final examination whereas CA contains class-test, quiz, attendance, presentation and assignments/case, study/term paper/project/viva/group work. CA will cover 40% of the total marks and the remaining 60% are reserved for SA. For Lab courses evaluation will be based on attendance, Lab assessment, and Lab report, Quiz, Viva and Project. The distribution of marks is as follows:

Theory Course:

Assessment Tools		**Marks (%)**	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	30%	60%
	Final Examination	30%	
	Total	**100%**	

Lab Course:

Assessment Tools		**Marks (%)**
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
	Total	**100%**

i) Grading Scale and Grades

Numerical Grade	**Letter Grade**	**Grade Point**
80% and above	A+ (A Plus)	4.00
75% to less than 80%	A (A Regular)	3.75
70% to less than 75%	A- (A Minus)	3.50
65% to less than 70%	B+ (B Plus)	3.25
60% to less than 65%	B (B Regular)	3.00
55% to less than 60%	B- (B Minus)	2.75
50% to less than 55%	C+ (C Plus)	2.50
45% to less than 50%	C (C Regular)	2.25
40% to less than 45%	D (D Regular)	2.00
Less than 40%	F (Failure)	0.00

ii) Cumulative Grade Point Average

Student's performance will be evaluated on the basis of Grade Point Average (GPA) semester wise and Cumulative Grade Point Average (CGPA) of total completed courses.

The CGPA will be computed in the following manner:

$$CGPA = \frac{\text{Sum of (Earned Credit } \times \text{ Corresponding Grade Points)}}{\text{Total Credits}}$$

iii) Retake

a. If a student obtains F grade(s) in any courses for any reasons, s/he must retake the course(s) within the succeeding two semesters.
b. For retake and improvement, a student can take a maximum of 18 credits or 6 courses altogether within the succeeding two semesters.
c. If s/he passes after appearing at the retake examination, the (passed) result will be used for calculation of GPA and CGPA, but past grade must be recorded in the students' database; or grade report will be shown as 'R' (Retake). But in final official transcript (after completion of the degree) 'R' will not be shown.
d. If a student obtains F grade(s) after the end of the program, s/he will get a chance to complete the course (s) within additional 3 years after the end of his/her specific time of
e. Completing the degree. But in case of fail in Pre-Requisite course(s), the student must retake the course in the succeeding semester.
f. Except for Pre-Requisite course(s), a student can retake the course(s) at his/her convenient semester(s). A retake student will complete all course curriculums (i.e. class attendance, class test, assignment etc.) including midterm and final examinations of the specific course(s). In special cases, if the student cannot attend classes or continuous assessment (i.e., assignment, class test etc.), previous marks can be accepted to calculate GPA.
g. If course(s) cannot be offered due to any reason (i.e., course drop or unavailability of students etc.), department can take necessary steps to arrange only midterm and final examination for the retake student(s). In such cases, other marks except midterm and final examination will be carried forward from the previous semester where s/he attended the course(s).
h. The department may arrange separate examinations with separate questions (for midterm and final examinations only) for retake students if it cannot be accommodated in the regular examination schedule. But the examination must be completed in not more than 7 working days after the completion of midterm or final examinations.
i. Students who want to retake a course must get his/her registration completed at the beginning of each semester.

j. A student will have to pay requisite fee of the per credit fees for the retake course(s).
k. Retake rules are applicable for both Undergraduate and Graduate/Masters programs.
l. If a student retakes his/her failed course(s) after finishing normal duration of the program, s/he will pay only registration fee, exam fee and requisite fee for retake of course(s). If s/he fails to improve again, no refund of fees will be made.

iv) Improvement

a. A student obtaining B-, C+, C and D grades in theory course only may improve the grade(s) by appearing in the midterm and final examinations or final examination. A student may improve above mentioned grade(s) along with regular courses. In case of improvement after passing all courses of the respective program, a student will be allowed once in the succeeding semester, but s/he has to take approval from the head/coordinator of the department.
b. For improvement and retake a student can take a maximum of 18 credits or 6 courses altogether within the succeeding two semesters.
c. To prepare the improvement results, the course teachers can only modify midterm and final examination marks of the students in the result automation process. Other marks (i.e., class test, assignment etc.) will be automatically generated by the software from the previous database.
d. A student will have to pay requisite fee of the per credit fees for the improvement of grades.
e. If an examinee fails to improve his/her result, the previous result in the software will stand.
f. If a student improves his/her course(s) after finishing normal duration of the program, s/he will pay only registration fee, exam fee and requisite fee for improve of course(s). If s/he fails again, no refund of fees will be made.

v) Semester Drop & Cancelation of Admission

a. After getting enrolled for a semester, if any student fails to continue academic activities (i.e. class, exam, practical, assignment, presentation etc.) up to midterm examination, s/he will be considered as a semester drop student. In this case s/he will not be allowed to sit for the final exam.
b. After getting enrolled for a semester, if any student completes all academic activities, but fails to appear at the midterm examination, the student may be allowed to sit for the final exam.
c. Semester drop student may get readmission in the subsequent semester on payment of semester drop fee and his/her paid amount (full/partial) will be adjusted at the time of readmission. However, if any student discontinues the study forever, s/he will not get back the money paid at the time of admission.
d. In case of semester drop or withdrawal, a student will be considered as a fresh student for the semester. S/he will get all chances for improvement, retake and re-admission like a fresh student. However, a student must complete his/her program within the time mentioned in section 7 from the time of his /her first semester admission.

e. After cancellation of admission, If a student returns, s/he will be admitted to the same semester by paying the requisite fee (considered as semester drop student), but s/he must complete degree within stipulated time period.
f. If a student wants to cancel his/her admission, s/he should have to pay requisite fee for Admission Cancellation.

Appendix A

FYDP Book Template

Title of Your Final Year Design Project

By

Student 1 Name(ID)
Student 2 Name(ID)
Student 3 Name(ID)

Submitted in partial fulfilment of the requirements
of the degree of Bachelor of Science in Computer Science and Engineering

May 24, 2026



Department of Computer Science and Engineering
Varendra University



Department of Computer Science and Engineering
Varendra University

DECLARATION

We hereby declare that the work presented in this thesis/project entitled **"Your FYDP Title"** is the result of our own research carried out under the supervision of **"Supervisor Name"**.

We further declare that this thesis has not been submitted previously, in whole or in part, for any degree or diploma at any other university or institution. All referenced materials have been duly acknowledged.

Student 1 Name
Student 1 ID
Dept. of CSE
Varendra University

Student 2 Name
Student 2 ID
Dept. of CSE
Varendra University

Student 3 Name
Student 3 ID
Dept. of CSE
Varendra University

Student 4 Name
Student 4 ID
Dept. of CSE
Varendra University



Department of Computer Science and Engineering
Varendra University

CERTIFICATE

This is to certify that the thesis/project entitled **"Your FYDP Title"** has been submitted by **Student Name 1 (ID), Student Name 2 (ID), Student Name 3 (ID)** in partial fulfillment of the requirements for the degree of **Bachelor of Science in Computer Science and Engineering** at **Varendra University, Rajshahi, Bangladesh**.

The work presented in this thesis is an original contribution of the above-mentioned students and has been carried out under my direct supervision. To the best of my knowledge, this work has not been submitted, either in whole or in part, for any other degree or qualification at any other institution.

Supervisor

Supervisor Name
Designation
Department of Computer Science and Engineering
Varendra University

Acknowledgements

This work would have not been possible without the input and support of many people over the last two trimesters. We would like to express my gratitude to everyone who contributed to it in some way or other.

First, we would like to thank my academic advisors, ...

Our sincere gratitude goes to ...

We are also thankful to ...

Last but not the least, We owe to our family including our parents for their unconditional love and immense emotional support.

Publication List

[Optional] The main contributions of this research are either published or accepted or in preparation in journals and conferences as mentioned in the following list:

Journal Articles

1.

Conference Papers

1.

Additional Publications

Following is the list of relevant publications published in the course of the research that is not included in the thesis:

1.

Table of Contents

Declaration i

Certificate ii

Acknowledgements iii

Publication List iv

Table of Contents vi

List of Abbreviations vii

List of Figures viii

List of Tables ix

Abstract x

1 Introduction 1

1.1 Thesis/Project Overview . . . 1
1.2 Motivation . . . 1
1.3 Objectives . . . 2
1.4 Methodology . . . 2
1.5 Thesis/Project Outcome . . . 2
1.6 Organization of the Report . . . 3

2 Background 4

2.1 Preliminaries . . . 4
2.2 Literature Review . . . 4
2.2.1 Similar Applications . . . 4
2.2.2 Related Research . . . 5
2.3 Gap Analysis . . . 5
2.4 Summary . . . 5

3 System Architecture 6
3.1 Requirement Analysis . . . 6
3.1.1 Functional and Nonfunctional Requirements . . . 6
3.1.2 Context Diagram . . . 6
3.1.3 UI Design . . . 7
3.2 Detailed Methodology and Design . . . 7
3.3 Tools and Technologies Used . . . 7
3.4 Work Division and Team Management . . . 8
3.5 Time Frame . . . 8
3.6 Summary . . . 8

4 Implementation and Results 9
4.1 Environment Setup . . . 9
4.2 Testing and Evaluation . . . 9
4.3 Results and Discussion . . . 9
4.4 Summary . . . 10

5 Standards and Design Constraints 11
5.1 Compliance with the Standards . . . 11
5.1.1 Software Standards . . . 11
5.1.2 Hardware Standards . . . 11
5.1.3 Communication Standards . . . 12
5.2 Constraints and Limitations . . . 12
5.2.1 Economic Constraint . . . 13
5.2.2 Environmental Constraint . . . 13
5.2.3 Ethical Constraint . . . 14
5.2.4 Health and Safety Constraint . . . 14
5.2.5 Social Constraint . . . 14
5.2.6 Sustainability . . . 15
5.2.7 Lifelong Learning and Personal Development . . . 15
5.3 Cost Analysis . . . 15
5.4 Complex Engineering Problem . . . 16
5.4.1 Complex Problem Solving . . . 16
5.4.2 Engineering Activities . . . 17
5.5 Summary . . . 18

6 Conclusion 19
6.1 Summary . . . 19
6.2 Limitation . . . 19
6.3 Future Work . . . 19

References 20

List of Abbreviations

IMPORTANT: Maintain alphabetical order (A–Z) when adding new abbreviations

AI	=	Artificial Intelligence
API	=	Application Programming Interface
CSE	=	Computer Science & Engineering
DBMS	=	Database Management System
IoT	=	Internet of Things
ML	=	Machine Learning

List of Figures

List of Tables

5.1 Mapping with complex problem solving. 17
5.2 Mapping with complex engineering activities. 18

Abstract

The abstract should contain a summary of the work presented in this report in a single paragraph. The paragraph should provide a general background of the problem, methodology and results.

Chapter 1

Introduction

[*Must be present in FYDP-1 Report and also in Final Report*]

Every chapter should start with 1-2 sentences on the outline of the chapter.

1.1 Thesis/Project Overview

This section should clearly present the background and a problem statement that your project aims to solve. The Thesis/Project Overview section provides a concise introduction to the entire work, giving readers a quick understanding of what the project is, why it is important, and how it is carried out. It typically includes the problem statement, objectives, scope, methodology, and expected outcomes. The overview should briefly describe the context of the problem, the motivation behind choosing it, and the proposed solution approach, without going into detailed technical explanations.

In a thesis (research) work, for example, an overview of an AI-based disease prediction system may mention the need for accurate diagnosis, the use of machine learning models, dataset sources, and expected improvement in prediction accuracy. In a project (system/software) work, such as a web-based student management system, the overview may highlight the need for automation, key features (student records, result management), technologies used (e.g., web framework, database), and expected benefits like efficiency and accuracy. Overall, this section acts as a snapshot of the entire work, helping readers quickly grasp the purpose, approach, and significance of the project

1.2 Motivation

The Thesis/Project Motivation section explains why the problem was chosen and what inspired the work. It highlights the real-world need, existing challenges, and importance of solving the problem, linking them to academic, industrial, or societal relevance. This section typically includes the background context, observed issues in current systems, and the potential impact of an improved solution, helping readers understand the driving force behind the project.

In a thesis (research) work, for example, the motivation for an AI-based disease prediction system may come from the need for early and accurate diagnosis, limitations of existing models, and the growing importance of AI in healthcare. In a project (system/software) work, such as a student management system, the motivation may arise from manual record-keeping inefficiencies, data errors, and time-consuming administrative processes, encouraging the development of an automated solution. Overall, this section clearly communicates the purpose and significance of the work, showing why it is worth undertaking. The computational motivation that encourages you to solve the problem should be clearly stated here. In addition, you can mention why solving this problem will benefit you.

1.3 Objectives

The Thesis/Project Objectives section clearly states the specific goals that the work aims to achieve, usually in concise, measurable points. It translates the motivation into actionable targets, outlining what the system or research will accomplish. Objectives should be clear, achievable, and aligned with the problem statement, often divided into a general objective (overall goal) and several specific objectives (step-by-step aims such as design, implementation, and evaluation).

In a thesis (research) work, for example, an AI-based disease prediction study may have objectives like: to develop an accurate prediction model, to evaluate performance using metrics such as accuracy and F1-score, and to compare results with existing methods. In a project (system/software) work, such as a web-based student management system, objectives may include: to design a user-friendly interface, to implement modules for student records and result management, and to ensure efficient and secure data handling. Overall, this section defines what the project intends to achieve and provides a roadmap for the entire work.

Enumerate the objectives in clear and specific terms.

1. *Objective 1*
2. *Objective 2*
3. *Objective 3*

1.4 Methodology

Here you put a brief summary of the methodology.

1.5 Thesis/Project Outcome

What are or could be the possible outcomes of your work? The outcomes achieved in this theiss/project are as follows:

1. *Outcome 1 corresponding to Objective 1.*
2. *Outcome 2 corresponding to Objective 2.*
3. *Outcome 3 corresponding to Objective 3.*

1.6 Organization of the Report

Here put a chapter wise structure of the report in narrative form.

Chapter 2

Background

[*Must be present in FYDP-1 Report and also in Final Report*]

Every chapter should start with 1-2 sentences on the outline of the chapter.

2.1 Preliminaries

In this section, you have to provide the necessary background knowledge to understand the rest of the report [1].

2.2 Literature Review

The Literature Review section summarizes and analyzes existing research, systems, and technologies related to the project, showing what has already been done and where your work fits in. It typically includes a review of relevant papers, methods, tools, and findings, along with a brief comparison of their strengths and limitations. The goal is not just to describe past work, but to critically analyze it and identify trends, gaps, and opportunities that justify your proposed solution.

In a thesis (research) work, for example, a student working on an AI-based disease prediction model may review several studies using CNN, SVM, or hybrid models, compare their accuracy (e.g., 80–90%), and discuss limitations such as small datasets or lack of generalization. In a project (system/software) work, such as a web-based management system, the review may include existing applications or frameworks, discussing features, usability, and shortcomings like lack of scalability or poor user interface. Overall, this section demonstrates understanding of the domain, awareness of prior work, and the need for the proposed solution.

This section will contain you literature review.

2.2.1 Similar Applications

The Similar Applications section describes existing real-world systems, software, or applications that are closely related to your project. It focuses on practical implementations

(not just research papers) and explains their features, technologies, strengths, and limitations. The purpose is to show awareness of current solutions and to highlight how your system is different or improved.

In a thesis (research) work, for example, if the topic is AI-based disease prediction, this section may discuss existing applications like hospital decision-support systems or diagnostic apps, describing their capabilities and limitations (e.g., limited accuracy or lack of local data). In a project (system/software) work, such as a student management system, similar applications may include existing university portals or commercial software, analyzing features like record management, reporting, and user interface, while noting gaps such as poor usability or lack of customization. Overall, this section demonstrates practical relevance, comparison with real systems, and justification for the proposed solution.

2.2.2 Related Research

The Related Research section reviews and discusses previous academic studies, journal papers, and conference works that are directly connected to your thesis or project topic. It focuses on research methods, models, algorithms, datasets, and key findings, showing how other researchers have approached similar problems. The section should not only summarize these works but also compare them, highlight their strengths and limitations, and identify research gaps that your work aims to address.

In a thesis (research) work, for example, a student working on an AI-based disease prediction system may analyze several studies using techniques like CNN, SVM, or hybrid models, comparing their performance (e.g., accuracy, PR-AUC) and noting limitations such as small datasets or lack of generalization. In a project (system/software) work, such as a smart traffic system, the section may include research on traffic optimization algorithms or IoT-based solutions, discussing their effectiveness and constraints. Overall, this section demonstrates deep understanding of the research landscape and positions your work within existing scientific contributions.

2.3 Gap Analysis

Gap analysis identifies the limitations, shortcomings, or unexplored areas in existing research or systems and explains how the proposed work aims to address those gaps. Recommended Table Format. The table columns will include: Existing Work, Limitations, Identified Gap, and Proposed Solution. Here summarise the gap where you intend to work.

2.4 Summary

Chapter 3

System Architecture

[Must be present in FYDP-1 Report and also in Final Report]

Every chapter should start with 1-2 sentences on the outline of the chapter.

3.1 Requirement Analysis

3.1.1 Functional and Nonfunctional Requirements

The Functional and Non-Functional Requirements Analysis section defines what the system will do and how well it will perform, forming the foundation for design and implementation. Functional requirements describe the core features and operations of the system (e.g., user registration, data processing, report generation), while non-functional requirements specify quality attributes such as performance, security, usability, reliability, and scalability. This section should present requirements clearly—often using bullet points or tables—and may include use cases or scenarios.

In a thesis (research) work, for example, an AI-based prediction system may include functional requirements like data input, model training, and prediction output, and non-functional requirements like high accuracy, low computation time, and secure data handling. In a project (system/software) work, such as a web-based management system, functional requirements may include login, data entry, and report generation, while non-functional requirements may include fast response time (e.g., ¡2 seconds), user-friendly interface, and support for multiple users. Overall, this section ensures that the system is clearly defined, measurable, and aligned with user and system expectations.

3.1.2 Context Diagram

The Context Diagram section provides a high-level graphical overview of the system, showing how the proposed project interacts with external entities (users, systems, or organizations) through data flows. It represents the entire system as a single process (black box) and illustrates only the inputs and outputs, without showing internal details. The section should include a labeled diagram along with a short explanation of each

external entity and the type of data exchanged.

For example, in a thesis or project work like a Student Management System, the context diagram would show the system at the center, with external entities such as Student, Teacher, and Admin. Data flows may include login requests, student information, marks entry, and result reports. The accompanying description should briefly explain how each entity interacts with the system. Overall, this section helps readers quickly understand the system boundary, scope, and interactions, serving as a foundation for more detailed design diagrams.

In a thesis or project work like a Student Management System, the context diagram would show the system at the center, with external entities such as Student, Teacher, and Admin. Data flows may include login requests, student information, marks entry, and result reports. The accompanying description should briefly explain how each entity interacts with the system. Overall, this section helps readers quickly understand the system boundary, scope, and interactions, serving as a foundation for more detailed design diagrams.

3.1.3 UI Design

if required (may be for project work)

3.2 Detailed Methodology and Design

The Detailed Methodology and Design section explains how the project is carried out and how the system is structured, translating objectives into a clear technical plan. It typically includes the overall approach (research method or development model), system architecture, algorithms or models used, data collection/preprocessing (if any), and design components such as modules, database schema, and flow diagrams (e.g., flowchart, DFD, UML). This section should describe the step-by-step process from input to output, along with tools, technologies, and design decisions.

In a thesis (research) work, for example, an AI-based system may describe dataset collection, preprocessing, feature extraction, model architecture (e.g., CNN-BiLSTM), training process, and evaluation strategy, often supported by block diagrams. In a project (system/software) work, such as a web-based application, it may include system architecture (frontend–backend–database), module design (login, data management), database tables, API flow, and user interface design. Overall, this section demonstrates a well-structured, logical, and implementable plan, showing how the proposed solution is designed and executed.

3.3 Tools and Technologies Used

The Tools and Technologies Used section lists and briefly explains the software, hardware, programming languages, frameworks, and platforms utilized to develop the thesis

or project. Its purpose is to show how the system was implemented and why specific tools were chosen, often mentioning their role in development, testing, or deployment. This section may be presented in a table or categorized list (e.g., Programming Language, Framework, Database, Hardware, Development Tools).

In a thesis (research) work, for example, an AI-based project may use Python, TensorFlow/PyTorch, NumPy, and Jupyter Notebook, along with tools for data preprocessing and visualization. In a project (system/software) work, such as a web-based application, the technologies may include HTML, CSS, JavaScript, a backend framework (e.g., Django or Node.js), and a database like MySQL, along with version control tools like Git. The section should also briefly justify choices—for instance, selecting Python for its rich AI libraries or a specific framework for scalability. Overall, this section demonstrates the technical foundation and implementation environment of the work.

3.4 Work Division and Team Management

he Work Division and Team Management section explains how responsibilities were distributed among team members and how the project was coordinated and managed. It typically describes each member's role (e.g., development, design, testing, documentation), the task allocation strategy, and how collaboration was maintained using meetings, version control, or project management tools. This section may include a table showing team members and their assigned tasks, along with a brief explanation of workflow, communication, and timeline management (e.g., milestones or Gantt chart).

For example, in a thesis/project team of three students developing a web-based system, one member may handle frontend design (UI/UX), another may work on backend development and database, and the third may focus on testing, integration, and documentation. Team management may involve weekly meetings, task tracking using tools like Git or Trello, and collaborative coding via version control. Overall, this section demonstrates organized teamwork, clear responsibility distribution, and effective coordination, ensuring the successful completion of the project.

In a two-column table, the left column will contain the names of the team members, and the right column will list the tasks of the project/thesis completed by the respective team members.

3.5 Time Frame

There will be a Gantt chart that illustrates the different phases of the project work on the total timeline, along with the specific roles of each team member in those phases.

3.6 Summary

Chapter 4

Implementation and Results

[Must be present in Final Report. Incomplete version might be included in FYDP-1 Report, however it is optional.]

Every chapter should start with 1-2 sentences on the outline of the chapter.

4.1 Environment Setup

4.2 Testing and Evaluation

The Testing and Evaluation section explains how a system is tested and how well it performs, using test cases, metrics, and experimental results to validate its effectiveness. In a thesis (research) work, this typically involves dataset-based evaluation and performance metrics—for example, an AI disease detection model may be tested on unseen data and achieve 91% accuracy, outperforming an existing model with 85%, with analysis explaining the improvement. In a project (software/system) work, it focuses more on functional and performance testing—for example, a web-based student management system may be tested with multiple users, showing correct outputs for all test cases and maintaining an average response time of 1.2 seconds under load. In both cases, the section provides measurable evidence, comparison, and analysis to prove that the system meets its objectives

4.3 Results and Discussion

The Results and Discussion section presents the key findings of the work and explains their meaning in relation to the project objectives. It includes a clear presentation of results (tables, graphs, outputs), followed by interpretation—why the results are good or not, what patterns are observed, and how they compare with existing work. In a thesis (research) work, this often involves analyzing model performance and scientific outcomes—for example, an AI model achieving 92% accuracy may be discussed in terms of improved feature extraction, comparison with earlier studies (e.g., 85%), and reasons for any limitations such as overfitting or dataset bias. In a project (software/system) work, it focuses on sys-

tem behavior and usability—for example, a web application showing stable performance with 1.2-second response time under 100 users may be discussed in terms of efficiency, scalability, and user experience, along with any constraints like performance degradation at higher loads. Overall, this section not only reports results but critically interprets them, highlights strengths and weaknesses, and connects outcomes to the original objectives

4.4 Summary

Chapter 5

Standards and Design Constraints

[Must be present in FYDP-1 Report and also in Final Report]

Every chapter should start with 1-2 sentences on the outline of the chapter.

5.1 Compliance with the Standards

Only mention the standards that are related to your project. This list is not complete. For each of the standards discuss the alternates with pros and cons and rationale of selection.

5.1.1 Software Standards

The Software Standards section describes the guidelines, protocols, and best practices followed during development to ensure the system is reliable, secure, maintainable, and consistent. It typically covers coding standards (naming conventions, formatting), documentation practices, version control, testing standards, security guidelines, and any relevant international or industry standards (e.g., ISO/IEEE). The purpose is to show that the project was developed in a systematic and professional manner, following accepted engineering practices.

For example, in a thesis/project work, a student may follow coding standards like proper indentation and meaningful variable names, use Git for version control, apply testing standards such as unit and integration testing, and ensure security practices like password hashing and input validation. In a web-based system, they may follow REST API standards and basic OWASP security guidelines to prevent vulnerabilities. Overall, this section demonstrates that the software is developed with quality assurance, consistency, and adherence to recognized standards, making it robust and maintainable.

5.1.2 Hardware Standards

The Hardware Standards section describes the hardware specifications, guidelines, and best practices followed to ensure the system is safe, reliable, compatible, and efficient. It typically includes details such as required hardware components (e.g., microcontrollers,

sensors, servers, PCs), configuration specifications (CPU, RAM, storage), power requirements, interfacing standards, and compliance with safety or industry standards. The purpose is to show that the hardware used is appropriate, standardized, and suitable for the system's operation.

For example, in a thesis/project work involving an IoT-based system, the student may use ESP32/Arduino boards, temperature sensors, and regulated power supply, ensuring proper voltage levels (e.g., 5V/3.3V), secure wiring, and standard communication protocols like I2C, SPI, or UART. In a software-only project, this section may describe the minimum system requirements such as a computer with specific CPU, RAM, and OS configuration for deployment. Overall, this section demonstrates that the hardware setup follows standard practices for performance, safety, and compatibility, supporting reliable system operation.

5.1.3 Communication Standards

The Communication Standards section describes the protocols, data formats, and rules used for data exchange between different components of the system (e.g., client–server, device–device, or module–module). It explains how reliable, secure, and consistent communication is ensured, including aspects like network protocols, API design, message formats, error handling, and security measures. The goal is to show that the system follows standardized and interoperable communication practices.

For example, in a thesis/project work, a web-based application may use HTTP/HTTPS protocols with RESTful APIs, exchanging data in JSON format, and applying authentication tokens (e.g., JWT) for secure communication. In an IoT-based project, communication may follow protocols like MQTT, HTTP, or WebSocket, with devices sending sensor data to a cloud server. The section may also mention error handling, data validation, and encryption to ensure reliability and security. Overall, this section demonstrates that the system uses standard, efficient, and secure communication methods for proper interaction between its components.

5.2 Constraints and Limitations

The Constraints and Limitations section explains the practical restrictions faced during the project and the inherent weaknesses of the proposed solution. It typically covers constraints such as limited time, budget, hardware resources, dataset size, tools, or technical expertise, as well as system limitations like reduced accuracy, scalability issues, dependency on internet or specific platforms, or restricted functionality. This section should be honest and realistic, showing awareness of what the system cannot fully achieve and why.

For example, in a thesis (research) work, an AI model may be limited by a small or imbalanced dataset, leading to lower generalization performance despite good training accuracy. In a project (system/software) work, such as a web application, limitations

may include performance degradation under high user load or dependency on stable internet connectivity. Overall, this section demonstrates critical evaluation and transparency, helping readers understand the scope, challenges, and areas for future improvement.

5.2.1 Economic Constraint

The Economic Constraints section explains the financial limitations and affordability considerations that influence the design, development, and deployment of the system. It identifies cost-related factors such as budget limits, hardware/software expenses, maintenance cost, and scalability cost, and describes how the project is designed to remain cost-effective. In a thesis (research) work, for example, a student may use open-source tools (e.g., Python, TensorFlow) and publicly available datasets to minimize expenses while still achieving strong results. In a project (system/software) work, such as a web-based management system, the design may focus on low-cost hosting, minimal hardware requirements, and efficient resource usage—for instance, developing a system that runs on standard servers instead of expensive infrastructure. Overall, this section demonstrates that the solution is economically feasible and sustainable, especially within real-world budget constraints

5.2.2 Environmental Constraint

The Environmental Constraints section describes how the system is affected by environmental factors and how it impacts the environment, including issues like energy consumption, hardware usage, heat generation, e-waste, and sustainability. It also explains any limitations due to infrastructure (e.g., power availability, network conditions) and how the design addresses them. In a thesis (research) work, this might involve analyzing computational cost—for example, an AI model may require high GPU power, so the study can discuss optimizing the model to reduce energy consumption or using efficient architectures. In a project (system/software) work, it may focus on deployment—for example, a web system designed to run on low-power servers to reduce electricity usage.

Green computing can be incorporated by adopting environmentally friendly practices such as using energy-efficient algorithms, cloud-based shared resources instead of dedicated hardware, low-power devices, code optimization to reduce CPU usage, and minimizing unnecessary data processing or storage. For instance, a student project could implement a lightweight machine learning model that reduces computation time by 30%, thereby lowering power consumption and contributing to sustainable computing. Overall, this section shows awareness of environmental impact and demonstrates efforts to design a more sustainable and eco-friendly system. To estimate the environmental impact of computation, a simple electricity-based carbon model is applied. Using the Bangladesh grid emission factor (≈ 0.67 kg CO_2 per kWh), the carbon footprint is computed from the total energy used during model training. A typical large deep-learning workflow may require a 250 W GPU for multiple long training runs, resulting in significantly higher energy use and emis-

sions. In contrast, the proposed LitePhospho model uses a lightweight architecture that trains on a 100 W CPU/small GPU for fewer hours. As a result, the total computational carbon emission is considerably lower.r.

5.2.3 Ethical Constraint

The Ethical Constraints section explains how the project adheres to moral principles and professional responsibilities during development and deployment. It addresses issues such as data privacy, confidentiality, informed consent, fairness, transparency, avoidance of bias, and responsible use of technology. The section identifies potential ethical risks—like misuse of user data, biased AI decisions, or plagiarism—and describes the measures taken to prevent them. In a thesis (research) work, for example, an AI-based system using personal or medical data must ensure data anonymization, secure storage, and proper consent from data sources, while also evaluating and reducing algorithmic bias. In a project (system/software) work, such as a web or mobile application, ethical considerations may include secure authentication, protection of user information, and clear user policies. Overall, this section demonstrates that the system is developed in a way that is fair, responsible, and aligned with professional ethical standards.

5.2.4 Health and Safety Constraint

The Health and Safety Constraints section explains how the project considers and minimizes risks to users, developers, and the environment during development and operation. It identifies potential hazards—such as electrical risks (in hardware/IoT projects), prolonged screen exposure, poor ergonomics, data privacy concerns, or system misuse—and describes measures taken to ensure safety and compliance with standards. In a thesis (research) work, for example, an AI-based healthcare system should ensure data privacy, secure handling of sensitive information, and avoidance of misleading outputs that could affect patient decisions. In a project (system/software) work, such as an IoT-based smart device, safety measures may include proper circuit insulation, low-voltage design, secure connections, and user guidelines to prevent accidents. For software-only systems, considerations may include reducing eye strain through UI design, preventing data loss, and ensuring secure authentication. Overall, this section demonstrates that the system is designed with user well-being, safety standards, and risk mitigation in mind.

5.2.5 Social Constraint

he Social Constraints section explains how the project interacts with and is influenced by societal factors, and how it affects users and communities. It considers issues such as accessibility, cultural sensitivity, digital divide, user acceptance, ethical use, and inclusiveness. The section identifies potential social limitations—like lack of internet access, low digital literacy, language barriers, or resistance to new technology—and describes how the system design addresses them. In a thesis (research) work, for example, an AI-based

application may consider bias in data and ensure fairness so that different groups are not disadvantaged. In a project (system/software) work, such as a mobile app, the system may include local language support (e.g., Bangla), simple user interface, and low-bandwidth operation to make it usable for a wider population. Overall, this section demonstrates awareness of the system's social impact and responsibility, ensuring it is usable, fair, and beneficial to society.

5.2.6 Sustainability

he Sustainability section explains how the project is designed to be environmentally, economically, and socially sustainable over the long term. It highlights practices that reduce resource consumption, ensure efficient operation, and maintain usability for future users. This includes aspects such as energy efficiency, scalability, maintainability, use of open-source technologies, and minimal environmental impact. In a thesis (research) work, for example, a student may develop an optimized AI model that achieves high accuracy with reduced computational cost, thereby lowering energy consumption. In a project (system/software) work, such as a web or IoT system, sustainability may involve low-power hardware, efficient code, cloud-based shared resources, and easy system updates to extend system lifespan. Overall, this section demonstrates that the solution is not only effective now but also viable, efficient, and responsible for long-term use and future development.

5.2.7 Lifelong Learning and Personal Development

The Lifelong Learning and Personal Development section highlights how the thesis or project contributed to the student's continuous learning ability and overall skill development. It reflects on the knowledge and competencies gained during the work, such as learning new programming languages, tools, frameworks, or research methodologies, as well as improving problem-solving, critical thinking, teamwork, and communication skills. In a thesis (research) work, for example, a student may learn how to read and analyze research papers, design experiments, and implement advanced models (e.g., deep learning), which prepares them for future research or higher studies. In a project (system/software) work, a student might gain hands-on experience in system design, debugging, version control, and user interaction—for instance, developing a web application may enhance full-stack development skills and real-world problem-solving ability. Overall, this section demonstrates how the work has strengthened the student's ability to adapt, learn independently, and grow professionally beyond the project itself.

5.3 Cost Analysis

The cost-benefit analysis will assess whether the proposed system is economically and practically worthwhile by comparing the total cost of development and operation with the expected benefits. It typically includes cost components such as hardware, software, de-

velopment time, maintenance, and training, and benefits such as time savings, improved accuracy, efficiency, scalability, or social impact. In a thesis (research) work, this may focus on research value—for example, an AI model developed using open-source tools may have minimal financial cost but high benefit in terms of improved prediction accuracy and contribution to knowledge. In a project (system/software) work, it is often more practical—for example, a web-based management system costing BDT 50,000 to develop may reduce manual work by 70%, save administrative time, and improve data accuracy, making it cost-effective in the long run. Overall, this section demonstrates that the proposed solution provides greater benefits compared to its cost, justifying its implementation Provide a cost analysis in terms of budget required and revenue model. In case of budget, you must show an alternate budget and rationales.

5.4 Complex Engineering Problem

5.4.1 Complex Problem Solving

The Complex Engineering Problem (CEP) section explains why a thesis or project involves significant engineering difficulty, requiring analysis, judgment, and integration of multiple factors rather than a routine solution. To justify CEP (as per BAETE/Washington Accord style), you should explicitly show that the work satisfies WP1, WP2, and WP3.
WP1 (Depth of Knowledge Required): The problem demands advanced and specialized knowledge beyond basic coursework.

WP2 (Range of Conflicting Requirements): The solution must balance multiple, often conflicting constraints (e.g., accuracy vs. cost, performance vs. energy, usability vs. security).

WP3 (Depth of Analysis Required): The problem requires in-depth analysis, modeling, experimentation, and evaluation of alternatives, not a straightforward implementation.

Example (Thesis Work – AI-based Disease Prediction)

This work can be justified as a CEP because:

WP1: It requires knowledge of machine learning, deep learning architectures, and data preprocessing techniques.

WP2: It must balance high accuracy with limited dataset size, computational cost, and ethical concerns like data privacy.

WP3: It involves extensive experimentation (model tuning, comparison with baseline models, performance evaluation using metrics like accuracy and F1-score).

Example (Project Work – Smart Traffic Management System)

WP1: Requires knowledge of IoT, networking, and real-time systems.

WP2: Must handle conflicts between real-time performance, cost of sensors, network latency, and scalability.

WP3: Requires analysis of traffic patterns, algorithm design for signal optimization, and testing under different traffic scenarios.

Overall, the CEP section should clearly demonstrate that the work involves advanced knowledge, multiple constraints, and rigorous analysis, thereby qualifying it as a Complex Engineering Problem rather than a simple or routine task.

In this section, provide a mapping with problem solving categories. For each mapping add subsections to put rationale (Use Table 5.1). For P1, you need to put another mapping with Knowledge profile and rational thereof.

Table 5.1: Mapping with complex problem solving.

WP1 Dept of Knowledge	WP2 Range of Conflicting Requirements	WP3 Depth of Analysis	WP4 Familiarity of Issues	WP5 Extent of Applicable Codes	WP6 Extent of Stakeholder Involvement	WP7 Interdependence
✓	✓	✓				

5.4.2 Engineering Activities

The Complex Engineering Activities (CEA) section explains how the student has carried out non-routine, technically demanding engineering tasks that involve design, implementation, and decision-making under constraints. It demonstrates that the work is not just theoretical but includes practical realization, integration of components, testing, and iterative improvement. To justify CEA (aligned with BAETE/Washington Accord), you should explicitly show that the work satisfies EA1 and EA2:

EA1 (Range of Resources and Techniques): The project uses diverse tools, technologies, and methods, such as programming frameworks, hardware/software integration, simulations, datasets, and testing tools.

EA2 (Level of Interaction and Integration): The work involves integration of multiple subsystems or components, requiring coordination between different modules, technologies, or stakeholders.

Example (Thesis Work – AI-based Disease Detection)

EA1: Uses Python, TensorFlow/PyTorch, data preprocessing techniques, and performance evaluation tools.

EA2: Integrates data collection, preprocessing pipeline, model training, evaluation, and possibly a user interface for prediction, forming a complete system.

Example (Project Work – Smart Home Automation System) EA1: Uses microcontrollers (e.g., Arduino/ESP32), sensors, mobile app development, and networking protocols.

EA2: Integrates hardware (sensors/actuators), software (control logic), and communication (Wi-Fi/Bluetooth) into a unified system.

Overall, this section should clearly show that the student has engaged in hands-on engineering activities involving multiple tools and system integration, proving the work qualifies as Complex Engineering Activities, not just a simple or isolated task.

In this section, provide a mapping with engineering activities. For each mapping add subsections to put rationale (Use Table 5.2).

Table 5.2: Mapping with complex engineering activities.

EA1 Range of resources	EA2 Level of Interaction	EA3 Innovation	EA4 Consequences for society and environment	EA5 Familiarity
√	√			

5.5 Summary

Chapter 6

Conclusion

[Must be present in FYDP-1 Report and also in Final Report. Might be incomplete in FYDP-1 Report.]

Every chapter should start with 1-2 sentences on the outline of the chapter.

6.1 Summary

6.2 Limitation

6.3 Future Work

References

[1] Jon Kleinberg and Eva Tardos. *Algorithm design*. Pearson Education India, 2006.