BANGLADESH ARMY UNIVERSITY OF ENGINEERING & TECHNOLOGY (BAUET)

Qadirabad, Dayarampur, Natore-6431











Syllabus for Bachelor of Science in Computer Science and Engineering

CSE

3rd Edition

Effective from the Session 2022-2023

An Institute of Bangladesh Army

Approved by UGC

Bangladesh Army University of Engineering & Technology (BAUET)

Qadirabad, Dayarampur, Natore-6431



Syllabus

for

Bachelor of Science in
Computer Science and Engineering

Department of Computer Science and Engineering

Faculty of Electrical and Computer Engineering (ECE)

Effective from the Session 2022-2023
(Third Edition)

Published by:
Department of Computer Science and Engineering
Bangladesh Army University of Engineering & Technology
Qadirabad, Dayarampur, Natore-6431, Bangladesh.

Edition:
First Edition : 2015
Second Edition : 2020
Third Edition : 2023

Copyright:
© 2023 *Dept. of CSE, BAUET;* All Rights Reserved.

Address for Correspondence:
Head,
Department of Computer Science and Engineering
Bangladesh Army University of Engineering & Technology
Qadirabad, Dayarampur, Natore-6431, Bangladesh.
Email: head_cse@bauet.ac.bd
Website: https://bauet.ac.bd/cse/

Cover Concept:
Mithun Kumar, Assistant Professor, Dept. of CSE.

Cover Design:
Md. Ruhul Amin Lemon

Printed by:
Uttoran Offset Printing Press, Rajshahi.

Disclaimer:

All the contents published in this syllabus are the property of Department of Computer Science and Engineering, BAUET. The users of this syllabus are prohibited to reuse, copy, distribute or republish any part of contents in any manner without written permission from the head of the department. The purpose of the syllabus of undergraduate studies is to provide guidance to concerned students and teachers in the Department of Computer Science and Engineering.

Owner Personal Information

Name:	
ID Number:	
Address:	
Mobile No:	

Preface to 3rd Edition

This preface introduces the **Outcome Based Education (OBE)** Curriculum for the Computer Science and Engineering Program, a comprehensive framework designed to align educational objectives with the needs of the industry and society according to **BNQF (Bangladesh National Qualifications Framework)** and UGC guidelines. Some new courses have been incorporated in this edition and some courses have been updated according to the requirements of **UGC's** new guidelines, **BAETE (Board of Accreditation for Engineering and Technical Education)** as well as **BAC (Bangladesh Accreditation Council)**. Other important changes in this curriculum are that students can choose their elective courses from the 3rd year 2nd semester so that they will be able to select the specialized field of interest. One of the most salient features of this curriculum is Integrated Design Projects (Software Development Project-I & II) through which students will solve complex engineering problems.

OBE emphasizes the outcomes of education, focusing on the demonstrable knowledge, skills, and competencies that students should acquire by the end of their program. The OBE approach outlined in this curriculum seeks to bridge the gap between academia and industry by providing students with a well-rounded education that combines theoretical foundations with practical application. By clearly defining learning outcomes, curriculum designers and educators can shape the teaching and learning process to ensure that students develop the necessary abilities and mindset to succeed in their professional careers. The OBE framework places a strong emphasis on active learning, critical thinking, problem-solving, and teamwork. It encourages educators to adopt innovative teaching methodologies, such as project-based learning, experiential learning, and collaborative activities, to facilitate deeper understanding and engagement among students. Additionally, this curriculum will promotes the integration of emerging technologies and industry best practices, enabling students to stay abreast of the latest trends and advancements in the field. The OBE Curriculum for Computer Science and Engineering Program of BAUET will encourage a holistic development of students, fostering not only technical expertise but also essential transferable skills, such as communication, collaboration, and adaptability. It promotes the cultivation of a growth mindset and a lifelong learning attitude, enabling graduates to continuously evolve and thrive in a rapidly changing technological landscape. BAUET, as an educational institutions strive to produce well-rounded graduates who are equipped to address the complex challenges of the digital era, the Outcome Based Education Curriculum for Computer Science and Engineering Program offers a roadmap for curricular transformation. By aligning educational outcomes with industry expectations, this framework empowers institutions to deliver a relevant, engaging, and future-proof education that prepares students to become competent professionals and innovative problem solvers.

I hope that this OBE Curriculum for Computer Science and Engineering Program will inspire and guide educational institutions in their pursuit of excellence and equip students with the skills and mindset needed to shape the future of the computing field.

Qadirabad Cantonment,
Natore-6431, Bangladesh

Mohammed Golam Sarwar Bhuyan
Professor & Head,
Department of CSE

TABLE OF CONTENTS

		Page No.
PREFACE TO THIRD EDITION		iv
TABLE OF CONTENT		v
CHAPTER-1: GENERAL INFORMATION		1-12
1.1	Title of the Academic Program	1
1.2	Name of the University	1
1.3	Vision of the University	1
1.4	Mission of the University	1
1.5	Name of the Program Offering Entity (Department)	1
1.6	Vision of the Program Offering Entity	1
1.7	Mission of the Program Offering Entity	1
1.8	Objectives of the Program Offering Entity	2
1.9	Name of the Degree	2
1.10	Description of the Program	2
1.11	Graduate Attributes (Based on need assessment)	3
1.12	Program Educational Objectives (PEOs)	4
1.13	Program Learning Outcomes (PLOs)	5
1.14	Mapping Mission of the Department with PEOs	6
1.15	Mapping PLOs with the PEOs	7
1.16	Mapping Courses with the PLOs	9
CHAPTER-2: STRUCTURE OF THE SYLLABUS		13-23
2.1	Duration of the program	13
2.2	Admission Requirements	13
2.3	Total minimum credit requirement to complete the program	13
2.4	Total class weeks in a Year/semester	14
2.5	Minimum CGPA requirements for graduation	15
2.6	Maximum academic years of completion	15
2.7	Category of the Courses	15
CHAPTER-3: COURSE REQUIREMENTS FOR THE B.Sc. in CSE		24-33
3.1	Course Distribution Summary	24
3.2	1st Year 1st Semester Courses	25
3.3	1st Year 2nd Semester Courses	25
3.4	2nd Year 1st Semester Courses	26
3.5	2nd Year 2nd Semester Courses	27
3.6	3rd Year 1st Semester Courses	28
3.7	3rd Year 2nd Semester Courses	28
3.8	4th Year 1st Semester Courses	31
3.9	4th Year 2nd Semester Courses	32

CHAPTER-4: DETAIL OUTLINE OF UNDERGRADUATE COURSE OFFERED BY THE DEPT. OF CSE 34-101

4.1 1st Year 1st Semester 34
4.2 1st Year 2nd Semester 42
4.3 2nd Year 1st Semester 48
4.4 2nd Year 2nd Semester 54
4.5 3rd Year 1st Semester 61
4.6 3rd Year 2nd Semester 68
4.7 Elective Courses (I and II) 73
4.8 4th Year 1st Semester 82
4.9 Elective Courses (III and IV) 85
4.10 4th Year 2nd Semester 93
4.11 Elective Courses (V and VI) 96

CHAPTER-5: GRADING/EVALUATION SYSTEM 102-105

5.1 Grading Policy 102
5.2 Distribution of Marks 103
5.3 Marks Distribution of Lab/Project-Based Laboratory 104
5.4 Marks Distribution of Programming-Based Laboratory 104
5.5 Marks Distribution of Communicative English 104
5.6 Marks Distribution of Software Development Project 104
5.7 Calculation of GPA (Grade Point Average) 104

CHAPTER-6: RULES AND REGULATIONS FOR UNDERGRADUATE PROGRAM 106-109

6.1 Course Appraisal and Lesson Plan 106
6.2 Teacher-Student Interaction 106
6.3 Student Mentoring 106
6.4 Batch Adviser 106
6.5 Course Registration 106
6.6 Registration Procedure 106
6.7 Pre-Conditions for Registration 107
6.8 Registration Deadline 107
6.9 Penalty for Late Registration 107
6.10 Attendance, Conduct and Discipline 107
6.11 Promotion to the Next Semester 108
6.12 Minimum Earned Credit and CGPA (Cumulative Grade Point Average) Required for Obtaining a Degree 108
6.13 Consequences of Poor Performance (Referred/Improvement/Backlog) 108

6.14 Course Repetition 108
6.15 Class Tests 108
6.16 Earned Credits 108
6.17 Rounding off the Decimal Marks 108
6.18 Rounding off the GPA/CGPA 108
6.19 Number of Grade Sheets 109
6.20 Withdrawal Policy 109
6.21 Transcript 109
6.22 Certificate 109
6.23 Awards 109

CHAPTER-7: COURSES OFFERED TO OTHER DEPARTMENTS 110-110
7.1 Courses Offered to the Department of EEE 110
7.2 Courses Offered to the Department of ME 110
7.3 Courses Offered to the Department of Business Administration 110
7.4 Courses Offered to the Department of Law and Justice 110
7.5 Courses Offered to the Department of English Language and Literature 110
Appendix-A: Learning Domain 111-112
Appendix-B: Equivalence Table 113-120

Chapter-1
General Information

1.1. Title of Academic Program

Bachelor of Science in Computer Science and Engineering

1.2. Name of the University

Bangladesh Army University of Engineering & Technology (BAUET)

1.3. Vision of the University

The University aspires to transform into a center of excellence in Science, Engineering and Technology program by providing innovative, multi-disciplinary courses and extensive research facilities to the young generation of the country and beyond. It endeavors to make the University a hub of knowledge and be recognized as a leading university in the country.

1.4. Mission of the University

The Mission of the BAUET is to provide state-of-the-art education and research in science, engineering and other relevant programs to develop human resources for the socio-economic well-being of the society.

1.5. Name of the Program Offering Entity (Department)

Department of Computer Science and Engineering (CSE)

1.6. Vision of the Program Offering Entity

To create skilled and competent professionals in the field of Computer Science and Engineering with high morals to meet national and global needs through creative research and innovations.

1.7. Mission of the Program Offering Entity

Mission	Mission Statement
DM1	To provide state-of-the-art education and knowledge in Computer Science and Engineering, to produce competent engineers, capable of solving real-world complex engineering problems to meet the needs of industry and society **(Statement-1)**.
DM2	To contribute towards the creation of new knowledge through eminence research and innovation in CSE and allied fields to address emerging national and global issues for the well-being of the society (**Statement-2**).

DM3	To enable students in attaining the required ethics with an attitude of entrepreneurial skills and social consciences (**Statement-3**).
DM4	To embed leadership qualities amongst the students to follow successful professional career paths and to pursue advanced studies in computer engineering and a life-long learner in cutting-edge developments in the field of computing and Information Technology (**Statement-4**).

***Legend: DM – Department Mission**

1.8. Objectives of the Program Offering Entity

i.	Graduates will apply their knowledge and skills to succeed in their careers and/or obtain advanced degrees.
ii.	Graduates will behave ethically and responsibly and will remain informed and involved as full participants in their profession and society.
iii.	Graduates will creatively solve problems, communicate effectively and successfully function in diverse and inclusive multi-disciplinary teams.
iv.	Graduates will apply principles and practices of computing grounded in mathematics and science to successfully complete hardware and/or software-related engineering projects to meet customer business objectives and/or productively engage in research.

1.9. Name of the Degree

Bachelor of Science in Computer Science and Engineering **abbreviated as B.Sc. in CSE**

1.10. Description of the Program

The B.Sc. Engineering courses in Computer Science and Engineering program shall be offered over a period of four academic years, each of a normal duration of one calendar year. The four academic years shall be designated as 1st Year, 2nd Year, 3rd Year and 4th Year in succeeding higher levels of study. The academic year will be divided into two semesters (1st Semester and 2nd Semester) each having duration of 24 weeks. Under no circumstances, any student shall be allowed to continue his/her study for B.Sc. in CSE degree for more than six academic years. A student will be required to have 80% attendance of the total number of periods of lectures/tutorials/laboratory classes held during the semester in every course to appear as a regular candidate at that semester final examinations. The courses offered for Bachelor of Science in Computer Science and Engineering program will consist of theories, laboratories, viva-voce, quizzes/class tests, assignments, presentations, case

studies, industrial training, mini projects (laboratory courses), Software Development Project (I and II) and Final Year Design Project (FYDP)/Thesis are of 41 theory courses, 34 laboratory courses. **Minimum 130 credits and Cumulative Grade Point Average (CGPA) 2.25 out of 4.00 are required to obtain the degree.**

1.11. Graduate Attributes (based on need assessment)

Learning Outcome Domain	Level Descriptors
Fundamental Skills	**F1.** Demonstrate knowledge and critical understanding of the well-established principles of his/her field of study and of the way in which those principles have developed; **F2.** Apply underlying concepts and principles outside the context in which they were first studied, where appropriate, the application of those principles in an employment context; **F3.** Apply knowledge and skills in addressing issues/solving problems with minimal supervision; **F4.** Evaluate critically the appropriateness of different approaches to solving problems in his/her field of study; **F5.** Support supervision of junior staff via a mentor or a leader/manager; and **F6.** Display advanced digital literacy which is adequate to perform complex tasks and bring about solutions.
Social Skills	**S1.** Communicate and interact effectively and clearly, ideas, information, problems and solutions as a team to peers, experts and non-experts in Bangla and English; **S2.** Express her/himself fluently and spontaneously in English and Bangla; **S3.** Use language flexibly and effectively for social, academic and professional purposes; **S4.** Produce clear, well structured, detailed text on complex subjects, showing controlled use of organizational patterns, connectors and cohesive devices in advanced proficiency level of Bangla and English;

	S5. Demonstrate the ability to incorporate entrepreneurial skills in planning daily activities; and **S6.** Display advanced civic literacy and knowledge, exercising civic rights and obligations at all levels as well as participating in changes for the improvement of Bangladesh society.
Thinking Skills	**T1.** Exercise very substantial degree of autonomy and often significant responsibility in making judgments/decisions towards the management of self, others and for the allocation of substantial resources; and **T2.** Demonstrate professional knowledge and practical skills in both technical and management to lead a team in inexperienced environment.
Personal Skills	**P1.** Engage in self-direction and self-enterprise skills; **P2**. Demonstrate social, professional, environmental and ethical practice/values; **P3.** Show-case global knowledge and competencies to fulfil employment, entrepreneurial and lifelong learning skills; and **P4.** Contribute significantly to the society.

1.12.Program Educational Objectives (PEOs)

PEOs	PEO Statements
PEO1	Graduates will grow and practice as computing professionals both in industry and government and/or will be able to successfully pursue advanced degrees.
PEO2	Graduates will provide effective solutions to the complex engineering problems related to software and/or hardware by creating, selecting, applying appropriate and modern technologies, skills and tools.
PEO3	Graduates will communicate effectively and work collaboratively maintaining high level of ethical and professional values for improving the society.
PEO4	Graduates will take leadership positions in the industry and also initiate businesses offering innovative technical solutions to national and international problems.

1.13.Program Learning Outcomes (PLOs)

Program Learning Outcomes (PLOs) represent the knowledge, skills and attitudes the students should have at the end of a four-year engineering program. The Bachelor of Computer Science and Engineering (CSE) program will have following learning outcomes:

PLOs	PO Statements
PLO1	**Engineering knowledge:** Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO2	**Problem Analysis:** Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO3	**Design/development of solutions:** Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
PLO4	**Investigation:** Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
PLO5	**Modern tool usage:** Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations.
PLO6	**The engineer and society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems.
PLO7	**Environment and sustainability:** Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts.
PLO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO9	**Individual work and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
PLO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PLO11	**Project management and finance:** Demonstrate 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, to manage projects and in multidisciplinary environments.
PLO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

1.14.Mapping Mission of the Department with PEOs

PEO No.	**PEO statements**	**Departmental mission statements**			
		statement 1	**statement 2**	**statement 3**	**statement 4**
Graduates of the Computer Science and Engineering program are expected to attain or achieve the following Program Educational Objectives within **3 to 5** years of graduation:					
PEO-1	Graduates will grow and practice as computing professionals both in industry and government and/or will be able to successfully pursue advanced degrees.	**Yes**	No	No	**Yes**
PEO-2	Graduates will provide effective solutions to the complex engineering problems related to software and/or hardware by creating, selecting, applying appropriate and modern technologies, skills and tools.	**Yes**	**Yes**	**Yes**	No
PEO-3	Graduates will communicate effectively and work collaboratively maintaining high level of ethical and professional values for improving society.	No	No	**Yes**	**Yes**
PEO-4	Graduates will take leadership positions in the industry and also initiate businesses offering innovative technical solutions to national and international problems.	No	No	**Yes**	**Yes**

1.15.Mapping PLOs with the PEOs

No.	PLO Statement	PEO-1	PEO-2	PEO-3	PEO-4
PLO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**Yes**	**Yes**	No	No
PLO2	**Problem analysis:** Identify, formulate, research and analyze complex engineering problems and reach substantiated conclusions using the principles of mathematics, the natural sciences and the engineering sciences.	**Yes**	**Yes**	No	No
PLO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety and of cultural, societal and environmental concerns.	**Yes**	**Yes**	**Yes**	No
PLO4	**Investigation:** Conduct investigations of complex problems, considering experimental design, data analysis and interpretation and information synthesis to provide valid conclusions.	**Yes**	**Yes**	No	No
PLO5	**Modern tool usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools, including prediction and modeling, to complex engineering activities with an understanding of their limitations.	**Yes**	**Yes**	No	No
PLO6	**The engineer and society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural	**Yes**	No	**Yes**	No

No.	PLO Statement	PEO-1	PEO-2	PEO-3	PEO-4
	issues and the consequent responsibilities relevant to professional engineering practice.				
PLO7	**Environment and sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.	No	No	**Yes**	No
PLO8	**Ethics:** Apply ethical principles and commit to the professional ethics, responsibilities and the norms of the engineering practice.	No	No	**Yes**	**Yes**
PLO9	**Individual work and teamwork:** Function effectively as an individual and as a member or leader of diverse teams and in multidisciplinary settings.	No	**Yes**	No	**Yes**
PLO10	**Communication:** Communicate effectively about complex engineering activities with the engineering community and with society at large. Be able to comprehend and write effective reports, design documentation, make effective presentations and give and receive clear instructions.	No	No	**Yes**	**Yes**
PLO11	**Project management and finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to one's work as a team member or a leader to manage projects in multidisciplinary environments.	No	**Yes**	**Yes**	**Yes**
PLO12	**Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological change.	**Yes**	No	**Yes**	**Yes**

1.16. Mapping Courses with the PLOs

Course Code According to BNQF	Course Code (Dept.)	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PPO 8	PLO 9	PLO10	PLO11	PLO12
1st Year 1st Semester													
0611	CSE-1100	✓	✓			✓							
0533	PHY-1101	✓	✓										
0533	PHY-1102	✓	✓			✓							
0531	CHEM-1101	✓	✓	✓				✓					
0531	CHEM-1102	✓	✓					✓					
0541	MATH-1141	✓	✓	✓									
0232	HUM-1150	✓									✓		
0222	GED-1151	✓					✓	✓					
0713	EEE-1161	✓		✓									
0713	EEE-1162					✓				✓	✓		
1st Year 2nd Semester													
0613	CSE-1211	✓	✓	✓									
0613	CSE-1212	✓	✓	✓		✓				✓	✓		✓
0541	CSE-1213	✓	✓	✓									
0541	MATH-1241	✓	✓										
0714	EEE-1261	✓	✓	✓									
0714	EEE-1262					✓				✓			
0715	ME-1270	✓	✓			✓				✓			
0232	HUM-1250	✓	✓		✓						✓	✓	✓
0223 0521	GED-1251	✓	✓				✓		✓				
2nd Year 1st Semester													
0613	CSE-2101	✓	✓	✓									✓
0613	CSE-2102	✓	✓	✓		✓							✓
0613	CSE-2103		✓	✓							✓		✓
0613	CSE-2104		✓	✓		✓				✓			✓
0612	CSE-2105	✓		✓					✓				✓
0612	CSE-2106		✓	✓		✓				✓		✓	✓

Course Code According to BNQF	Course Code (Dept.)	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PPO 8	PLO 9	PLO10	PLO11	PLO12
0611	CSE-2107	✓	✓	✓									
0611	CSE-2108	✓	✓	✓		✓				✓			
0541	MATH-2141	✓	✓										
2nd Year 2nd Semester													
0613	CSE-2211	✓	✓	✓									
0613	CSE-2212	✓	✓	✓		✓				✓			✓
0612	CSE-2213	✓	✓	✓									
0612	CSE-2214	✓	✓			✓	✓	✓					✓
0611	CSE-2215	✓	✓	✓		✓							
0613	CSE-2216	✓				✓				✓	✓		
0713	EEE-2261	✓	✓										
0713	EEE-2262					✓				✓			
0541	MATH-2241	✓	✓										
0542	STAT-2251	✓	✓	✓									
3rd Year 1st Semester													
0613	CSE-3101	✓	✓	✓									
0613	CSE-3102	✓	✓		✓	✓				✓	✓	✓	✓
0612	CSE-3103	✓	✓	✓							✓		
0612	CSE-3104	✓	✓	✓	✓	✓				✓			
0613	CSE-3105	✓	✓	✓	✓								
0613	CSE-3106	✓	✓	✓		✓				✓			✓
0613	CSE-3108		✓	✓	✓	✓				✓			
0541	MATH-3141	✓	✓	✓									
0311 0314	GED-3151	✓					✓	✓					
3rd Year 2nd Semester													
0613	**CSE-3200**	✓	✓	✓		✓				✓		✓	
0611	CSE-3211	✓	✓	✓									
0611	CSE-3212	✓	✓	✓		✓				✓			
0613	CSE-3213	✓		✓	✓								

Course Code According to BNQF	Course Code (Dept.)	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PPO 8	PLO 9	PLO10	PLO11	PLO12
0613	CSE-3214		✓	✓	✓	✓							
0611	CSE-3215	✓	✓	✓									
0611	CSE-3216	✓	✓	✓		✓				✓			
0031	CSE-3224								✓	✓	✓	✓	
0411 0412 0413	GED-3251	✓	✓			✓					✓	✓	
Elective (2T+1L)													
0413	CSE-3217	✓	✓	✓	✓								
0611	CSE-3219	✓	✓	✓					✓				✓
0611	CSE-3221	✓	✓	✓	✓								
0613	CSE-3223	✓	✓	✓	✓								
0613	CSE-3225	✓	✓	✓									
0613	CSE-3226	✓	✓		✓	✓							
0613	CSE-3227	✓		✓	✓						✓		
0613	CSE-3228	✓		✓		✓							
0613	CSE-3229	✓	✓	✓									
0613	CSE-3230	✓	✓	✓	✓	✓				✓			
0613	CSE-3231	✓	✓		✓								
0613	CSE-3232		✓	✓	✓	✓				✓			
4th Year 1st Semester													
061	CSE-4000	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
0613	CSE-4100	✓	✓	✓		✓				✓		✓	
0612	CSE-4101	✓	✓	✓									
0612	CSE-4102	✓	✓	✓	✓	✓							
0612	CSE-4103	✓	✓	✓	✓								
0613	CSE-4105	✓	✓	✓					✓		✓		
Elective (2T+1L)													
0611	CSE-4107	✓	✓	✓	✓						✓		
0413	CSE-4109	✓	✓	✓	✓					✓			
0611	CSE-4111	✓	✓	✓									

Course Code According to BNQF	Course Code (Dept.)	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PPO 8	PLO 9	PLO10	PLO11	PLO12
0613	CSE-4113	✓	✓	✓	✓								
0613	CSE-4115	✓	✓	✓	✓								
0613	CSE-4116		✓	✓	✓	✓							
0613	CSE-4117	✓	✓	✓	✓								
0613	CSE-4118	✓	✓	✓		✓							
0613	CSE-4119	✓	✓	✓									
0613	CSE-4120			✓		✓				✓			
4th Year 2nd Semester													
061	CSE-4000	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
0613	CSE-4211	✓	✓	✓									
0613	CSE-4212		✓	✓		✓							
0413	GED-4251	✓									✓	✓	✓
Elective (2T+1L)													
0613	CSE-4213	✓	✓	✓									
0612	CSE-4215	✓	✓	✓				✓					
0612	CSE-4217	✓		✓									
0611	CSE-4219	✓	✓	✓							✓		
0611	CSE-4221	✓	✓	✓				✓			✓		
0611	CSE-4222	✓	✓	✓	✓	✓					✓		
0612	CSE-4223	✓	✓	✓							✓		
0612	CSE-4224					✓		✓	✓	✓	✓	✓	
0611	CSE-4225	✓	✓	✓							✓		
0611	CSE-4226			✓	✓	✓				✓	✓		

Chapter-2
Structure of the syllabus

2.1.	**Duration of the Program: Years:** 4 **Semesters:** 8
2.2.	**Admission Requirements:**
	SSC/Dakhil and HSC/Alim Examinations: HSC/Alim or equivalent examination in Science Group with Mathematics, Physics and Chemistry scoring minimum GPA 3.0 for each. The sum total GPA of SSC/Dakhil and HSC/Alim should be minimum 7.0 (with additional subject).
	GCE Applicants: i. O Level: Minimum C Grade in five subjects including, Mathematics, Physics and Chemistry (in the scale of A=5, B=4, C=3, D=2 and E=1) ii. A Level: Minimum C Grade in 2 subjects including Mathematics, Physics/Chemistry. iii. The sum total of GOA in GCE A and O level should be 6. iv. The candidates with E grade in any subject will not be considered.
2.3.	**Total minimum credit requirement to complete the program:** (According to BNQF Part- B for Higher Education)
	Minimum credit requirements for the award of bachelor degree will be recommended by the respective academic committee to the academic council. **Calculation:** The minimum total credit hours for earning degree of the program is 130.00 For, Theory: 55x14=770 min = 1 credit hour Laboratory: 55x14x2=1540 min=1 credit hour In CSE course curriculum, Total Theory contact hours = 120.00 Total laboratory contact hours = 78.00 Total weeks in a semester = 14 One contact hour = 55 minutes $For\ theory:\ Total\ Credit\ Hour$ $= \frac{total\ contact\ hour\ X\ 55\ minutes\ X\ 14\ weeks}{one\ contact\ hour\ X\ 14\ weeks}$ $= \frac{120X\ 55min\ X\ 14\ Weeks}{770\ minutes}$ $= 120\ credit\ hour$ $For\ sessional:\ Total\ Credit\ Hour$ $= \frac{total\ contact\ hour\ X\ 55\ minutes\ X\ 14\ weeks}{1\ contact\ our\ X\ 14\ weeks\ X\ 2}$

	$= \frac{78\ X\ 55min\ X\ 14\ Weeks}{1540\ minutes}$ $= 39\ credit\ hour$ Total calculated credit hour= Total credit hour for theory + Total credit hour for laboratory = (120 + 39+1*) $Credit\ Hour$ = ***160*** $Credit\ Hour$ ****One credit hour extra added for industrial attachment.*** **Calculated credit hour 160** $credit\ hour$**>130** $credit\ hour$**, which satisfied the program compliance criteria according to BNQF.**
2.4.	**Total class weeks in a Year/Semester:**
	There will be two Semesters: 1st Semester and 2nd Semester. 1st Semester will be of 24 weeks and 2nd Semester will be of 28 weeks (Total 52 weeks). An Academic Calendar will be provided to all the enrolled students to make them familiar to all academic events. The holiday will also be included in the calendar. Duration of 1st Semester and 2nd Semester will be as follows:

1st Semester:		
Sl.	**Events**	**Durations**
1.	Classes before Mid Semester	7 weeks
2.	Mid Semester Break	1 week
3.	Classes after Mid Semester	7 weeks
4.	Lab Test Week	1 week
5.	Preparatory Leave	2 weeks
6.	Semester Final Examination	3 weeks
7.	Result Publication and Semester End Vacation	3 weeks
	Total:	**24 weeks**

2nd Semester:		
Sl.	**Events**	**Durations**
1.	Classes before Mid Semester	7 weeks
2.	Mid Semester Break	1 week
3.	Classes after Mid Semester	7 weeks
4.	Lab Test Week	1 week
5.	Preparatory Leave	2 weeks
6.	Semester Final Examination	3 weeks
7.	Result Publication and Semester End Vacation	3 weeks
8.	Industrial Training	4 weeks
	Total:	**28 weeks**

Note: Those who will not be able to clear any of the courses (only theoretical) of any discipline in a particular Semester (1st Semester and 2nd Semester) will be required to appear at the referred examination (Re-examination) for fulfilling the condition as per policy to clear the subject(s).

2.5.	**Minimum CGPA requirements for graduation:**	
	The minimum CGPA requirements for obtaining a Bachelor Degree is 2.25 [As per BAUET Exam policy]	
2.6.	**Maximum Academic Years of Completion:**	
	A student must complete his/her studies within a maximum period of six (06) years for 4-years bachelor degree.	
2.7	**Category of Courses:**	
	i.	**General Education Courses:** General education courses refer to interdisciplinary courses, beyond B.Sc. in CSE program that provides well-rounded learning experience to the students of an academic program. i.e. **Language** (Communicative English-I & II Laboratory) History and Cultures (Bangladesh Studies: History and Culture), **General Education** (Society, Ethics and Environment, Project Management and Finance, Engineering Economics and Sociology, Engineering Management and Leadership), **Basic Science and Engineering** (Physics, Chemistry, Basic Mechanical Engineering and Drawing) and **Mathematics** (Differential Calculus and Integral Calculus, Ordinary, Partial Differential Equations and Coordinate Geometry, Vector Analysis, Matrices and Laplace Transformation, Complex Variable and Fourier Analysis, Numerical Analysis and Applied Statistics and Queuing Theory)

Language, History and Cultures (01Theory+ 02 Laboratory)							
Sl.	**BNQF Code**	**Course Code (Dept.)**	**Course Title**	**Hours/Week**		**Credits**	**Pre-requisite**
				Theory	**Laboratory**		
1.	0232	HUM-1150	Communicative English-I Laboratory	-	3.00	1.50	
2.	0222	HUM-1151	Bangladesh Studies: History and Culture	2.00	-	2.00	
3.	0232	HUM-1250	Communicative English-II Laboratory	-	3.00	1.50	HUM-1150

General Education (04Theory+ 00 Laboratory)							
Sl.	BNQF Code	Course Code (Dept.)	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	0223 0521	GED-1251	Society, Ethics and Environment	3.00	-	3.00	
2.	0311 0314	GED-3151	Engineering Economics and Sociology	3.00	-	3.0	
3.	0411 0412 0413	GED-3251	Project Management and Finance	3.00	-	3.00	
4.	0413	GED-4251	Engineering Management and Leadership	2.00	-	2.00	

Basic Science and Engineering (05 Theory+ 06 Laboratory)							
Sl.	BNQF Code	Course Code (Dept.)	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	0533	PHY-1101	Physics	3.00	-	3.00	
2.	0533	PHY-1102	Physics Laboratory	-	1.50	0.75	
3.	0531	CHEM-1101	Chemistry	2.00	-	2.00	
4.	0531	CHEM-1102	Chemistry Laboratory	-	1.50	0.75	
5.	0713	EEE-1161	Electrical Circuit Analysis	3.00	-	3.00	
6.	0713	EEE-1162	Electrical Circuit Analysis Laboratory	-	1.50	0.75	
7.	0714	EEE-1261	Electronic Devices and Circuits	3.00	-	3.00	EEE-1161
8.	0714	EEE-1262	Electronic Devices and Circuits Laboratory	-	1.50	0.75	
9.	0715	ME-1270	Basic Mechanical Engineering and		3.00	1.50	

			Drawing Laboratory				
10.	0713	EEE-2261	Electrical Drives and Instrumentation	3.00	-	3.00	EEE-1261
11.	0713	EEE-2262	Electrical Drives and Instrumentation Laboratory	-	1.50	0.75	

Mathematics (05 Theory + 00 Laboratory)							
Sl.	**BNQF Code**	**Course Code (Dept.)**	**Course Title**	**Hours/Week**		**Credits**	**Pre-requisite**
				Theory	**Laboratory**		
1.	0541	MATH-1141	Differential Calculus and Integral Calculus	3.00	-	3.00	
2.	0541	MATH-1241	Ordinary, Partial Differential Equations and Coordinate Geometry	3.00	-	3.00	
3.	0541	MATH-2141	Vector Analysis, Matrices and Laplace Transformation	3.00	-	3.00	
4.	0541	MATH-2241	Complex Variable and Fourier Analysis	3.00	-	3.00	
5.	0541	MATH-3141	Numerical Analysis	3.00	-	3.00	

Statistics (01Theory+ 00 Laboratory)							
Sl.	**BNQF Code**	**Course Code Dept.)**	**Course Title**	**Hours/Week**		**Credits**	**Pre-requisite**
				Theory	**Laboratory**		
1.	0542	STAT-2251	Applied Statistics and Queuing Theory	3.00	-	3.00	

ii.	**Core Courses:**
	Core courses refer to the courses that characterize the discipline of Computer Science and Engineering program. All the CSE courses belong to this category.

Sl.	BNQF Code	Course Code (Dept.)	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	0611	CSE-1100	Introduction to Computer Systems Laboratory	-	3.00	1.50	
2.	0613	CSE-1211	Structured Programming	3.00	-	3.00	
3.	0613	CSE-1212	Structured Programming Laboratory	-	3.00	1.50	
4.	0541	CSE-1213	Discrete Mathematics	3.00	-	3.00	
5.	0613	CSE-2101	Data Structures and Algorithms-I	3.00	-	3.00	CSE-1211
6.	0613	CSE-2102	Data Structures and Algorithms-I Laboratory	-	3.00	1.50	
7.	0613	CSE-2103	Object Oriented Programming	3.00	-	3.00	CSE-1211
8.	0613	CSE-2104	Object Oriented Programming Laboratory	-	3.00	1.50	
9.	0612	CSE-2105	Database Systems	3.00	-	3.00	
10.	0612	CSE-2106	Database Systems Laboratory	-	3.00	1.50	
11.	0611	CSE-2107	Digital Logic Design	3.00	-	3.00	
12.	0611	CSE-2108	Digital Logic Design Laboratory	-	3.00	1.50	
13.	0613	CSE-2211	Data Structures and Algorithms-II	3.00	-	3.00	CSE-2101
14.	0613	CSE-2212	Data Structures and Algorithms-II Laboratory	-	3.00	1.50	
15.	0612	CSE-2213	Data Communication	3.00	-	3.00	
16.	0612	CSE-2214	Data Communication Laboratory	-	1.50	0.75	
17.	0611	CSE-2215	Computer Organization and Architecture	3.00	-	3.00	
18.	0613	CSE-2216	Java Programming Laboratory	-	2.00	1.00	CSE-2103

19.	0613	CSE-3101	Software Engineering and Information System Design	3.00	-	3.00	
20.	0613	CSE-3102	Software Engineering and Information System Design Laboratory	-	2.00	1.00	
21.	0612	CSE-3103	Computer Network	3.00	-	3.00	
22.	0612	CSE-3104	Computer Network Laboratory	-	3.00	1.50	
23.	0613	CSE-3105	Operating Systems	3.00	-	3.00	
24.	0613	CSE-3106	Operating Systems Laboratory	-	3.00	1.50	
25.	0613	CSE-3108	Web Programming Laboratory	-	2.00	1.00	
26.	0613	CSE-3200	Software Development Project – I*	-	1.50	0.75	
27.	0611	CSE-3211	Microprocessors, Micro-controllers and Assembly Language	3.00	-	3.00	
28.	0611	CSE-3212	Microprocessors, Micro-controllers and Assembly Language Laboratory	-	1.50	0.75	
29.	0613	CSE-3213	Artificial Intelligence	3.00	-	3.00	
30.	0613	CSE-3214	Artificial Intelligence Laboratory	-	1.50	0.75	
31.	0611	CSE-3215	Automata Theory and Compiler Design	3.00	-	3.00	
32.	0611	CSE-3216	Automata Theory and Compiler Design Laboratory	-	1.50	0.75	
33.	0031	CSE-3224	Industrial Training**	-	2.00	1.00	
34.	0613	CSE-4100	Software Development Project – II*	-	1.50	0.75	CSE-3200
35.	0612	CSE-4101	Digital Signal Processing	3.00	-	3.00	
36.	0612	CSE-4102	Digital Signal Processing Laboratory	-	1.50	0.75	
37.	0612	CSE-4103	Cellular and Wireless Communication	3.00	-	3.00	
38.	0613	CSE-4105	Data Science and Applications	3.00	-	3.00	
39.	0613	CSE-4211	Computer Graphics and Multimedia Systems	3.00	-	3.00	
40.	0613	CSE-4212	Computer Graphics and Multimedia Systems Laboratory	-	1.50	0.75	

Sl.	BNQF Code	Course Code (Dept.)	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	061	CSE-4000	Final Year Design Project (FYDP)/ Thesis***	-	6.00	3.00	7th Semester
2.	061	CSE-4000	Final Year Design Project (FYDP)/ Thesis***	-	6.00	3.00	8th Semester

	iii.	**Elective Courses:**
		Elective courses refer to the courses that are defined for specialization within the discipline of Computer Science and Engineering program. Elective courses has been introduced in 6th, 7th and 8th semesters respectively.

6th Semester Elective-I: (01Theory)							
Sl.	BNQF Code	Course Code	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	0413	CSE-3217	Fault Tolerant System	3.00	-	3.00	
2.	0611	CSE-3219	E-commerce and Web Security	3.00	-	3.00	
3.	0611	CSE-3221	Human Computer Interaction	3.00	-	3.00	
4.	0613	CSE-3223	Advanced Algorithms	3.00	-	3.00	

6th Semester Elective-II: (01Theory +01 Laboratory)							
Sl.	BNQF Code	Course Code	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	0613	CSE-3225	Digital Image Processing	3.00	-	3.00	
2.	0613	CSE-3226	Digital Image Processing Laboratory	-	1.50	0.75	
3.	0613	CSE-3227	Simulation and Modeling	3.00	-	3.00	
4.	0613	CSE-3228	Simulation and Modeling Laboratory	-	1.50	0.75	
5.	0613	CSE-3229	VLSI Design	3.00	-	3.00	
6.	0613	CSE-3230	VLSI Design Laboratory	-	1.50	0.75	
7.	0613	CSE-3231	Natural Language Processing	3.00	-	3.00	
8.	0613	CSE-3232	Natural Language Processing Laboratory	-	1.50	0.75	

7th Semester Elective-III: (01Theory)							
Sl.	BNQF Code	Course Code	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	0611	CSE-4107	Computer and Cyber Security	3.00	-	3.00	
2.	0413	CSE-4109	Software Testing and Quality Assurance	3.00	-	3.00	
3.	0611	CSE-4111	Parallel and Distributed Systems	3.00	-	3.00	
4.	0613	CSE-4113	Bioinformatics	3.00	-	3.00	

7th Semester Elective-IV: (01Theory +01 Laboratory)							
Sl.	BNQF Code	Course Code	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	0613	CSE-4115	Machine Learning	3.00	-	3.00	
2.	0613	CSE-4116	Machine Learning Laboratory	-	1.50	0.75	
3.	0613	CSE-4117	Data Mining and Data Ware-housing	3.00	-	3.00	
4.	0613	CSE-4118	Data Mining and Data Ware-housing Laboratory	-	1.50	0.75	
5.	0613	CSE-4119	Digital System Design	3.00	-	3.00	
6.	0613	CSE-4120	Digital System Design Laboratory	-	1.50	0.75	

8th Semester Elective-V: (01Theory)							
Sl.	BNQF Code	Course Code	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	0613	CSE-4213	Cloud Computing	3.00	-	3.00	
2.	0612	CSE-4215	Green Computing	3.00	-	3.00	
3.	0612	CSE-4217	Network Planning	3.00	-	3.00	
4.	0611	CSE-4219	Block chain and Crypto currency Technology	3.00	-	3.00	

8th Semester Elective-VI: (01Theory +01 Laboratory)							
Sl.	BNQF Code	Course Code	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	0611	CSE-4221	Internet of Things (IoT)	3.00	-	3.00	

2.	0611	CSE-4222	Internet of Things (IoT) Laboratory	-	1.50	0.75	
3.	0612	CSE-4223	Advanced Database Management Systems	3.00	-	3.00	
4.	0612	CSE-4224	Advanced Database Management Systems Laboratory	-	1.50	0.75	
5.	0611	CSE-4225	Pattern Recognition	3.00	-	3.00	
6.	0611	CSE-4226	Pattern Recognition Laboratory	-	1.50	0.75	

	iv.	**Capstone Project/Industrial Training/Final Year Design Project(FYDP)/Thesis and Complex Engineering Problems (CEP):**

Capstone projects are integrated with Software Development Project–I & II* (**CSE-3200 & CSE-4100**) and Complex Engineering related problems are assessed through assignments (theory courses), mini project (laboratory courses), Software Development Project (I and II) and Final Year Design Project (FYDP)/Thesis. Apart from the assessment of capstone projects and complex engineering related problems, each student has to complete Final Year Design Project (FYDP)/Thesis **(CSE-4000***)** in the combined duration of two semester (7^{th} and 8^{th} semester). All students and concerned supervisors has to follow standard guidelines prepared for Final Year Design Project (FYDP)/Thesis and an industrial training program (CSE-3224**) will be conducted at any convenient time or after the 3^{rd} Year, 2^{nd} Semester final examination for duration of 04 weeks as applicable or decided by the department. Evaluation report from industry has to be submitted at the end of the training and to be incorporated in the tabulation sheet accordingly.

Sl.	**BNQF Code**	**Course Code**	**Course Title**	**Hours/Week**		**Credits**	**Pre-requisite**
				Theory	**Laboratory**		
1.	0613	CSE-3200	Software Development Project – I*	-	1.50	0.75	
2.	0613	CSE-4100	Software Development Project – II*	-	1.50	0.75	CSE-3200
3.	0031	CSE-3224	Industrial Training**	-	2.00	1.00	
4.	061	CSE-4000	Final Year Design Project (FYDP)/ Thesis***	-	12.00	6.00	

Chapter-3
Course Requirements for the B.Sc. in CSE

Year/Semester wise distribution of courses

3.1 Course Distribution Summary:				
Sl.	**Broader Discipline/Category**	**Theory (T) and Laboratory(L)**	**Credit Hours**	**Percentage of Credit (%)**
1.	Language, History and Cultures	1T+2L	5.00	3.125
2.	General Education	4T+0L	11.00	6.875
3.	Basic Science and Engineering	5T+6L	19.25	12.031
4.	Mathematics	5T+0L	15.00	9.375
5.	Statistics	1T+0L	3.00	1.875
6.	Computer Science and Engineering Core Courses	19T+21L	80.50	50.312
7.	Final Year Design Project(FYDP)/Thesis	0T+2L	6.00	3.75
8.	Elective Courses	6T+3L	20.25	12.656
	Total:	**41T+34L**	**160.00**	**100.00**

Summary of Undergraduate Course Plan:						
Sl. No.	**Year/Semester**	**Theory**		**Laboratory**		**Total Credits**
		No. of Course	**Credits**	**No. of Course**	**Credits**	
1.	1st Year 1st Semester	5	13.00	5	5.25	18.25
2.	1st Year 2nd Semester	5	15.00	4	5.25	20.25
3.	2nd Year 1st Semester	5	15.00	4	6.00	21.00
4.	2nd Year 2ndSemester	6	18.00	4	4.00	22.00
5.	3rd Year 1st Semester	5	15.00	4	5.00	20.00
6.	3rd Year 2nd Semester	6	18.00	6	4.75	22.75
7.	4th Year 1st Semester	5	15.00	4	5.25	20.25
8.	4th Year 2nd Semester	4	11.00	3	4.50	15.50
	Total:	**41**	**120.00**	**34**	**40.00**	**160.00**

1st Year 1st Semester							
Sl.	BNQF Code	Course Code	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	0611	CSE-1100	Introduction to Computer Systems Laboratory	-	3.00	1.50	
2.	0533	PHY-1101	Physics	3.00	-	3.00	
3.	0533	PHY-1102	Physics Laboratory	-	1.50	0.75	
4.	0531	CHEM-1101	Chemistry	2.00	-	2.00	
5.	0531	CHEM-1102	Chemistry Laboratory	-	1.50	0.75	
6.	0541	MATH-1141	Differential Calculus and Integral Calculus	3.00	-	3.00	
7.	0232	HUM-1150	Communicative English-I Laboratory		3.00	1.50	
8.	0222	HUM-1151	Bangladesh Studies: History and Culture	2.00	-	2.00	
9.	0713	EEE-1161	Electrical Circuit Analysis	3.00	-	3.00	
10.	0713	EEE-1162	Electrical Circuit Analysis Laboratory	-	1.50	0.75	
			Total:	**13.00**	**10.50**	**18.25**	

1st Year 2nd Semester							
Sl.	BNQF Code	Course Code	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	0613	CSE-1211	Structured Programming	3.00	-	3.00	
2.	0613	CSE-1212	Structured Programming Laboratory	-	3.00	1.50	
3.	0541	CSE-1213	Discrete Mathematics	3.00	-	3.00	
4.	0541	MATH-1241	Ordinary, Partial Differential Equations	3.00	-	3.00	

			and Coordinate Geometry				
5.	0714	EEE-1261	Electronic Devices and Circuits	3.00	-	3.00	EEE-1161
6.	0714	EEE-1262	Electronic Devices and Circuits Laboratory	-	1.50	0.75	
7.	0715	ME-1270	Basic Mechanical Engineering and Drawing Laboratory	-	3.00	1.50	
8.	0232	HUM-1250	Technical and Communicative English-II Laboratory	-	3.00	1.50	Hum-1150
9.	0223 0521	GED-1251	Society, Ethics and Environment	3.00	-	3.00	
			Total:	**15.00**	**10.50**	**20.25**	

2nd Year 1st Semester							
Sl.	**BNQF Code**	**Course Code**	**Course Title**	**Hours/Week**		**Credits**	**Pre-requisite**
				Theory	**Laboratory**		
1.	0613	CSE-2101	Data Structures and Algorithms-I	3.00	-	3.00	CSE-1211
2.	0613	CSE-2102	Data Structures and Algorithms-I Laboratory	-	3.00	1.50	
3.	0613	CSE-2103	Object Oriented Programming	3.00	-	3.00	CSE-1211
4.	0613	CSE-2104	Object Oriented Programming Laboratory	-	3.00	1.50	
5.	0612	CSE-2105	Database Systems	3.00	-	3.00	
6.	0612	CSE-2106	Database Systems Laboratory	-	3.00	1.50	
7.	0611	CSE-2107	Digital Logic Design	3.00	-	3.00	
8.	0611	CSE-2108	Digital Logic Design Laboratory	-	3.00	1.50	
9.	0541	MATH-2141	Vector Analysis, Matrices and Laplace Transformation	3.00	-	3.00	
			Total:	**15.00**	**12.00**	**21.00**	

2nd Year 2nd Semester							
Sl.	BNQF Code	Course Code	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	0613	CSE-2211	Data Structures and Algorithms-II	3.00	-	3.00	CSE-2101
2.	0613	CSE-2212	Data Structures and Algorithms-II Laboratory	-	3.00	1.50	
3.	0612	CSE-2213	Data Communication	3.00	-	3.00	
4.	0612	CSE-2214	Data Communication Laboratory	-	1.50	0.75	
5.	0611	CSE-2215	Computer Organization and Architecture	3.00	-	3.00	
6.	0613	CSE-2216	Java Programming Laboratory	-	2.00	1.00	CSE-2103
7.	0713	EEE-2261	Electrical Drives and Instrumentation	3.00	-	3.00	EEE-1261
8.	0713	EEE-2262	Electrical Drives and Instrumentation Laboratory	-	1.50	0.75	
9.	0541	MATH-2241	Complex Variable and Fourier Analysis	3.00	-	3.00	
10.	0542	STAT-2251	Applied Statistics and Queuing Theory	3.00	-	3.00	
			Total:	**18.00**	**8.00**	**22.00**	

3rd Year 1st Semester							
Sl.	BNQF Code	Course Code	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	0613	CSE-3101	Software Engineering and Information System Design	3.00	-	3.00	
2.	0613	CSE-3102	Software Engineering and Information System Design Laboratory	-	2.00	1.00	
3.	0612	CSE-3103	Computer Network	3.00	-	3.00	
4.	0612	CSE-3104	Computer Network Laboratory	-	3.00	1.50	
5.	0613	CSE-3105	Operating Systems	3.00	-	3.00	
6.	0613	CSE-3106	Operating Systems Laboratory	-	3.00	1.50	
7.	0613	CSE-3108	Web Programming Laboratory	-	2.00	1.00	
8.	0541	MATH-3141	Numerical Analysis	3.00	-	3.00	
9.	0311 0314	GED-3151	Engineering Economics and Sociology	3.00		3.00	
			Total:	**15.00**	**10.00**	**20.00**	

3rd Year 2nd Semester							
Sl.	BNQF Code	Course Code	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	0613	CSE-3200	Software Development Project – I*	-	1.50	0.75	
2.	0611	CSE-3211	Microprocessors, Micro-controllers and Assembly Language	3.00	-	3.00	

3.	0611	CSE-3212	Microprocessors, Micro-controllers and Assembly Language Laboratory	-	1.50	0.75	
4.	0613	CSE-3213	Artificial Intelligence	3.00	-	3.00	
5.	0613	CSE-3214	Artificial Intelligence Laboratory	-	1.50	0.75	
6.	0611	CSE-3215	Automata Theory and Compiler Design	3.00	-	3.00	
7.	0611	CSE-3216	Automata Theory and Compiler Design Laboratory	-	1.50	0.75	
8.	--	CSE-****	**Elective-I**	3.00	-	3.00	
9.	--	CSE-****	**Elective-II**	3.00	-	3.00	
10.	--	CSE-****	**Elective-II Laboratory**	-	1.50	0.75	
11.	0411 0412 0413	GED-3251	Project Management and Finance	3.00	-	3.00	
			Total:	**18.00**	**7.50**	**21.75**	

*Note. **Pre-requisite Courses**: CSE-1211, CSE-2101, CSE- 2103, CSE-2105, CSE-2211 and their corresponding laboratories including CSE-2216, CSE-3108

*****3rd Year Industrial Training***

Sl.	BNQF Code	Course Code	Course Title	Hours/Week		Credits	Prerequisite
				Theory	Laboratory		
1.	0031	CSE-3224	Industrial Training**	-	2.00	1.00	

***Note:** Each student has to complete two Software Development Project (CSE-3200 and CSE-4100) and topics or fields of the project work will be decided by the department.

****Note:** Industrial Training (CSE-3224) will be conducted at any convenient time or after the 3rd Year, 2nd Semester final examination for the duration of 04 weeks as applicable or will be decided by the department. Evaluation report from industry has to be submitted at the end of the training and to be incorporated in the tabulation sheet accordingly.

6th Semester Elective-I (One Course):

Sl.	BNQF Code	Course Code	Course Title	Hours/Week		Credits	Prerequisite
				Theory	Laboratory		
1.	0413	CSE-3217	Fault Tolerant System	3.00	-	3.00	
2.	0611	CSE-3219	E-commerce and Web Security	3.00	-	3.00	
3.	0611	CSE-3221	Human Computer Interaction	3.00	-	3.00	
4.	0613	CSE-3223	Advanced Algorithms	3.00	-	3.00	

6th Semester Elective-II (One Course including laboratory):

Sl.	BNQF Code	Course Code	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	0613	CSE-3225	Digital Image Processing	3.00	-	3.00	
2.	0613	CSE-3226	Digital Image Processing Laboratory	-	1.50	0.75	
3.	0613	CSE-3227	Simulation and Modeling	3.00	-	3.00	
4.	0613	CSE-3228	Simulation and Modeling Laboratory	-	1.50	0.75	
5.	0613	CSE-3229	VLSI Design	3.00	-	3.00	
6.	0613	CSE-3230	VLSI Design Laboratory	-	1.50	0.75	
7.	0613	CSE-3231	Natural Language Processing	3.00	-	3.00	
8.	0613	CSE-3232	Natural Language Processing Laboratory	-	1.50	0.75	

4th Year 1st Semester							
Sl.	BNQF Code	Course Code	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	061	CSE-4000	Final Year Design Project (FYDP)/ Thesis***	-	6.00	3.00	
2.	0613	CSE-4100	Software Development Project – II*	-	1.50	0.75	CSE-3200
3.	0612	CSE-4101	Digital Signal Processing	3.00	-	3.00	
4.	0612	CSE-4102	Digital Signal Processing Laboratory	-	1.50	0.75	
5.	0612	CSE-4103	Cellular and Wireless Communication	3.00	-	3.00	
6.	0613	CSE-4105	Data Science and Applications	3.00	-	3.00	
7.	--	CSE-****	**Elective-III**	3.00	-	3.00	
8.	--	CSE-****	**Elective-IV**	3.00	-	3.00	
9.	--	CSE-****	**Elective-IV Laboratory**	-	1.50	0.75	
			Total:	**15.00**	**10.50**	**20.25**	

***Note:** Each student has to complete Final Year Design Project (FYDP)/Thesis **(CSE-4000)** in the combined duration of two semester (7th and 8th semester). All students and concerned supervisors has to follow standard guidelines prepared for Final Year Design Project (FYDP)/Thesis.

7th Semester Elective-III (One Course):

Sl.	BNQF Code	Course Code	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	0611	CSE-4107	Computer and Cyber Security	3.00	-	3.00	
2.	0413	CSE-4109	Software Testing and Quality Assurance	3.00	-	3.00	

3.	0611	CSE-4111	Parallel and Distributed Systems	3.00	-	3.00	
4.	0613	CSE-4113	Bioinformatics	3.00	-	3.00	

7th Semester Elective-IV (One Course including laboratory):

Sl.	BNQF Code	Course Code	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	0613	CSE-4115	Machine Learning	3.00	-	3.00	
2.	0613	CSE-4116	Machine Learning Laboratory	-	1.50	0.75	
3.	0613	CSE-4117	Data Mining and Data Ware-housing	3.00	-	3.00	
4.	0613	CSE-4118	Data Mining and Data Ware-housing Laboratory	-	1.50	0.75	
5.	0613	CSE-4119	Digital System Design	3.00	-	3.00	
6.	0613	CSE-4120	Digital System Design Laboratory	-	1.50	0.75	

4th Year 2nd Semester							
Sl.	BNQF Code	Course Code	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	061	CSE-4000	Final Year Design Project (FYDP)/ Thesis***	-	6.00	3.00	
2.	0613	CSE-4211	Computer Graphics and Multimedia Systems	3.00	-	3.00	
3.	0613	CSE-4212	Computer Graphics and Multimedia Systems Laboratory	-	1.50	0.75	
4.	--	CSE-****	**Elective -V**	3.00	-	3.00	

5.	--	CSE-****	**Elective -VI**	3.00		3.00	
6.		CSE-****	**Elective –VI Laboratory**	-	1.50	0.75	
7.	0413	GED-4251	Engineering Management and Leadership	2.00		2.00	
			Total:	**11.00**	**9.00**	**15.50**	

8th Semester Elective-V (One Course):

Sl.	BNQF Code	Course Code	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	0613	CSE-4113	Cloud Computing	3.00	-	3.00	
2.	0612	CSE-4215	Green Computing	3.00	-	3.00	
3.	0612	CSE-4217	Network Planning	3.00	-	3.00	
4.	0611	CSE-4219	Blockchain and Cryptocurrency Technology	3.00	-	3.00	

8th Semester Elective-VI (One Course including laboratory):

Sl.	BNQF Code	Course Code	Course Title	Hours/Week		Credits	Pre-requisite
				Theory	Laboratory		
1.	0611	CSE-4221	Internet of Things (IoT)	3.00	-	3.00	
2.	0611	CSE-4222	Internet of Things (IoT) Laboratory	-	1.50	0.75	
3.	0612	CSE-4223	Advanced Database Management Systems	3.00	-	3.00	
4.	0612	CSE-4224	Advanced Database Management Systems Laboratory	-	1.50	0.75	
5.	0611	CSE-4225	Pattern Recognition	3.00	-	3.00	
6.	0611	CSE-4226	Pattern Recognition Laboratory	-	1.50	0.75	

Chapter-4
Detail outline of undergraduate course offered by the dept. of CSE

1st Year 1st Semester

BNQF Code:0611 **Course Code: CSE-1100**	**Contact Hours/Week:** 3.00
Course Title: Introduction to Computer Systems Laboratory	**Credit Hour:** 1.50
Rationale:	
Introduction to Computer Systems Laboratory course provides an introduction to the layers of architectures in modern computer systems from hardware device levels upwards. It also helps students to understand the fundamental terminologies of Computer Science and Engineering, Hardware and Software.	
Course Contents:	
Computer Science and Engineering as a Discipline: Computer Science, Computer Engineering, Theoretical Computer Science, Central Themes of CSE, Subfields of CSE, Course Map for Four Year Undergrad CSE Degree, Role of Mathematics in CSE, Role of Electrical Engineering in CSE, Diversified Applications of CSE: Artificial Intelligence, Machine Learning, Digital Image Processing, Computer Graphics, Computer Security etc. **Hardware:** Types and Generation of Computers, Data Representation, Computer Arithmetic, Processor, Types of Memory, Peripherals, Interfacing, Assembler, Compiler, Interpreter, Levels of Programming Language, Data Communication and Computer Network. **Software:** Computer Programming, Data Structure & Algorithms, Database System, Types of Software, Software Licenses, Software Engineering, Familiarization with Various Operating Systems (Windows, Linux, Android, IOS Etc.), Computer Operations: Text Processing (MS-WORD, Libre Writer etc.), Spreadsheet (MS-EXCEL, LibreCalc etc.), Presentation (MS-POWERPOINT, Libre Impress etc.), Browser Software (Chrome, Firefox etc.)	

Reference Book (s):

1. Computer Fundamentals (7th Edition) – Peter Norton, McGraw Hill Education (2017).
2. Introduction to Computers, McGrew Hill Inc- Subramanian
3. The Complete PC Upgrade and Maintenance Guide (16th Edition) – Mark Minasi, Sybex (2005).
4. How to Think Like a Computer Scientist: Learning with Python (2nd Edition) –Allen B. Downey, Samurai Media Limited (2016).
5. Core Python Programming (2nd Edition) - Wesley J Chun, Prentice Hall (2006).

BNQF Code: 0533 Course Code: PHY-1101	Contact Hours/Week: 3.00
Course Title: Physics	**Credit Hour: 3.00**
Rationale:	
Enable to use the understanding to predict how an object will behave under particular conditions and to help improving the functionalities of everyday objects.	
Course Contents:	
Waves & Oscillations: Differential equation of simple harmonic oscillator, total energy and average energy, Combination of simple harmonic oscillations, spring-mass system, damped oscillation, forced oscillation, resonance, stationary wave, phase velocity, group velocity, Wave motion, wave energy. **Optics and Laser**: Theories of light: Interference of light, Young's double slit experiment, Fresnel's biprism. Interference in thin films, Newton's rings, Interferometers, Diffraction of light: Fresnel and Fraunhofer diffractions, Diffraction by single slit, diffraction by double slits, diffraction gratings, Resolving power of optical instruments, Polarization of light: production and analysis of polarized light, polarization by double refraction, Brewster's law, Maluslaw, Nicoleprism, optical activity and polarimeter. Laser, spontaneous and stimulated emission, Helium-Neon laser, laser applications, Fiber optics. **Heat and thermodynamics**: Principal of temperature measurements, resistance thermometer, thermos-electric thermometer, pyrometer. Kinetic theory of gases: Maxwell's distribution of molecular speeds, mean free path, equipartition of energy, Brownian motion, Vander Weal's equation of state, review of the first law of the thermodynamics and it's application, reversible and irreversible process, second law of thermodynamics, Carnot cycle, efficiency of heat engines, Carnot's Theorem, entropy and disorder, thermodynamic functions, Maxwell relations, Clausius-Clapeyron equation, Gibbs phase rule, third law of thermodynamics. **Structure of Matter**: Crystalline and non-crystalline solids, single crystal and polycrystal solids, unit cell, crystal systems, co-ordinations number, crystal planes and directions, sodium chloride and CsCl structure, packing factor, Miller indices, relation between inter-planar spacing and Miller indices, Bragg's law, methods of determination of inter-planar spacing from diffraction patterns; Defects in Solids: Point defect, line defects, Bonds in solids, inter atomic distances, calculation of cohesive and bonding energy; Introduction to Band Theory: Distinction between metal, semiconductor and insulator	

Reference Book (s):

1. Physics for Engineers, Part-1 & Part-2 (4th ed)- Dr. Giasuddin Ahmad, Hafiz Book Centre(2000).
2. Wave sand oscillations (2nded)-Brijlal and Subramannyam, Vikas Publishing House PvtLtd(1994).
3. A Text Book of Optics - Brijlal and N. Subrahmanyam, S. Chand (2006).
4. Fundamental of Optics (3rd ed)-Jenkine and White, McGraw Hill(1957).
5. Fundamentals of Physics (10th ed)-Halliday, Resnick and Walker, Wiley(2013).
6. Physics part-I & II (2nd ed) - Resnick and Halliday, John Wiley & Sons, Inc.(1968).

BNQF Code:0533 Course Code: PHY-1102	Contact Hours/Week: 1.50
Course Title: Physics Laboratory	**Credit Hour: 0.75**
Rationale:	
Laboratory works based on PHY 1101	
Course Contents:	
Determination of the moment of inertia of a fly-wheel about its axis of rotation. Determination of angle of a prism and hence calculation of refractive index of the material of it. Determination of the mechanical equivalent of heat, J by Joule's Calorimeter. Determination of the spring constant and the effective mass of a loaded spring and hence to calculate the modulus of rigidity of it. Determination of velocity of sound in air by resonance tube method. Determination of the wavelength of the monochromatic light by Newton's ring method. Determination of the acceleration due to gravity "g" by means of a compound pendulum. Determination of the specific heat of a solid by the method of mixture. Determination of the thermal conductivity of a bad conductor by Lee's method. Determination of the wavelengths of various spectral lines by a spectrometer using a plane diffraction grating	

Reference Book (s):

1. Physics for Engineers, Part-1 & Part-2 (4th ed)- Dr. Giasuddin Ahmad, Hafiz Book Centre(2000).
2. Wave sand oscillations (2nded)-Brijlal and Subramannyam, Vikas Publishing House PvtLtd(1994).
3. A Text Book of Optics - Brijlal and N. Subrahmanyam, S. Chand (2006).
4. Fundamental of Optics (3rd ed)-Jenkine and White, McGraw Hill(1957).
5. Fundamentals of Physics (10th ed)-Halliday, Resnick and Walker, Wiley(2013).
6. Physics part-I & II (2nd ed) - Resnick and Halliday, John Wiley & Sons, Inc.(1968).

BNQF Code:0531 Course Code: CHEM-1101	Contact Hours/Week: 2.00
Course Title: Chemistry	**Credit Hour: 2.00**
Rationale:	
Chemistry course provides an introduction to chemistry of various branches with a special focus on basic and fundamental knowledge of chemistry. Topics include atomic structure, chemical bonding, electro-chemistry, oxidation-reduction, thermodynamic, thermo chemistry, solution, modern periodic table and acid-base.	
Course Contents:	
Atomic structure: Nuclear charge, various atomic models, Spectrum, Quantum number, Orbit and Orbital, Various principles of electronic configuration. **Chemical bonds:** Various types of bonds, VSEPR theory, Lattice and formation energy, Bond order. **Electrochemistry:** Conductors, Degree of ionizations, Faraday's law, Kohlrausch law, Transport number. **Oxidation-Reductio**n: REDOX reaction, Oxidation number and valency, Electromotive force (EMF), Balancing REDOX reaction.	

Chemical Equilibria: Types of chemical equilibrium, Law of mass action, K_p, K_c and K_x, Le-Chatelier's principle.

Thermodynamics and Thermochemistry: Thermo dynamical terms, Thermodynamically processes, First law of Thermodynamics, Enthalpy, Heat capacity, Joule-Thomson effect, Thermo chemistry, Thermo chemical law.

Acids and Bases: Theories and modern definition of acid and bases, Dissociation constant, Streanth, pH, Buffer solution.

Modern Periodic Table: Ionization potential, Electron affinity, Electro negativity, Transition elements, Inert gases, Lanthanides and actinides.

Solutions: Types of solutions, Henry's law, Nernst distribution law, Raoult's law, Osmosis and osmotic pressure.

Liquid state: Vapor pressure, Surface tension and viscosity, Refractive index, Optical activity.

Reference Book(s):

1. Introduction to Modern Inorganic Chemistry- S. Z. Haider
2. Modern Inorganic Chemistry- R. D. Madan
3. Fundamental concepts of Inorganic Chemistry- S. Gilreath:
4. Advanced Inorganic Chemistry- S. Prakash & G. Tuli
5. Essentials of Physical Chemistry- B. S. Bahl and G. D. Tuli
6. Principle of Physical chemistry- M. M. Haque and M. A. Nawab
7. A text book of Physical Chemistry- S Glasstone Essentials of Physical Chemistry- B. S. Bahl and G. D. Tuli

BNQF Code:0531 **Course Code: CHEM-1102**	**Contact Hours/Week: 1.50**
Course Title: Chemistry Laboratory	**Credit Hour: 0.75**
Rationale:	
The purpose of this course will be to develop practical knowledge on inorganic chemistry which will be useful in various engineering courses later on.	
Course Contents:	
Volumetric analysis: Acidimetry-alkalimetry; titrations involving redox reactions, determination of Cu, Fe and Ca volumetrically.	

Reference Book(s):

1. Inorganic Quantitative Analysis- AI Vogel
2. Analytical Chemistry- Verma

BNQF Code:0541 **Course Code: MATH-1141**	**Contact Hours/Week: 3.00**
Course Title: Differential Calculus and Integral Calculus	**Credit Hour: 3.00**
Rationale:	
To get the basic idea of the rate at which one quantity changes relative to another, understand the concept of the word limit, continuity and differentiability and the relation between the area and anti-derivatives and ability to calculate an anti-derivative	
Course Contents:	

Limit, Continuity and Differentiability: Aim and objective of calculus, Function, Domain and Range, Existence of Limit, Continuous Function and its property, Differentiability

Differentiation: Formula of Differentiation, Derivatives of different kind of functions, Differentiations of explicit and implicit functions, Successive Differentiation, Leibnitz's Theorem and Differentiations using Leibnitz's Theorem.

Expansion of Function: Mean value theorem, Rolle's Theorem, Taylor's Series, Expanding of a Function using Taylor's Series.

Maximum and Minimum: Increasing and Decreasing of a Function, Turning Point, Point of Inflation, Concave Up and Down, Maximum and Minimum of Different kind of Functions.

Partial Differentiations and Geometric Applications of Differentiations: Multivariable Function, Partial Differentiations of multivariable functions, Tangent and Normal equations for different kind of function at a point.

Integration: Formula of integration, Integration by methods of substitution, Integration by parts, Integration of special function, Integration of partial fraction

Definite Integration and Applications of Integration: Properties of definite integration, Beta and Gamma Function, Successive integration, Evaluate the Arc Length, Surface Area, Area and Volume.

Reference Book (s):

1. Calculus - Haward Anton (9th ed)- Stephen Davis, Wiley(2012).
2. Differential Calculus- B. C. Das and B.N.Mukherjee
3. Integral Calculus- B. C. Das and B.N.Mukherjee
4. Differential and Integral Calculus (5th ed)-MatinChakraborty, Dhaka Standard Publication(2015).
5. A Text Book on Integral Calculus (4th ed)- Mohammad, Bhattacharjee&Latif, Dhaka(2010).

BNQF Code:0232 **Course Code: HUM-1150**	**Contact Hours/Week: 3.00**
Course Title: Communicative English-I Laboratory	**Credit Hour:1.50**

Rationale:

This course has mainly been designed to improve speaking and oral communication skills of the students. The course includes instructions and experience in speech preparation and speech delivery within various real life situations, formal and informal. Emphasis will be given on various speeches, such as informative, persuasive and interactive.

Course Contents:

Speaking: Introduction to Language: Introducing basic skills of language, English for Science and Technology, Self-introduction and introducing others: How a speaker should introduce himself to any stranger / unknown person / a crowd, Asking and giving directions, Discussing everyday routines and habits, Making requests /offers /invitations /excuses /apologies/complaints, Describing personality, discussing and making plans(for a holiday or an outing to the cinema), Describing pictures / any incident / event, Practicing storytelling, Narrating personal experiences/Anecdotes, Telephone conversations (role play in group or pair),

Situational talks / dialogues: Practicing different professional conversation (role play of doctor-patient conversation, teacher –student conversation);
Listening: Listening and understanding: Listening, note taking and answering questions; Difference between different accents: British and American accents; Documentaries from BBC and CNN will be shown and students will try to understand**;** Listening to short conversations between two persons/more than two**;** **Reading:** Reading techniques: scanning, skimming, predicting, inference; Reading Techniques: analysis, summarizing and interpretation of texts**; Writing:** Introductory discussion on writing, prewriting, drafting; Topic sentence, paragraph development, paragraph structure, describing a person/scene/picture, narrating an event Paragraph writing, Compare-contrast and cause- effect paragraph

Reference Book(s):

1. Jones,L.(1981). Functions of English. (Student's Book, 2nd Ed.) Melbourne, Australia: Cambridge University Press.
2. Dixon,R.J.(1987).Complete course in English.(Book4).New Delhi, India: Prentice Hall of India. (For book presentation)
3. S.M.Amanullah- A Guide to Correct Speech, Albatross Publications
4. R.C. Sharma & Krisna Mohan- Buisness Correspondence and Report Writing, Tata McGraw- Hill Publication Ltd
5. Materials provided by the instructor.

BNQF Code:0222 **Course Code: GED-1151**	**Contact Hours/Week: 2.00**
Course Title: Bangladesh Studies: History and Culture	**Credit Hour: 2.00**
Rationale:	
This course has been designed for students' Knowledge of historical and cultural traits, Heritage, and Socio-economic condition in Bangladesh. It will focus on the language and people of Bangladesh, its historical background, emergence of Bangladesh as a new nation, its social structure, art and literature, religious philosophies, archaeological evidence of the cultural heritage, geography, politics and the governance. It will also enhance their understanding of current phenomena in the light of history and culture which will make them responsible global citizen.	
Course Contents:	
History: Ancient period and Muslim period of Bengal, British Period, Pakistan period: an overview (1952-1971), The problem of national integration under Ayub regime, Elite in crisis during Pakistan rule, nation-building in the new state, The ideals and philosophy of constitution making of Bangladesh, Study on the coup and assassination of Bangobandhu Sheikh Mujib, Philosophy and fundamental changes in Zia regime, Constitutional amendments of Bangladesh, Corruption and good governance in Bangladesh, Issues of governance of Bangladesh, Bangladesh economy, Ideas on political and ethnic conflict in Bangladesh, Geographical setting of Bangladesh, environmental challenges of Bangladesh, Bangladesh foreign policy: realities and challenges, Foreign policy-decision-making process in Bangladesh, Engineering developments in Bangladesh.	

Culture: Anthropological background of the people; major indigenous communities and their culture; human settlements and archaeological sites; sculpture and iconography; arts and crafts; transportation systems; indigenous performances; festivals; goddess worship, folk belief and superstition. Cultural literature of Alaol, Mir Mosharraf Hossain, Kazi Nazrul Islam, Jasimuddin, Begum Rokeya, Lalon Shah , Rabindranath Tagore, Zainul Abedin.

Reference Book(s):

1. "Bangladesh in International Politics" - Muhammad Shamsul Huq (1995), The University Press Limited, Dhaka-1000
2. "Constitution, Constitutional Law and Politics: Bangladesh Perspective"-Md. Abdul Halim, CCB Foundation, Dhaka-1000
3. "Bangladesh in the Twenty-First Century: Towards an Industrial Society" - A M A Muhith (1999), The University Press Limited, Dhaka-1000
4. "Bangladesh Foreign Policy: Realities, Priorities and Challenges" – Harunur Rashid (2012, 2nd Edition), Academic Press and Publishers Library ,Dhaka-1209
5. "The Changing Pattern of Bangladesh Foreign Policy: A Comparative Study of Mujib and Zia Regimes" – Zaglul Haider (2008), The University Press Limited, Dhaka-1000
6. Bangladesh Studies and Culture- Sumon Das & M.N. Mohabbat, Human Publications
7. History of Emergence of Bangladesh- Muntasir Mamun & Mahbubur Rahman, UGC

BNQF Code:0713 **Course Code: EEE-1161**	**Contact Hours/Week: 3.00**
Course Title: Electrical Circuit Analysis	**Credit Hour: 1.50**

Rationale:

The foundational course on electrical circuits is a basis of making freshmen engineering students well familiarize about the arena of DC and AC circuits. The course is aimed towards the methods of electric circuit analysis and evaluating their responses which can be very well achieved by the understanding of circuit laws, techniques and theorems for both AC and DC excitations. Investigation of first and second order DC circuits is vital in understanding circuit elements like capacitors and inductors used in daily life. A hands-on flavour of the poly phase circuits will enhance the practical knowledge, which addresses the issue of faults and power in the transmission lines. Although the course may seem somewhat rudimentary in its design, it imprints the groundwork for engineers who may pursue advanced course on electrical engineering.

Course Contents:

Fundamental electrical concepts and measuring units; Direct current (dc): Current, voltage, resistance, power and energy; Series/Parallel Circuits; Methods of network analysis and Network Theorems; Capacitors; Inductors and introduction to magnetic circuits; Alternating current (ac): Instantaneous current, voltage and power for various combinations of R, L and C circuits, Effective current and voltage, Average power; Phasor representation of sinusoidal quantities; Sinusoidal Single-Phase Circuit Analysis; Introduction to three phase circuits; Power factor and power equation (Δ and Y circuits);

Reference Book (s):

1. Introductory Circuit Analysis (12th ed) - Robert L. Boylestad, Pearson Education India (2013).
2. Alternating Current Circuits (3rd ed) - Russel M Kerchner and George FCorcoran,J. Wiley & Sons Inc. (1951).
3. Fundamentals of Electric Circuits (6th ed) - Charles K Alexander, Mathew N O Sadiku, McGraw-Hill Education (2016).
4. Introduction to Electric Circuits (6th ed) - Richard C. Dorf, James A. Svoboda, Wiley (2013).

BNQF Code:0713 **Course Code: EEE-1162**	**Contact Hours/Week: 1.50**
Course Title: Electrical Circuit Analysis Laboratory	**Credit Hour: 0.75**

Rationale:

This course of electrical engineering discipline aims to familiarize the students with implementation of basic electrical circuits in hardware domain. Designed for fresher students, experiments of this laboratory course will enable them to assemble beginner-level circuits to experimentally verify some fundamental circuit laws and theorems (KVL, KCL, Thevenin, Norton). This course also familiarizes the students with hardware implementation of AC circuits and measurement of ac quantities by oscilloscope. Finally, this course is targeted to introduce the students with hardware projects that will provide them with the first hand on experience about application of electrical engineering in real life and simulation of electrical circuits in a widely used simulation software (Proteus).

Course Contents:

Fundamental electrical concepts and measuring units; Direct current (dc):
Current, voltage, resistance, power and energy; Series/Parallel Circuits; Methods of network analysis and Network Theorems; Capacitors; Inductors and introduction to magnetic circuits;
Alternating current (ac): Instantaneous current, voltage and power for various combinations of R, L and C circuits, Effective current and voltage, Average power; Phasor representation of sinusoidal quantities; Sinusoidal Single-Phase Circuit Analysis; Introduction to three phase circuits; Power factor and power equation (Δ and Y circuits);

Reference Book (s):

1. Introductory Circuit Analysis (12th ed) - Robert L. Boylestad, Pearson Education India (2013).
2. Alternating Current Circuits (3rd ed) - Russel M Kerchner and George FCorcoran,J. Wiley & Sons Inc. (1951).
3. Fundamentals of Electric Circuits (6th ed) - Charles K Alexander, Mathew N O Sadiku, McGraw-Hill Education (2016).
4. Introduction to Electric Circuits (6th ed) - Richard C. Dorf, James A. Svoboda, Wiley (2013).

1st Year 2nd Semester

BNQF Code:0613 **Course Code: CSE-1211**	**Contact Hours/Week: 3.00**
Course Title: Structured Programming	**Credit Hour:0.75**
Rationale:	
To introduce the fundamental principles, mechanism of programming skills and develop basic programming skills to program design and development.	
Course Contents:	
Programming concepts: Programming and coding; Program development stages; Compilers, interpreters and IDE; Syntax and semantics; Flowcharts; **Structured programming language:** Data types, Operators, Expressions, Control structures; **Functions and program structure:** Function basics, Parameter passing conventions, scope rules and storage classes; Header files, User defined header files; Preprocessor; Pointer and it's uses; Arrays; Multidimensional Arrays; Strings; **User defined data types:** Structures, Unions, Enumeration; **Input and Output:** Standard input and output, Formatted input and output, Fileaccess; Variable length argument list; Command line parameters; Error Handling; Exception Handling; Linking; Library functions; Type casting; **Memory allocation**: Static and Dynamic; Recursive Functions; **Introduction to data structure:** Stack, Queue; File I/O; Graphics.	

Reference Book(s):

1. Teach Yourself C – Herbert Schidlt
2. Programming in Ansi C - E Balagurusamy
3. C: The Complete Reference – Herbert Schildt
4. C Programming Language – Dennis M.Ritche

BNQF Code:0613 **Course Code: CSE-1212**	**Contact Hours/Week: 3.00**
Course Title: Structured Programming Laboratory	**Credit Hour:1.50**
Rationale:	
To introduce the fundamental principles, mechanism of programming skills and develop basic programming skills to program design and development.	
Course Contents:	
Basic Knowledge: Mathematical problems using printf, scanf, Operators, If, Else if, Switch; **Programming Concept:** Loop, Nested Loop, Function, Recursion **Dynamic Concept:** Arrays and Strings, Multidimensional Array and Pointers **User Defined Data Types**: Structures, Unions, Enumerations, File I/O, Header files, Preprocessor. Bitwise Operations & Dynamic memory allocation.	

Reference Book(s):

1. Teach Yourself C – Herbert Schidlt
2. Programming in Ansi C - E Balagurusamy
3. C: The Complete Reference – Herbert Schildt
4. C Programming Language – Dennis M. Ritche

BNQF Code:0612 Course Code: CSE-1213	Contact Hours/Week: 3.00
Course Title: Discrete Mathematics	**Credit Hour:3.00**

Rationale:

The course is designed to develop logical thinking and its application to computer science (to emphasize the importance of proving statements correctly and de-emphasize the hand-waving approach towards correctness of an argument). The subject enhances one's ability to reason and ability to present a coherent and mathematically accurate argument.

Course Contents:

Mathematical Logic: Propositional calculus and predicate calculus, Mathematica reasoning and proof techniques

Set Theory: Sets, Relations, Partially ordered sets, Functions

Counting: Permutations, Combinations, Principles of inclusion and exclusion Pascal's triangle, Discrete Probability, Recurrence relations and recursive algorithms Growth of functions, pigeonhole Principle and applications, Advance Counting Techniques

Graph: Introduction to graph, graph terminology, representing graph and graph isomorphism, paths, reachability, connectivity, Euler and Hamilton path, shortest path problems, Graph coloring, matrix representation of graph

Trees: Introduction of trees, application of trees, tree traversal, labeling trees, spanning trees, minimal spanning tree.

Algebraic structures: Rings and groups, Monoid Groups, Abelian group, properties of groups, Permutation Groups, Subgroups, Cyclic Group.

Reference Book(s):

1. Discrete Mathematics & Its Applications- Kenneth H Rosen
2. Discrete Mathematics with Applications -Thomas Koshy
3. Combinatories: Theory and Applications - V. Krishnamurthy, East-West Press.
4. Discrete Mathematics - Seymour Lipschutz, M. Lipson, Tata Mc GrawHill
5. Discrete Matheamatical Structures - Kolman, Busby Ross, Prentice Hall International

BNQF Code:0541 Course Code: MATH-1241	Contact Hours/Week: 3.00
Course Title: Ordinary, Partial Differential Equations and Coordinate Geometry	**Credit Hour:3.00**

Rationale:

This course aims to make the students knowledgeable about relevant aspects of the differential equations with special focus on the solutions procedures regarding ordinary & partial differential equations as well as some problems of engineering interest and familiarize & understand about coordinate geometry.

Course Contents:

Ordinary Differential Equations:

Introduction to differential equations & their formations, solutions of first order & first degree ordinary differential equations by various methods, solutions of ordinary differential equations of first order but not of the first degree, solutions of linear

ordinary differential equations of second & higher orders with constant & variable coefficients, initial & boundary value problems and applications of ordinary differential equations.

Partial Differential Equations:

Introduction to partial differential equations & their formations, linear and nonlinear partial differential equations of first order, higher order linear partial differential equations with constant & variable coefficients, applications of partial differential equations (heat equation, wave equation, Laplace equation & so on).

Coordinate Geometry:

Introduction to co-ordinate geometry, transformation of co-ordinates, pair of straight lines, general equation of second degree & their properties and reduction to its standard forms.

Reference Book(s):

1. Ordinary and Partial Differential Equations -Raisinghania.
2. A Text Book on Co-ordinate Geometry with Vector Analysis - Rahman&Bhattacharjee.
3. Differential Equations with Applications-M. M. K. Chowdhury
4. Differential Equations- S.L. Ross
5. Differential Equations- Frank Ayres
6. Differential Equations-Dr. B.D. Sharma
7. Differential Equations, Jai prakashan-M. L. Khanna
8. Partial Differential Equations, McGraw-Hill- Bernard Epstein
9. The elements of coordinate geometry-S. L. Loney

BNQF Code:0714 **Course Code: EEE-1261**	**Contact Hours/Week: 3.00**
Course Title: Electronic Devices and Circuits	**Credit Hour:3.00**

Rationale:

This subject is classified under the applied technology group and is strongly intended to teach the students the concepts, principles and working of basic electronic components and their implementations on circuits. It is targeted to provide a basic foundation for technology areas like electronics devices, communication systems, industrial electronics as well as instrumentation, control systems and various electronic circuit design.

Course Contents:

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.

Bipolar Junction Transistor (BJT): Principle of operation, I-V characteristics, transistor circuit configurations (CE, CB, CC), BJT biasing, load lines, BJTs at low frequencies, hybrid model- h parameters, simplified hybrid model, small signal analysis of single and multi-stage amplifiers, frequency response of BJT amplifiers.

Field Effect Transistor (FET): 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, introduction to CMOS.

Operational Amplifiers (OP-AMPS): Linear applications of OPAMPs, gain, input and output impedances; active filters, frequency response and noise.

Introduction to oscillators SCR, TRIAC, DIAC and UJT: Characteristics and applications, Introduction to IC fabrication processes.

Reference Book(s):

1. Electronic Devices and Circuit Theory -Robert L. Boylestad and Louis Nashelsky
2. Electronic Principles – Albert P .Malvino.
3. Micro Electronics Circuits-Adel S. Sedra & Keneth C. Smith-Oxford University Press
4. Operation Amplifiers and Linear Integrated Circuits-Robert F. Coughlin-Prentice Hall of India Private Limited

BNQF Code:0714 **Course Code: EEE-1262**	**Contact Hours/Week: 1.50**
Course Title: Electronic Devices and Circuits Laboratory	**Credit Hour:0.75**
Rationale:	
Electronics Devices and Circuits Laboratory course is designed to familiarize the students with some basic electronic components and to examine the characteristics and working of these components in electronic devices and circuits by hand-held experiments and computer aided simulation tool. After being acquainted with these basic components, students will be able to apply the achieved knowledge to implement electronic devices to perform different mathematical operations and to design oscillator circuits for practical purpose.	
Course Contents:	
Electronic Devices and Circuits Laboratory based on EEE-1261	

Reference Book(s):

1. Electronic Devices and Circuit Theory -Robert L. Boylestad and Louis Nashelsky
2. Electronic Principles – Albert P .Malvino.
3. Micro Electronics Circuits-Adel S. Sedra & Keneth C. Smith-Oxford University Press
4. Operation Amplifiers and Linear Integrated Circuits-Robert F. Coughlin-Prentice Hall of India Private Limited

BNQF Code:0715 **Course Code: ME-1270**	**Contact Hours/Week: 3.00**
Course Title: Basic Mechanical Engineering and Drawing Laboratory	**Credit Hour:1.50**
Rationale:	
This course is designed to introduce the students with various fields of Mechanical Engineering with a special consideration to the fields relevant to the computer science and engineering discipline. A good number of theory based and lab based sessions are included to enhance the confidence of the students in this branch of engineering and drawing different geometric view of landscape and other site details.	
Course Contents:	
IC Engine, Automobile, Hybrid and Electric Vehicle: Types of IC Engine, Operating principle, thermodynamic cycle, Valve timing diagram, VVTi, ECM, Sensors used in modern vehicle, Hybrid Technology, Electric vehicle; **Power plant:** Types of power plant, Introduction to Coal based, Gas based and Nuclear power plant, Control system of power plant, Steam generator, Cooling tower; **Heat Transfer and equipment:** Modes of heat transfer, Heat transfer using finned surface, Thermo-electric cooling, Heat pipe, Cooling of microchip and processor;	

Pump, Compressor, Valve: Centrifugal pump, Positive displacement pump, Hydraulic and pneumatic actuator, Control valve (Pressure, flow and direction control valve); **Kinematics of Rigid body:** Truss, Frame, Kinematic linkage; **Power transferring devices:** Belt- pulley, Various types of gear and gear train, Fluid Coupling, CVT; **Robotics and Control:** Introduction to Robotics, Plane, rotational and spatial motion with applications to manipulators, Geometric configurations, arms and grippers, Control system of robots

Engineering Drawing & CAD Laboratory Introduction: Lettering, numbering and heading, Instrument and their use;

Geometric view: Sectional views and isometric views of solid geometrical figure, Plan, Elevation and Section of one-story building, Detailed drawing of lattice towers, Use of AutoCAD software

Reference Book(s):

1. Prathomik Engineering Drawing - Hemanta Kumar Bhattacharyya

BNQF Code:0232 **Course Code: HUM-1250**	**Contact Hours/Week: 3.00**
Course Title: Communicative English-II Laboratory	**Credit Hour:1.50**

Rationale:

This course has mainly been designed to improve speaking and oral communication skills of the students. Speaking English cannot be learnt easily unless the students have the opportunity to immerse themselves in it. The course includes instructions and experience in speech preparation and speech delivery within various real life situations, formal and informal. 'Practice' is the most important thing to be kept in mind while learning to speak English. It is not important to speak English like a native English speaker but it is more important to speak correct English. The best way to speak good English is to keep it simple and crisp. Emphasis will be given on various speeches, such as informative, persuasive and interactive. It will help in learning correct pronunciation of most commonly used words. Since it is interactive, the candidates will be able to improve their communication skills.

Course Contents:

Reading: Reading Comprehension - Practice using different techniques, Academic reading - comprehension from departmental or subject related passages, Vocabulary for Engineers (some common Engineering terms for both general and dept specific), reading subject specific text to develop vocabulary; **Writing:** Writing semi-formal, Formal/official letters, Official E-mail, Applying for a job - Writing Cover Letter and Curriculum Vitae, Statement of Purpose (SOP) writing, Proposal Writing: writing steps, principles and techniques, outlining, revising, editing, proofreading; Report writing, article writing: comparison-contrast and cause – effect, argumentative and opinion expression, assignment writing; Analyzing and describing graphs or charts Practicing analytical and argumentative writing;

Speaking: Public Speaking: Basic elements and qualities of a good public speaker, Set Speech: How to get ready for any speech, Individual / Group presentation: How to be ready for presentation, prepare script for good speech, preparing PowerPoint slides, etc. Selected books/Selected stories for presentation;

Listening: Listening to long lecture on some topics, Listening and understanding speeches/lectures of different accent;

Reference Book(s):

1. Jones,L.(1981). Functions of English. (Student's Book, 2nd Ed.) Melbourne, Australia: Cambridge University Press.
2. Dixon,R.J.(1987).Complete course in English.(Book4).New Delhi, India: Prentice Hall of India. (For book presentation)
3. S.M.Amanullah- A Guide to Correct Speech, Albatross Publications
4. R.C. Sharma &Krisna Mohan- Buisness Correspondence And Report Writing, Tata McGraw- Hill Publication Ltd
5. Materials provided by the instructor.

BNQF Code:0223, 0521 **Course Code: GED-1251**	**Contact Hours/Week: 3.00**
Course Title: Society, Ethics and Environment	**Credit Hour:3.00**

Rationale:

This course provides students with an understanding of the impact of technology on society and the environment. The course examines ethical issues governing social, technological and environmental policies, and the impact of their implementation. Students will learn to analyze, question and resolve ethical dilemmas by developing a personal framework for ethical and moral decision-making. They will explore your responsibilities in your personal and professional lives, in the community and in the global environment. Class discussions will include: privacy versus law enforcement, access to information, freedom of speech versus control of content, stem cell research and medical advances in the context of culture, global warming, green energies and sustainable technologies.

Course Contents:

Engineering Ethics and Codes: Introduction to Ethics, Theories of Ethics, Principles of Engineering Ethics, Employers and employees, inter-professional relationship, Fundamental Canons, NSPE codes, IEEE codes, ACM codes, Institutionalization of ethical conduct, Ethical Dilemmas

Technology and Computer Ethics: Computer crime and cyber security, Privacy and Confidentiality issue in CSE, Legal framework, Copyright laws, ICT Act, Right to Information, Patents, Ethical challenges for CSE engineers with advancement of modern technology in society, Case studies related ethical issues in ICT.

Engineering Ethics and Professionalism: Responsible professionals, corporations, The origin of ethical thought, Ethics and the law, Moral reasoning and codes of ethics, ethical decision making strategies, codes of ethics and case studies, moral issues and ethical theories.

Social issues on Environmental Protection and Law: Sustainable development goal (SDGs), Environment and natural resources, Global environmental problems, environmental ethics, Pollution, Solution and prevention, Environmental policy and protection tools, Waste: problem and solutions, Urban environment, Industrialization, Climate change, Voluntary tools in the environmental protection, impact of environmental laws in solving environmental problems, Environmental legislation and its importance, Environmental ethics and social responsibility, Importance of sustainability assessment tools and institutions before and after laws are adopted.

Reference Book(s):

1. Charles B. Fleddermann, "Engineering Ethics", Fourth Edition, 2012.
2. Mike W. Martin, Roland Schinzinger, "Introduction to Engineering Ethics", Second Edition, 2010
3. Introduction to Engineering Ethics (3rd Edition) - Schinzinger and Martin; McGraw Hill.
4. Environmental Engineering: Principles and Practice - Wiley

2nd Year 1st Semester

BNQF Code:0613 **Course Code: CSE-2101**	**Contact Hours/Week: 3.00**
Course Title: Data Structures and Algorithms-I	**Credit Hour:3.00**

Rationale:

This course introduces students to the basic concepts of Data Structures, developing Programming Skills for Advanced Data Structures such as Stack, Queue, Trees, Hash Tables, and Priority Queues etc. Demonstrate programming problems and improve the knowledge of Algorithms.

Course Contents:

Introduction: Internal data representation; Abstract data types; Introduction to algorithms.

Asymptotic analysis: Growth of functions, O, Ω and Θ notations; Correctness proof and techniques for analysis of algorithms; Master Theorem.

Elementary data structures: Arrays, linked lists, stacks, queues, trees and tree traversals, graphs and graph representations, heaps, binary search trees.

Graph Traversals: DFS, BFS, Applications of DFS and BFS.

Sorting: Heapsort, merge sort, quicksort; Data structures for set operations.

Methods for the design of efficient algorithms: Divide and conquer, greedy methods, dynamic programming.

Reference Book(s):

1. Classic Data Structures 2nd Ed – Debasis Samanta
2. Data Structures using C 2nd Ed – Aaron M. Tenenbaum, Yedidyah Langsam, Moshe J. Augenstein
3. Data Structures (Schaum's Outline Series), Tata McGraw-Hill- Seymour Lipshultz

BNQF Code:0613 **Course Code: CSE-2102**	**Contact Hours/Week: 3.00**
Course Title: Data Structures and Algorithms-I Laboratory	**Credit Hour:1.50**

Rationale:

This course will practically implement the basic algorithms, such as sorting, finding shortest paths as well as to analyze the runtime and memory use. Apply the different types of algorithms such as divide and conquer, Dynamic programming etc.

Course Contents:

Introduction: Internal data representation; Abstract data types; Introduction to algorithms. **Asymptotic analysis**: Growth of functions, O, Ω and Θ notations; Correctness proof and techniques for analysis of algorithms; Master Theorem. **Elementary data structures:** Arrays, linked lists, stacks, queues, trees and tree traversals, graphs and graph representations, heaps, binary search trees**. Graph Traversals:** DFS, BFS, Applications of DFS and BFS. **Sorting:** heapsort, merge

sort, quicksort; Data structures for set operations. **Methods for the design of efficient algorithms**: Divide and conquer, greedy methods, dynamic programming.

Reference Book(s):

1. Classic Data Structures 2nd Ed – Debasis Samanta
2. Data Structures using C 2nd Ed – Aaron M. Tenenbaum, Yedidyah Langsam, Moshe J. Augenstein
3. Data Structures (Schaum's Outline Series), Tata McGraw-Hill- Seymour Lipshultz

BNQF Code:0613 **Course Code: CSE-2103**	**Contact Hours/Week: 3.00**
Course Title: Object Oriented Programming	**Credit Hour:3.00**
Rationale:	
This course is to provide students with an overview of the concepts and fundamentals of Object Oriented Programming. Object oriented programming is a programming paradigm that relies on the concept of objects, encapsulated data structures that have properties and functions and which interact with other objects.	
Course Contents:	
OOP Introduction: Philosophy of Object Oriented Programming (OOP), Advantages of OOP over structured programming; Features: Encapsulation, Inheritance, Polymorphism **Introduction to class and objects** : classes and objects, access specifiers, static and non-static members **Constructors and Destructors**: Constructors, Destructors, Copy Constructors **Pointers of objects**: Array of objects, object pointers, and object references, Type conversion. **Functions**: Member Functions, In-line functions, friend functions, static functions **Inheritance**: single and multiple inheritances **Polymorphism**: overloading, abstract classes, virtual functions and overriding **Error Handling**: Exception Handling; Object Oriented I/O: Object Oriented I/O **Templates:** Template functions and classes **C++DATAFILE:** C++ file stream classes, Input and output file, Mode of files, File pointer, Random file accessing **Threads**: Multi-threaded Programming, Abstract Data Types	

Reference Book(s):

1. C++: The Complete Reference - Herbert Schildt
2. Object Oriented Programming with C++ - Balaguruswamy, McGraw Hill Publications.
3. Object-Oriented Programming in C++ - Robert Lafore, SAMS Publications

BNQF Code:0613 **Course Code: CSE-2104**	**Contact Hours/Week: 3.00**
Course Title: Object Oriented Programming Laboratory	**Credit Hour:1.50**
Rationale:	

Object-oriented programming is a programming paradigm that includes or relies on the concept of objects, encapsulated data structures that have properties and functions and which interact with other objects.
Course Contents: **Introduction to OOP**: Advantages of OOP over structured programming **Introduction to classes and objects**: Encapsulation, classes and objects, access specifiers, static and non-static members **Constructors and Destructor**: Constructors, Destructors and Copy Constructors **Array of objects**: Array of objects, object pointers, and object references **Function**: Member Functions, In-line functions, friend functions, static functions **Inheritance:** single and multiple inheritance **Polymorphism:** overloading, abstract classes, virtual functions and overriding **Exception Handling**: Exception Handling; OOP I/O: Object Oriented I/O **Templates**: Template functions and classes, Overview of Standard Template Library (Vectors & Iterators); **C++DATAFILE:** C++ file stream classes, Input and output file, Mode of files, File pointer, Random file accessing **Thread**: Multi-threaded Programming, Abstract Data Types.

Reference Book(s):

1. Teach Yourself C++ by HerbertSchildt
2. Object Oriented Programming with C++ by E Balagurusamy
3. Complete Reference C++ by Herbert Schildt
4. Programming with C++ by Schaums Outline Series

NQF Code:0612 **Course Code: CSE-2105**	**Contact Hours/Week: 3.00**
Course Title: Database Systems	**Credit Hour:3.00**
Rationale:	
This course is designed to introduce the basic concepts of database, learn the foundations of database systems, focusing on basics such as the relational algebra and data model, schema normalization, query optimization, and database designing.	
Course Contents: **Concepts of Database Systems**: Files and Databases, Database Management Systems; Transaction management, Structure of a DBMS, Applications. **Entity-Relationship Concepts**: Entity types, Entity set, Attribute and key, Relationships, Relation types, Entity relationship, ER modeling, ER diagrams, Database design using ER diagrams, Enhanced Entity- Relationship (EER) model. **Normalization**: Normal forms, Normalized Relations and Database performance; De-normalization. **Relational Model**: Structure of relational databases, Relational algebra, Relational algebra operations, Modification of the database, Introduction to views, Pitfalls in relational database design. **SQL**: Data Definition Language, Data Manipulation Language, Basics of SQL, Query designing in SQL using aggregate functions and nested queries, Embedded SQL, Triggers, Procedures; Indexes; Declarative Constrains and Database Triggers.	

Concurrency Control: Lock based protocols, Timestamp based protocols, Validation based protocols, Deadlock.
Recovery System: Failure classification, Storage structure, Recovery and atomicity, Log- based recovery, Recovery with concurrent transactions, Advanced recovery techniques, RAID model.
Advanced Database Management Systems: No SQL Systems, distributed systems, object-oriented System, Temporal, Database Security, Data Warehousing and Data Mining, Database Administration and Tuning.

Reference Book(s):

1. Database System Concept, Abraham Silberschatz, Henry F. Korth, S.Sudarshan, Fourth Edition
2. Files and Databases- An Introduction, Peter D. Smith and G.M. Barnes, Addison- Wesley
3. Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, Third edition

BNQF Code:0612 **Course Code: CSE-2106**	**Contact Hours/Week: 3.00**
Course Title: Database Systems Laboratory	**Credit Hour:1.50**

Rationale:

This course is designed to introduce the basic concepts of database, learn the foundations of database systems, focusing on basics such as the relational algebra and data model, schema normalization, query optimization, and database designing.

Course Contents:

Introduction to SQL: Overview of the SQL query, Language, SQL data definition, Basic structure of SQL, Queries, Null values, Aggregate functions, Modification of the database.
Intermediate SQL: Join expressions, Views, Transactions, Integrity constraints, SQL data types and schemas.
Advanced SQL: Accessing SQL from a programming language, Functions and procedures, Triggers, Recursive Queries, Advanced aggregation features.

Reference Book(s):

1. Database System Concept, Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Fourth Edition
2. Files and Databases- An Introduction, Peter D. Smith and G.M. Barnes, Addison- Wesley
3. Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke,Third edition

BNQF Code:0611 **Course Code: CSE-2107**	**Contact Hours/Week: 3.00**
Course Title: Digital Logic Design	**Credit Hour:3.00**

Rationale:

This course is designed to learn about different logic gates, to design and analysis of digital circuits, gather knowledge about different types of computer chips and learn to represent signals and sequences of a digital circuit through numbers.

Course Contents:
Fundamental of Digital Logic System: Number Systems and their conversion, weighted and non-weighted codes, Error detection code, Binary addition and subtraction, 2's complement method. **Logic Gates and Boolean Algebra:** Logic Gates, Boolean algebra, Truth Tables and K-Maps, Karnaugh map logic simplification tool, Combinational circuits analysis and design **Integrated Circuit Logic Families:** Diode Logic Gates, Transistor Gates, MOS Gates, Logic Families: TTL and CMOS Logic with Operation Details. **Sequential Circuit Concept:** Introduction to Flip-Flops i.e. J-K F/F, Introduction to Latches, design procedures, introduction to develop state diagram and state table, **Structured Sequential Circuits:** Registers, shift Registers, parallel Loading of Registers, **Counters:** Synchronous, asynchronous, MOD counter, Up Counter, Down Counter. **Programmable logic design:** Programmable Logic Devices, Programmable Read Only memory (PROM), Programmable logic Array (PLA), Programmable Array Logic (PAL).

Reference Book(s):

1. Digital Logic and Computer Design (4th ed) - M. Morris Manno(2007)
2. Digital Systems: Principles and Applications, Prentice Hall-Ronald J. Tocci
3. Digital Computer Electronics (3th ed) - Albert P. Malvino, Jerald A Brown(2001)

BNQF Code:0611 **Course Code: CSE-2108**	**Contact Hours/Week: 3.00**
Course Title: Digital Logic Design Laboratory	**Credit Hour:1.50**

Rationale:
This course aims to provide students with knowledge of problem solving with digital logic circuits & systems. It exploits areas like Boolean algebra, combinational circuits, sequential circuits and memory elements. The students are taught about the number system, logic gates as well as digital IC technology. The basic building blocks of combinational and sequential circuits are introduced to enable students to develop circuit solutions to problems and to understand the design and operation of hardware models of digital systems.
Course Contents:
Fundamentals of Digital Logic System, Logic Gates and Boolean algebra, Minimization Technique, Switching Devices, Switching Characteristics of Diodes, Characteristics of Transistor, Integrated Circuit Logic Families, DTL, TTL, Adder and Subtractor, Flip-Flops (FF) and Related Devices, Counter.

Reference Book(s):

1. Digital Logic and Computer Design (4th ed) - M. Morris Manno(2007)
2. Digital Systems: Principles and Applications, Prentice Hall-Ronald J. Tocci
3. Digital Computer Electronics (3th ed) - Albert P. Malvino, Jerald A Brown(2001)

BNQF Code:0541 **Course Code: MATH-2141**	**Contact Hours/Week: 3.00**
Course Title: Vector Analysis, Matrices and Laplace Transform	**Credit Hour:3.00**

Rationale:

In this course, students will learn at the basic properties of vectors and scalars, gradient, divergence and curl, line integration, surface integration, volume integration. Matrices as objects rather than just as a tool for solving systems of linear equations. Fourier series is used to represent any function in terms of a periodic function that is in terms of sines and cosines functions.

Course Contents:

Vector Analysis: Scalars and vectors, equality of vectors, addition and subtraction of vectors, multiplication of vectors by scalars, linear dependence and independence of vectors, scalar and vector product of two vectors and their geometrical interpretation, and triple products, vector differentiation, gradient, divergence and curl, vector integration, definition of line, surface and volume integrals, Green's theorem, divergence theorem of Gauss's, Stoke's theorem and their applications.

Matrices: Definition of matrices, algebra of matrices, inverse of matrix, rank and elementary transformations of matrices, solution of system of linear equations, eigenvalues and eigenvectors, Cayley-Hamilton theorem and its application.

Laplace Transformation: Definition, Laplace transformations of some elementary functions, sufficient conditions for existence of Laplace transformation, some important properties of Laplace transformations, Laplace transformations of derivatives, the unit step function, periodic functions, some special theorems on Laplace transformations, partial fraction, inverse Laplace transformations & their properties and applications of Laplace transformations to solve boundary value problems.

Reference Book(s):

1. Vector Analysis - Seymour Lipschutz, Dennis Spellman and Murray R. Spiegel, Schaum'soutlines
2. Vector Analysis - M. D.Raisinghania
3. Elementary Linear algebra - Wiely, Howard Anton and Chris Rorres Schaum's Outline of Theory and Problems of Matrices, McGraw-Hill-Frank Ayres, Jr
4. Matrices- M.L.Khanna
5. Schaum's Outline of Theory and Problems of Laplace Transforms - Murray R. Spiegel (1965)
6. Advanced Engineering Mathematics (10th ed) – ErwinKreyszig

2nd Year 2nd Semester

BNQF Code:0613 **Course Code: CSE-2211**	**Contact Hours/Week: 3.00**
Course Title: Data Structure and Algorithms-II	**Credit Hour: 3.00**

Rationale:

The course is designed to focus on basic and essential topics in data structures and algorithms. The course is designed to focus on basic and essential topics in data structures and algorithms. This course aims to give a solid foundation in the design and analysis of the major classes of algorithms. Students will be able to create their own versions of a specific computational task and compare their performance at the end of the course.

Course Contents:

Introduction to Data Structures and Algorithms: Introduction, Different data structures, Advantages of using applications. Overview of data structures and algorithms: Necessity of Analysis of an Algorithm
Complexity Analysis and Methods of Complexity Analysis: Run Time, Asymptotic Notation (Big-O, Big-Θ, Big-Ω), complexity from Recurrence Relation, Substitution method, Iteration Method
Algorithms: BFS,DFS ,Greedy Algorithm Properties, Fractional Knapsack Problem
Minimum Spanning Tree: Kruskal and Prims Algorithm
Single Source Shortest Path: Dijkstra's Algorithm, Proof of correctness, Lower Bound Theory, Bin Packing Algorithm, Topological Sort
Backtracking: 8 queen problem
Dynamic Programming: Dynamic Algorithm Properties**,** 0-1 Knapsack, Single Source Shortest Path: Bellman-Ford Algorithm
All pair of shortest path: Floyd Warshall Algorithm
Bitmasking with DP: Traveling Salesperson Problem
Linear Time Sorting: Radix Sort, Bucket Sort, Proof of Correctness of Sorting algorithms, Lower bound on sorting
Advanced Data Structure: AVL trees, Red Black trees, Splay trees, Fibonacci heaps, Hashing
Branch and Bounds: LC Branch and Bound, FIFO Branch and Bound
P and NP Problems: Introduction to Optimization and Decision Problems, Tractable and Intractable Problems, Deterministic and Nondeterministic Algorithms, P and NP Set of problems, NP-hardness and NP completeness, Proof of NP-completeness for algorithms
Flow Networks: Maximum Flow, Minimum Cut problem, Ford-Fulkerson Algorithm

Reference Book(s):

1. Data Structures – Edward Martin Reingold; Wilfred J. Hansen(2011)
2. Data structures and algorithm (1st ed) – John E. Hopcroft; Jeffrey D .Ullman(1983)
3. Data Structures and Algorithms in Java (4th ed) - Michael T. Goodrich; Roberto Tamassia (2005)
4. Introduction to Algorithms (3rd ed) - T. H. Cormen; C. E. Leiserson; R. L. Rivest; C. Stein, MIT Press(2009)
5. Algorithm Design (1st ed) - J. Kleinberg; E. Tardos(2005)
6. Algorithm Design and Applications (1st ed) - Michael T. Goodrich; Roberto Tamassia, Wiley(2014)

BNQF Code:0613 **Course Code: CSE-2212**	**Contact Hours/Week: 3.00**
Course Title: Data Structure and Algorithms-II Laboratory	**Credit Hour: 1.50**
Rationale:	
The Data Structure and Algorithm-II course is designed to provide hands on implementation of commonly used data structures and algorithms. The lab begins with the implementation of some commonly used data structures and then covers the implementation of some important algorithms with required modifications and optimizations.	
Course Contents:	
Linear Time Sorting: Radix Sort, Bucket Sort, Proof of Correctness of Sorting algorithms **Basic Concept of STL**: Vector, Set, Map, Pair, Priority Queue **Algorithms:** Greedy Algorithm Properties, BFS, DFS, Fractional Knapsack Problem, **Minimum Spanning Tree:** Kruskal and Prims Algorithm, **Single Source Shortest Path:** Dijkstra's Algorithm, Proof of correctness, Topological Sort, **Backtracking:** 8 Queen problem **Dynamic Programming:** Dynamic Algorithm Properties**,** 0-1 Knapsack, **Single Source Shortest Path:** Bellman-Ford Algorithm, **All pair of shortest path:** Floyd Warshall Algorithm, **Flow Algorithm:** Ford-Fulkerson Algorithm	

Reference Book(s):

1. Introduction to Algorithms (3rd ed) – Thomas H. Cormen; Charles E. Leiserson; Ronald L. Rivest; Clifford Stein (2017)

BNQF Code:0612 **Course Code: CSE-2213**	**Contact Hours/Week:3.00**
Course Title: Data Communication	**Credit Hour: 3.00**
Rationale:	
Data Communication course provides the knowledge of data transmission concepts, fundamentals of data and signals, Layered design of LAN, MAN and WAN, basics of transmission medium, transmission error detection and correction etc.	
Course Contents: **Basic concepts:** Concepts and Terminology, Data representation, Data flow, Networks and network models, Protocol and standards, OSI reference model, TCP/IP protocol suite. **Data and signals:** Analog and Digital data, Time and frequency domain concepts; Transmission impairment; Noisy and Noiseless channel. **Digital Transmission:** Digital-to-Digital conversion: Line coding, block coding, scrambling; Analog-to Digital conversion: Pulse code modulation, Delta modulation, Transmission modes: Parallel and serial transmission. **Analog Transmission:** Digital-to-Analog conversion: ASK, FSK, PSK, QAM. Analog-to-Analog conversion: Amplitude modulation, Frequency modulation, Phase modulation **Bandwidth Utilization:** Multiplexing: Frequency-division multiplexing;	

Wavelength-division multiplexing; Time-division multiplexing, spread spectrum; Frequency hopping and Direct sequence spread spectrum. Line coding scheme; Pulse code modulation; Delta Modulation; Amplitude shift keying; Frequency shift keying; Phase shift keying; Amplitude, Frequency and Phase modulation

Transmission Medium and Switching Techniques: Guided Media: Twisted-Pair Cable, Coaxial Cable, Optical-Fiber Cable; Unguided Media: Radio wave, Microwave Infrared; Switching: Circuit-switching, Packet Switching and Message Switching

Error Detection and Correction: Data word, Codeword, Redundancy, Forward Error Detection, Retransmission, Parity Checker, Single Bit Error, Burst Errors, Block Coding, Cyclic Codes, Checksum, Forward Error Correction

Data Link Control and Media Access Control (MAC): Data Link Control: Data link layered protocol, HDLC and Point-to-Point Protocol; Multiple Access Techniques: Random Access (ALOHA, CSMA, CSMA/CD, CSMA/CA), Controlled Access (Reservation, Polling, Token Passing) Channelization (FDMA, TDMA, SDMA, OFDMA, CDMA)

Reference Book(s):

1. Data Communication and Networking(4th ed) - Behrouz A Forouzan(2017)
2. Data and Computer Communication - William Stallings
3. Data Communication & Networks – R LBrewster
4. Introduction to Telecommunication: Voice, Data and the Internet (1st Edition) – Marion Cole; Prentice Hall (2010)
5. Modern Digital and Analog Communication System (4th Edition) – B P Lathi; Oxford (2011

BNQF Code:0612 **Course Code: CSE-2214**	**Contact Hours/Week:1.50**
Course Title: Data Communication Laboratory	**Credit Hour: 0.75**

Rationale:

The objective of this course is to cover the principles of analog and digital communication systems involving different modulation and coding schemes. This course will enable students to understand how these systems work and have an ability to apply knowledge to real-world problems.

Course Contents:

Introduction to MATLAB / Delta Modulation, AM/FM / AM Modulator & Demodulator, Digital to digital Conversion; Line Coding/ DSB-SC and SSB Demodulators, FM Modulator and Demodulator, ASK/PSK/FSK, CDMA, Checksum.

Reference Book(s):

1. Data Communication and Networking (4th ed) - Behrouz A Forouzan(2017)
2. Data and Computer Communication - William Stallings
3. Data Communication & Networks – R LBrewster
4. Introduction to Telecommunication: Voice, Data and the Internet (1st Edition) – Marion Cole; Prentice Hall (2010)
5. Modern Digital and Analog Communication System (4th Edition) – B P Lathi; Oxford (2011

BNQF Code:0611 Course Code: CSE-2215	Contact Hours/Week: 3.00
Course Title: Computer Organization and Architecture	Credit Hour:3.00

Rationale:

This course introduces students to the basic concepts of computers, their design and how they work. It encompasses the definition of the machine's instruction set architecture, its use in creating a program, and its implementation in hardware. The course addresses the bridge between gate logic and executable software, and includes programming both in assembly language (representing software) and HDL (representing hardware).

Course Contents:

Fundamentals of Computer Design: Introduction to Von Neumann Organization, RISC and CISC Machines, Computer Design, Processor Design, HDL for Simple CPU Implementation, Information representation, Measuring performance, Instructions and Data Access Methods, Operations and Operands of Computer Hardware, Representing Instruction, Addressing Styles; Arithmetic Logic Unit (ALU) Operations, Floating Point Operations

Processor design: Data Paths-single Cycle and Multi Cycle Implementations, Arithmetic and Logic Unit (ALU) and Register Set Design, CPU Instruction Set Design, Addressing Modes, Assembly Language and Assembler Design, Stack Implementation for Supporting Function Calling with Parameters, Interrupts, Exceptions, Operating System Calls and I/O Operations, Bus Architecture, Turbo Boost Technology

Memory organization: Cache Memory: Computer Memory System Overview, Cache Memory Principles, Elements of Cache Design, Pentium 4 Cache Organization, ARM Cache Organization,

Internal Memory: Memory organization, ARM Cache Organization, cache, Error Correction, virtual memory, channels; Concepts of DMA and Interrupts, Advanced DRAM Organization;

External Memory: Magnetic Disk, RAID, Solid State Drives, Optical Memory, Magnetic Tape, Input/ Output: External Devices, I/O Modules, Programmed I/O, Interrupt Driven I/O, Direct Memory Access, I/O Channels and Processors, Thunderbolt and Infini Band

Multiprocessors: Types of Multiprocessors, Performance, Single Bus Multiprocessors, Multiprocessors Connected by Network, Clusters.

Pipelining and Parallel Processing: Pipelining, Pipeline Hazards, Branch Prediction, Speculative Execution, Instruction Level Parallelism, Superscalar Processor, Parallel Processing, Threading.

Parallel Organization: Multiple Processor Organizations, Symmetric Multiprocessors, Cache Coherence and the MESI Protocol, Multithreading and Chip Multiprocessors, Non-uniform Memory Access, Vector Computation

Reference Book(s):

1. Computer Organization and Architecture - William Stalling
2. Computer Organization and Design - David APatterson
3. Structured Computer Organization - Andrew S.Tanenbaum
4. Computer Architecture and Organization, McGraw-Hill- John P. Hayes
5. Computer Organization, McGraw-Hill- Carl Hamacher, ZvonkoVranesic and Safwat Zaky

BNQF Code:0613 Course Code: CSE-2216	Contact Hours/Week: 2.00
Course Title: Java Programming Laboratory	Credit Hour:1.00

Rationale:

The Java Programming Laboratory course is designed to provide a comprehensive knowledge about Objects, Class, Inheritance, Polymorphism, and Encapsulation to do programming in an effective manner and solve practical life problems by building real-time projects.

Course Contents:

Object-Oriented Programming (JAVA): Basic concepts on Java, basic operation, command line, objects and classes in Java, class inheritance, encapsulation, polymorphism, exception handling, abstract classes, interfaces, Java Array, String, JAVA I/O (serialization) and stream, Generic Class and methods, Collection Frameworks, Concurrency, Swing components and swing Layouts.

Reference Book(s):

1. Java, The Complete Reference (9th ed) - Herbert Schildt

BNQF Code:0713 Course Code: EEE-2261	Contact Hours/Week: 3.00
Course Title: Electrical Drives and Instrumentation	Credit Hour:3.00

Rationale:

This course is designed to familiarize students with electrical energy conversion devices such as generator, motor, transformer and deliver fundamental knowledge on electrical measurement and instrumentation system. The course is designed with the basic contents of electrical machines construction, operating principles, characteristics and applications. Students will also be able to learn different electrical measurement and instrumentation techniques, data conditioning and telemetry devices working principles for engineering applications.

Course Contents:

Introduction: Three phase circuits, alternators and transformers, principles & operation of DC Machines, synchronous, induction, universal and stepper motors, thyristor and microprocessor-based speed control of motors;

Instrumentation amplifiers: Differential, logarithmic, and chopper amplifiers, frequency and voltage measurements using digital techniques, recorders and display devices, spectrum analyzers and logic analyzers, data acquisition and interfacing to microprocessor-based systems;

Transducers: Terminology, types of transducers, principles and applications of photovoltaic, piezoelectric, thermoelectric, variable resistance and opto-electronics transducers. Noise reduction in instrumentation;

Reference Book(s):

1. A Text Book of Electrical technology - B.LTheraja
2. Electrical Machinery and Transformers - Irving L.Kossow
3. A Course in Electrical and Electronic Measurements and Instrumentation - A.K.Sawhney
4. Electronic Instrumentation and Measurements - David A. Bel
5. Electrical Machines-Nagrath and Kothari, McGrawHill

BNQF Code:0713 **Course Code: EEE-2262**	**Contact Hours/Week: 1.50**
Course Title: Electrical Drives and Instrumentation Laboratory	**Credit Hour:0.75**
Rationale:	
This course is designed to help the students to explore various DC and AC machines and put theory in practice. Our mission is to expose students to the constructions of electrical machines and analyse their performance. This course is targeted to verify the properties of generator, motor etc. and relate them with their theoretical knowledge. Our aim is to give the students the basic idea of how these machines fit in large context. This course is also designed to give the students the basic idea of electronic instrumentation system.	
Course Contents:	
Electrical Drives and Instrumentation Laboratory based on EEE-2262	

Reference Book(s):

1. A Text Book of Electrical technology - B.LTheraja
2. Electrical Machinery and Transformers - Irving L.Kossow
3. A Course in Electrical and Electronic Measurements and Instrumentation - A.K.Sawhney
4. Electronic Instrumentation and Measurements - David A.Bel
5. Electrical Machines-Nagrath and Kothari, McGrawHill
6. Alternating Current Machines-A.F.Puchstein and T.C. Lioyd-John willey and SonsInc.

BNQF Code:0541 **Course Code: MATH-2241**	**Contact Hours/Week: 3.00**
Course Title: Complex Variable and Fourier Analysis	**Credit Hour: 3.00**
Rationale:	
This course goals to create the students knowledgeable about relevant aspects of the complex variable with special focus on the Fourier techniques & solutions procedures regarding these as well as some problems of engineering interest and understand their uses in concurrent applications.	
Course Contents:	
Complex Variables: Complex number system, complex functions, limits & continuity of complex variables and related theorems, complex differentiation & the Cauchy-Riemann equations, analytic & harmonic functions, singularities, line integral of complex functions, Cauchy's integral theorem, Cauchy's integral formula, Liouville's theorem, Taylor's theorem and Laurent's theorem, residues and Cauchy's residue theorem, contour integration and conformal mapping. **Fourier Analysis:** Real and complex form of Fourier series, Fourier integral, Fourier transforms, inverse Fourier transforms and their uses in solving boundary value problems.	

Reference Book(s):

1. Complex variable (2nd ed) – Schaum's Out-line Series by Spiegel(2009)
2. Complex Analysis – Prof. Haridashalder& Dr. Md. AmirulIslam
3. Complex Variables and Applications-James Ward Brown and Ruel V. Churchill

BNQF Code:0542 **Course Code: STAT-2251**	**Contact Hours/Week: 3.00**
Course Title: Applied Statistics and Queuing Theory	**Credit Hour: 3.00**

Rationale:

To achieve knowledge on probability and computation of probability with its practical and theoretical application in studying computer science.

Course Contents:

Statistics: Introduction, frequency distribution, mean, median, mode and other measure of central tendency standard deviation and other measure of dispersion, moments, skewness, kurtosis, elementary probability theory, elementary sampling theory, estimation, hypothesis testing, correlation and regression analysis.

Probability: Probability models, sample space, events, algebra of events, probability axioms, conditional probability, multiplication rule, total probability, Bayes rule.

Random Variables: Discrete, continuous and mixed random variables, probability mass, distribution and cumulative distribution functions.

Probability Distributions: Discrete probability distributions -binomial, Poisson, negative binominal distributions and their properties continuous probability distributions-uniform, normal, exponential distributions and their properties, stochastic process.

Queuing Theory and Model: Stochastic process, discrete time Markov chain and continuous time, Markov chains (birth-death process) queuing models (birth- death model, Monrovian model).

M/M/1, M/M/C, M/G/1, M/D/1, G/M/1 solution of network of queue-closed queuing models and approximate models, application of queuing models in computer science.

Queuing Model: M/M/1, M/M/C, M/G/1, M/D/1, G/M/1 solution of network of queue-closed queuing models and approximate models, application of queuing models in computer science.

Reference Book(s):

1. Introduction to Probability Models-Sheldon M. Ross, 9th Edition.
2. Introduction to Probability-Dimitri P. Bertsekas and John N.Tsitsiklis
3. Probability Theory-Monindra Kumar Roy
4. An Introduction to Statistics and Probability- M. Nurul Islam
5. An Introduction to the Theory of Statistics-R.N.Shil

3rd Year 1st Semester

BNQF Code:0613 **Course Code: CSE-3101**	**Contact Hours/Week: 3.00**
Course Title: Software Engineering and Information System Design	**Credit Hour: 3.00**

Rationale:

Understand fundamental concepts of information system and Analyze the user requirements, and designing different kind of system and architectural models for building software systems and testing mechanisms for assuring software quality including the dependability and availability.

Course Contents:

Concepts of software engineering: Software engineering paradigms: Different phases of software.

Design concepts and principles: Architectural design, user interface design, object oriented software development and design, iterative development and the unified process, sequential waterfall life cycles.

UML diagrams: Interaction and Collaboration Diagram for designing Software, class diagram. Structured and non-Structured programming.

Data- directed design techniques: Modular design; Design of automatic, redundant and defensive program; COCOMO model; Tree model; PNR curve; Statistical model.

Software testing: White box and black box testing, basis path testing, testing for specialized environment.

Software testing strategies: Unit testing, integration testing, validation testing, system testing; Art of debugging; Zips Concepts of software reliability and availability; Software repair, downtime, error and faults, specification and correction; New error generation hypothesis; Estimating number of bugs in a computer program; Reliability. Models; Availability models; Quality assurance; Quality measures; Different cost estimation models and their comparisons; Software maintenance; Maintenance-cost models: Growth dynamic models; Documentation; Software project organization; Management and communication skills.

Information Management: Different types of information; Qualities of information; Analysis of Information requirements for modern organizations; Role, tasks and attributes of a Systems Analyst; Sources of information; Information gathering techniques; Editing; Handling of missing information; Requirement's specifications; Steps of systems analysis.

Concepts of feasibility analysis: Analysis of technical facilities; Cost-benefit analysis; Design of an information system; Design Patterns; Hardware and software analysis.

Introduction to IT project management: Estimation of confidence level: Simplex method for minimization of project time; project team organization, IT Adoption and Diffusion theories;

Ethics and privacy: Control and security

Reference Book(s):

1. Software Engineering BY Ian Sommerville
2. Software Engineering- a practitioner's Approach BY Roger S.Pressman
3. Software Engineering: Principles and Practice BY Hans vanVliet
4. System Analysis and Design (2nd Edition) - Elias M. Awad; Galgotia Publications Pvt. Ltd. (2010)
5. System Analysis and Design (2nd Edition) - Raja Raman; Prentice Hall (2004)
6. System Analysis and Design Methods (7th Edition) - Jeffery L. Whitten; McGraw Hill (2007)
7. System Analysis and Design (9th Edition) – Kende l& Kendel; Pearson (2013)

BNQF Code:0613 **Course Code: CSE-3102**	**Contact Hours/Week: 2.00**
Course Title: Software Engineering and Information System Design Laboratory	**Credit Hour: 1.00**
Rationale:	
Understand and apply software development process. Analyse the user requirements and design the system models**.**	
Course Contents:	
Introduction: Analysis of Information requirements for modern organizations; Information gathering techniques; Editing; Handling of missing information; Requirement's specifications; Steps of systems analysis. **Concepts of feasibility analysis:** Analysis of technical facilities; Cost-benefit analysis; Design of an information system; Design Patterns; Hardware and software analysis**.** **Introduction to IT project management:** Estimation of confidence level: Simplex method for minimization of project time; project team organization, IT Adoption and Diffusion theories**.** **Ethics and privacy:** Control and security**.**	

Reference Book(s):

1. Software Engineering BY Ian Sommerville
2. Software Engineering- a practitioner's Approach BY Roger S.Pressman
3. Software Engineering: Principles and Practice BY Hans vanVliet
4. System Analysis and Design (2nd Edition) - Elias M. Awad; Galgotia Publications Pvt. Ltd. (2010)
5. System Analysis and Design (2nd Edition) - Raja Raman; Prentice Hall (2004)
6. System Analysis and Design Methods (7th Edition) - Jeffery L. Whitten; McGraw Hill (2007)
7. System Analysis and Design (9th Edition) – Kende l& Kendel; Pearson (2013)

BNQF Code:0612 **Course Code: CSE-3103**	**Contact Hours/Week: 3.00**
Course Title: Computer Network	**Credit Hour: 3.00**
Rationale:	
Computer Networks course provides an introduction to computer networks, with a special focus on the Internet architecture and protocols. Topics include layered network architectures, addressing, naming, forwarding, routing, communication	

reliability, the client-server model, web and email protocols. Besides the theoretical foundations of real Internet protocols.

Course Contents:

Fundamentals & Link Layer:

Building a network – Requirements - Layering and protocols - Internet Architecture – Network software – Performance; Link layer Services - Framing - Error Detection - Flow control.

Media Access & Internetworking:

Media access control - Ethernet (802.3) - Wireless LANs – 802.11 – Bluetooth - Switching and bridging – Basic Internetworking (IP, CIDR, ARP, DHCP, ICMP)

Routing:

Routing (RIP, OSPF, metrics) – Switch basics – Global Internet (Areas, BGP, IPv6), Multicast – addresses – multicast routing (DVMRP, PIM).

Transport Layer:

Overview of Transport layer - UDP - Reliable byte stream (TCP) - Connection management - Flow control - Retransmission – TCP Congestion control - Congestion avoidance (DEC bit, RED) – QoS – Application requirements.

Application Layer:

Traditional applications -Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – Web Services – DNS – SNMP.

Reference Book(s):

1. Computer Networks - Andrew S.Tanenbaum
2. Computer Networks: Protocols, Standards, and Interfaces - Uyless Black
3. Internetworking with TCP/IP: Principles, Protocols, Architecture - D. E.Comer
4. Complete Networking: A Top Down Approach Featuring the Internet – James F. Kurose, Keith W.Ross
5. Behrouz A. Forouzan, Data Communications and Networking, McGraw Hill, 4th Edition.

BNQF Code:0612 **Course Code: CSE-3104**	**Contact Hours/Week: 3.00**
Course Title: Computer Network Laboratory	**Credit Hour: 1.50**

Rationale:

This course is designed to impart knowledge about detailed knowledge of Computer Networks, various protocols used in Communication, Managing and configuring Cisco Switches and Routers, and various WAN technologies.

Course Contents:

Introduction to Computer Network, Network Hardware's and Software's, Network Cabling, Understanding use of IP Addressing, Variable Length Subnet Mask (VLSM), Practicing LAN topologies, Basic Configuration of Cisco Packet Tracer, Network Interface Connection/ Router & Switch Configuration, Basic Network Configuration using RIP, EIGRP, BGP,OSPF protocols. Configure Domain Name System (DNS), Dynamic Host Configuration Protocol (DHCP), World Wide Web (WWW), Simple Mail Transfer Protocols (SMTP), File Transfer Protocols (FTP), Physical, Access Control List (ACL), VLAN, Inter VLAN, VTP and Introduction to NS2. Socket Programming and network system administration commands.

Reference Book(s):

1. Computer Networks - Andrew S.Tanenbaum
2. Computer Networks: Protocols, Standards, and Interfaces - Uyless Black 3. Internetworking with TCP/IP: Principles, Protocols, Architecture - D. E.Comer
4. TCP/IP Illustrated Vol. I - W. R.Stevens
5. Complete Networking : A Top Down Approach Featuring the Internet – James F. Kurose, Keith W. Ross

BNQF Code:0613 **Course Code: CSE-3105**	**Contact Hours/Week:** 3.00
Course Title: Operating Systems	**Credit Hour: 3.00**

Rationale:

The Operating System (OS) course is designed to provide a comprehensive understanding to the modern Operating Systems. The course begins with the history of operating system and the review of computer hardware and concentrates on operating system concepts, system structure, process and threads, memory management, file system and related security aspects. It also deals with multiprocessor systems, virtualizations and cloud service.

Course Contents:

Introduction to Operating System: Operating System Concepts, Its Role in Computer Systems, Computer System Structure, Fundamental of Different Types of Computer System, Operating System Structure and Operation, Kernel, System Call, Protection and Security.

Process Management: Process concept, Model and Implementation, Process Scheduling, Process State, Co- operating Processes.

Threads: Basics Concept, Multithreading Models, Threading Issues.

CPU Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithm (SJF, FIFO, round robin, etc.), Algorithm Evaluation.

Concurrency and Synchronization: Inter-Process Communication and Inter-Thread Communication, Critical Region, Critical Section Problems and Solutions.

Memory Management: Memory Portioning, With and Without Swapping, Virtual Memory – Paging and Segmentation, Demand Paging, Page Replacement Algorithms, Implementation

File Systems: Files, Directories, Security, Protection.

Deadlocks: Modeling, Detection and Recovery, Prevention and Avoidance.

Secondary-Storage: Structure, Disk Scheduling, RAID Structure, I/O Hardware, Polling. Interrupts, Direct Memory Access, Application I/O Interface,

Others: Case Study of Some Operating Systems, Introduction to the Different Smart Device Operating System and Their Usage.

Reference Book(s):

1. Modern Operating Systems (4th ed) - Andrew S. Tanenbaum; Prentice Hall(2014)
2. Operating Systems Concepts, Wiley Publisher- Abraham Silberschatz and Peter Baer Galvin
3. Operating systems, McGraw-Hill- Madnick and J. Donovon Unix System Programming in C++, Prentice Hall Publication- Terrence

BNQF Code:0613 Course Code: CSE-3106	Contact Hours/Week: 3.00
Course Title: Operating Systems Laboratory	Credit Hour: 3.00

Rationale:

Operating systems are central to any computing device. This course is designed to introduce the internal operations and structures of modern operating systems. This course will cover topics which will help students to understand the components of operating systems. At the end of the course students will be able to explain how a modern operating system interacts with the computer hardware and apply the concepts to design solutions for different practical problems.

Course Contents:

Introduction: Development of Linux Operating System, Installation of Linux in various modes, Installation of windows application programs on Linux, Basic Linux Command

Linux Kernels and Office Environments: Compilation

Shell Programming: variables, statements, loop, array, functions etc;

Memory management: preemptive and non- preemptive algorithms and implementation

Inter process communication and Process scheduling: algorithms and implementation

Mutual exclusion and deadlock: algorithms and implementation

Security of Windows and UNIX like OS: hardening and security issues.

Reference Book(s):

1. Modern Operating Systems (4th ed) - Andrew S. Tanenbaum; Prentice Hall(2014)

2. "UNIX Shell Programming" – Kanetkar

BNQF Code:0613 Course Code: CSE-3108	Contact Hours/Week: 2.00
Course Title: Web Programming Laboratory	Credit Hour: 1.00

Rationale:

A web-based application is any program that is accessible via a network connection rather than being stored in the memory of a device. Web-based apps are frequently run within a web browser. However, web-based programs can also be client-based, in which a tiny portion of the software is downloaded to a user's desktop but processing is done on an external server through the internet.

Course Contents:

Intro to Web development: Information about architectural design of web systems, Show Sample Projects;

Frontend: Front end development of Web based Systems using HTML & CSS, Frontend development with frameworks and project version control with git, Intro to Bootstrap

Frontend-backend platform: Intro to Codeigniter, Laravel, Django

Introduction to java script: Dynamic web front end programming, concurrent and

asynchronous JS programming, debugging a web system with JavaScript;
Database Connection: Intro to SQL, NoSQL Databases, User access control using Firebase, Project integration, Intro to collection, Data store, Retrieval and hosting using Firebase and JavaScript
Web servers: Case of Apache, other web servers
Web Services: SOAP, WSDL (Web Service Description Language), XML-RPC protocol; configuration, maintenance, monitoring and security

Reference Book(s):

1. HTML 5 Black Book: Kogent Learning solutions.
2. "Learning PHP 5", David Sklar, O'Reilly Publication.
3. Rich Internet Application AJAX and Beyond WROX press.
4. Responsive Web Design with HTML5 and CSS3, Ben Frain, PACKT Publication.
5. "Web Technologies: Black Book", Dreamtech publication.
6. HTML5 Cookbook, By Christopher Schmitt, Kyle Simpson, O'Reilly Media.
7. Core Python Applications Programming by Wesley J Chun Third edition Pearson Publication.

BNQF Code:0541 **Course Code: MATH-3141**	**Contact Hours/Week: 3.00**
Course Title: Numerical Analysis	**Credit Hour:3.00**

Rationale:

Numerical analysis can solve problems where analytical solutions are not available (using mathematical approach) or very hard mathematical process. Numerical methods are capable of handling large systems of equations, different degrees of nonlinearities which are common in engineering practice. Numerical methods can handle any complicated physical geometries which are often impossible to solve analytically.

Course Contents:

Modeling, Computers and Error Analysis: Scope of Numerical Analysis in Mathematical Modeling and Engineering Problem Solving, Programming and Software. Error definitions, Approximations and Round-off errors, Truncation errors, Accuracy and Precision and the Taylor Series.
Roots of Equations: Bisection method, False-Position method, Iteration method, Newton-Raphson method, Ramanujan's method and Secant method.
Interpolation: Interpolation with one and two Independent Variables, Formation of Different Difference Table, Newton's Forward and Backward Difference, Gauss Forward and Backward Difference, Langrange's Interpolation.
Curve Fitting: Linear Regression, Polynomial Regression, Multiple Linear Regression, Linearization of Nonlinear Laws.
Numerical Differentiation and Integration: Numerical Differentiation. The General Integration Formula, Trapezoidal rule, Simpson's 1/3 Rule, Simpson's 3/8 Rule.
Systems of Linear Algebraic Equations: Solving small numbers of equations, LU Decomposition and Matrix inversion, Eigen Value and Eigen Vector, Gauss elimination and Gauss Jordan method, Gauss–Seidel and Jacobi's method
Numerical Solution of Differential Equations: Solution by Taylor's Series, Euler's Method, Modified, Euler's Method, Runge-Kutta Methods, Finite Difference Approximations, Solution of Partial Differential Equation.

Reference Book(s):

1. S.S. Sastry,"Introductory Methods of Numerical Analysis", 5th Edition.
2. Steven. C Chapra," Numerical Methods for Engineers, McGraw-Hill

BNQF Code:0311,0314 **Course Code: GED-3151**	**Contact Hours/Week: 3.00**
Course Title: Engineering Economics and Sociology	**Credit Hour: 3.00**

Rationale:

Economics and sociology course has been designed to understand the human inter-personal relationship and human psychology in the society and to apply this knowledge in the practical field as an engineer through the study of varied societies and cultures. Economics course is designed for the students to develop their competence in economic analysis and its role in problem solving. This course will help to understand societal and cultural issues in national, global and environmental context.

Course Contents:

Engineering Economics:

Microeconomics: Fundamentals of microeconomics, Basic elements of demand and supply, Utility analysis, Choice and indifference curve, Market, Factors of production, Analysis of cost, Factors of pricing.

Macroeconomics: Basic concept of macroeconomics, National income analysis, Saving, Consumptions, Inflation, Central and commercial banking, Fiscal and Monetary policy, Budget, Economic planning, Development theories.

Sociology: Understanding Society

Nature, scope and basic perspectives of sociology, Sociological imagination, Social research method, Types of society, Culture and Civilization, Socialization, Social stratification and problems, French and Industrial Revolution.

Social change and Theoretical perspectives:

Social and technological changes, Globalization, Family, Marriage, Migration, Capitalism, Socialism, Climate change and global risk, Urbanization, Unemployment, Marx, Weber, Durkheim, Beck theoretical perspectives

Reference Book(s):

1. Economic (19thed) – Samuelson(2009)
2. Economic (9thed) – John Sloman(2012)
3. Economic Development (12thed) – Michael Todaro(2015)
4. Money and Banking (2nded) – Dudly g luckett(1976)
5. "Sociology" – ., 2002) Richard T. Schaefer and Robert P. Lamm, MacGraw-Hill
6. "Social Problems" - LeRoy W. Barnes, The Dushkin Publishing Group, Guilford, CT, 2000
7. "Sociology – Primary Principles" - CN Shankar Rao

3rd Year 2nd Semester

BNQF Code:0613 Course Code: CSE-3200	Contact Hours/Week: 3.00
Course Title: Software Development Project – I*	**Credit Hour:1.50**
Rationale:	
The Individual Software Development Project – I course is designed to make its learners able to solve advanced level industry problems and develop real time projects professionally.	
Course Contents:	
Requirement Analysis and Design segment of Software Development Life Cycle, Analyzing Software Design Specification, Developing Software Design Specification, UML Diagrams, Designing UI of the application for SDS, Understanding software Development pipeline, role of a Project Manager over all life cycle of a project	

Reference Book(s):

1. Design Patterns: Elements Of Reusable Object Oriented Software, Erich Gamma, et al., new edition 2015
2. Clean Architecture: A Craftsman's Guide to Software Structure and Design, Robert C. Martin, Prentice Hall, 2017
3. Clean Code: A Handbook of Agile Software Craftsmanship, Robert C. Martin, Prentice Hall, 2008

BNQF Code:0611 Course Code: CSE-3211	Contact Hours/Week: 3.00
Course Title: Microprocessors, Micro-controllers and Assembly Language	**Credit Hour:3.00**
Rationale:	
This course is designed to teach students the concepts, principles and functioning of basic microprocessors, microcontrollers and assembly language. This course aims to provide a fundamental foundation of assembly language, microprocessor architecture, and discusses different interfaces and design of systems based on microprocessors and microcontrollers.	
Course Contents: **Microprocessors and Micro-controllers:** Introduction to Microprocessor and Microcontrollers, Architectural overview of Microprocessor and its operation, Common instruction types, Addressing modes. **Intel 8086 Microprocessor:** Internal architecture, register structure, programming model, addressing modes, instruction set; I/O pin diagram and control signals; I/O port organization and accessing; Cache Memory, TLB Structure; **Memory management in Intel 80X86 family:** Segmentation and Real Mode Memory Management.; Intel 80186, 80386 and 80486 segments register formats; Interrupts and Exception in Intel 80X86 families of processors, type of interrupts, interrupts in real mode and protected mode, interrupts priorities; **Input and Output:** I/O address spaces, Port organization, Memory mapped I/O,	

Hand-shaking I/O instruction, Keyboard-Display interface Timer handler,
Microcontrollers: Architecture of 8051, memory organization, special function registers, I/O ports.
Assembly Language: Basic Concepts; System/Processor Architecture; Assembly Language Fundamentals; Memory Segments, Registers, Addressing-modes; Assembly instruction types and their formats: Arithmetic, Logical, Transfer control and Conditional processing, String processing, Arrays, Procedures, Stacks, branches, Subroutine and parameter passing, Input/output and Interrupts

Reference Book(s):

1. Assembly Language Programming and Organization of the IBM PC--Ytha Yu, Charles Marut
2. The Intel Microprocessors - Barry B.Brey
3. Microprocessors and Interfacing - Douglas V. Hall
4. Microprocessorsand Microcomputer-based system design -Mohamed Rafiquzzaman.
5. 8051 Microcontroller-Internals, Instructions, Programming& Interfacing by SubrataGhoshal.
6. Making Embedded Systems: Design Patterns for Great Software by Elecia White.

BNQF Code:0611 **Course Code: CSE-3212**	**Contact Hours/Week: 1.50**
Course Title: Microprocessors, Micro-controllers and Assembly Language Laboratory	**Credit Hour:0.75**

Rationale:

This course introduces basics of assembly language programming, microprocessor architecture, and discusses different interfaces and design of systems based on microprocessors and microcontrollers.

Course Contents:

Basics of Assembly Language:
Compilation, input, output, variables, basic instructions, memory model, data segment, stack segment, code segment, Input Output Instruction;
Flow Control Instruction: Conditional and unconditional jump instructions, If-then-else, case, for loop, while loop, repeat loop;
Logic, Shift and Rotate Instructions: AND, OR, XOR, complement, shift left, shift right, rotate left, rotate right, rotate carry left, rotate carry right, Binary, Hexa Input Output;
Stack and Procedure: Push, Pushf, Pop, Popf;
Multiplication and Division: Mul, IMul, Div, IDiv;
Array and Addressing modes: 1D Array, DUP operator, Addressing-mode, register indirect mode,
String Instructions: Moving string, load string, scan string, compare string;
Basic Idea of MDA 8086: LED, Seven Segment display, LCD, Keyboard, Motor, Dot matrix Interface with 8086; Basic idea of ATMEGA 16 microcontroller and simulation.

Reference Book(s):

1. The Intel Microprocessors - Barry B. Brey
2. Microprocessors and Interfacing - Douglas V. Hall
3. Making Embedded Systems: Design Patterns for Great Software by Elecia White

BNQF Code:0613 **Course Code: CSE-3213**	**Contact Hours/Week: 3.00**
Course Title: Artificial Intelligence	**Credit Hour:3.00**

Rationale:

Artificial Intelligence course provides an introduction to the general appreciation of the goals, subareas, achievements and difficulties of artificial intelligence, with a special focus on basic search algorithms for problem solving, logic-based reasoning methods, knowledge representation techniques, game playing theories as well as various forms of learning including perceptron, decision tree, artificial neural net and genetic algorithm.

Course Contents:

Introduction to Artificial Intelligence and Intelligent Agent: Introduction, history of AI, goals, philosophy, subareas, achievements and difficulties of AI, programming without and with AI, applications, intelligence, types of intelligence, difference between human and machine intelligence, intelligent agents, characteristics, structure of agents and its functions, turing test, agent's interaction with environments, rationality.

Reasoning Under Uncertainty: Logics of non-monotonic reasoning, implementation, basic probability notation, bayes rule, certainty factors and rule-based systems, bayesian networks, dempster, shafer theory, fuzzy logic, fuzzy set operations.

Knowledge Representation: Approaches and issues in knowledge representation, knowledge, propositional logic, predicate logic, unification, resolution principle, inference rules, pursing with grammar, purse tree, associative network, conceptual graphs, frame structure, transition network, introduction to natural language processing.

Planning and Learning: Understand various searching techniques, conditional planning, continuous planning, multi-agent planning, forms of learning, supervised learning, unsupervised learning, inductive learning, reinforcement learning, game playing theories, perceptron learning, learning decision trees, belief networks, neural net learning, robotics.

Reference Book(s):

1. Artificial Intelligence: A Modern Approach (3rd Edition) – Stuart Jonathan Russell, Peter Norvig; Prentice Hall (2010)
2. Artificial Intelligence: A New synthesis – Nils J. Nilsson; Routledge
3. Introduction to Turbo Prolog – Carl Townsend

BNQF Code:0613 **Course Code: CSE-3214**	**Contact Hours/Week: 1.50**
Course Title: Artificial Intelligence Laboratory	**Credit Hour:0.75**

Rationale:

This course is designed to impart knowledge about detailed knowledge of Artificial Intelligence, various searching techniques, AI programming, intelligent agents and constraint satisfaction problem.

Course Contents:
Introduction to AI practical areas, agent program, Informed searching: BFS, DFS; Uninformed Searching: A* Search, Adversarial Searching: minimax, alpha-beta pruning; Constraint Satisfaction Problem: N-Queens.

Reference Book(s):

1. Artificial Intelligence: A Modern Approach (3rd Edition) – Stuart Jonathan Russell, Peter Norvig; Prentice Hall (2010)
2. Artificial Intelligence: A New synthesis – Nils J. Nilsson; Routledge
3. Introduction to Turbo Prolog – Carl Townsend

BNQF Code:0611 **Course Code: CSE-3215**	**Contact Hours/Week: 3.00**
Course Title: Automata Theory and Compiler Design	**Credit Hour: 3.00**

Rationale:

Real-world computers perform computations that by nature run like mathematical models to solve problems in systematic ways. The essence of the theory of computation is to help develop mathematical and logical models that run efficiently and to the point of halting. Since all machines that implement logic apply TOC, studying TOC gives learners an insight into computer hardware and software limitations. Compiler design introduces the theory and tools that can be employed in order to perform syntax- directed translation of a high-level programming language into an executable code. This course introduces regular languages and context free languages which are crucial to understand how compilers and programming languages are built.

Course Contents:

Formal Language and Regular Expressions: Languages, Definition Languages regular expressions, Finite Automata – DFA, NFA. Conversion of regular expression to NFA, NFA to DFA. Applications of Finite Automata to lexical analysis, Pushdown Automata, Closure and its property

Context Free grammars and parsing: Context free grammars, derivation, parse trees, ambiguity LL(K) grammars and LL (1) parsing, Bottom-up parsing handle pruning LR Grammar Parsing, LALR parsing, parsing ambiguous grammars, Turing Machine, Pumping Limma, Linear Bounded Automata

Semantics: Syntax directed translation, S-attributed and L-attributed grammars, Intermediate code – abstract syntax tree, translation of simple statements and control flow statements, Context Sensitive features – Chomsky hierarchy of languages and recognizers. Type checking, type conversions, equivalence of type expressions, overloading of functions and operations

Run time storage: Storage organization, storage allocation strategies scope access to now local names, parameters, language facilities for dynamics storage allocation

Code optimization: Principal sources of optimization, optimization of basic blocks, peephole optimization, flow graphs, Data flow analysis of flow graphs

Code generation: Machine dependent code generation, object code forms, generic code generation algorithm, Register allocation and assignment. Using DAG representation of Block, Moore and Mealy Machine.

Reference Book(s):

1. Compilers: Principles, Techniques & Tools (2nd ed)- Alfred V Aho, Monica S Lam, Ravi Sethi, and Jeffrey D Ullman, Pearson/Addison Wesley(2006).
2. Engineering A Compiler (2nd Ed) - Linda Torczon and Keith Cooper, Morgan Kaufmann Publishers Inc (2011).
3. Introduction to Automata Theory, Languages, and Computation 3rd Edition- John Hopcroft
4. An Introduction to Formal Languages and Automata 4th Edition- Peter Linz

BNQF Code:0611 **Course Code: CSE-3216**	**Contact Hours/Week: 1.50**
Course Title: Automata Theory and Compiler Design Laboratory	**Credit Hour: 0.75**

Rationale:

Automata theory and compiler design introduces the theory and tools that can be employed in order to perform syntax- directed translation of a high-level programming language into an executable code. This course introduces regular languages and context free languages which are crucial to understand how compilers and programming languages are built. These techniques can also be employed in wider areas of applications whenever we need a syntax-directed analysis of symbolic expressions and languages and their translation into a lower-level description. To implement tokenizer, arithmetic calculator and to able to write the code by using Flex and Bison.

Course Contents:

Laboratory on Compiler Design: Lexical Analysis, Syntax Analysis, Semantic Analysis, Syntax Directed Translation, Type Checking, Run Time System, Intermediate Code Generation and Code Generation, Simple Compiler Design using Flex and Bison/Lex and Yacc.

Reference Book(s):

1. Compilers: Principles, Techniques & Tools (2nd ed)- Alfred V Aho, Monica S Lam, Ravi Sethi, and Jeffrey D Ullman, Pearson/Addison Wesley(2006).
2. Engineering A Compiler (2nd Ed) - Linda Torczon and Keith Cooper, Morgan Kaufmann Publishers Inc (2011).
3. Introduction to Automata Theory, Languages, and Computation 3rd Edition-John Hopcroft
4. An Introduction to Formal Languages and Automata 4th Edition- Peter Linz

BNQF Code:0411,0412,0413 **Course Code: GED-3251**	**Contact Hours/Week: 3.00**
Course Title: Project Management and Finance	**Credit Hour:3.00**

Rationale:

Project Management and Finance course has been designed to understand the overlapping connection between engineering and management with financial matters through the study of Smart Technologies, Project Management and financial matters in an organization which will equip with the skills to understand the application of computing technology in real-world situations

Course Contents:

Engineering Management: Principles of management; **Introduction to Project Management**: Project Integration Management, Project Scope Management, Project Time Management, Project Cost Management, Project Quality Management, Project Human Resource Management, Project Risk Management; **MIS**: Introduction, Decision Support Systems, MIS in decision making, Concept of Invention, Innovation, and Entrepreneurship; **Cost Management**: elements of cost of products, allocation of overhead costs, marginal costing, standard costing, cost planning and control, budget and budgetary control; **Development and planning process**: annual development plan, National budget; **Accounting in Action:** Meaning & Definition Of Accounting, Users And Uses Of Accounting, Why Ethics Is A Fundamental Accounting Concept, Accounting Standards And The Measurement Principles-Monetary Unit Assumption And The Economic Entity Assumption, Accounting Equation, The Effects Of Business Transactions On The Accounting Equation, The Five Financial Statements And How They Are Prepared, Ethics In Accounting, Engineering Accounting; **Financial management**: objectives, strategy, financing, performance analysis of the enterprise, investment appraisal, criteria of investment; **Marketing Management:** Concepts, strategy, sales promotion, patent laws; **Technology Management**: Management of innovation and changes, technology life cycle, Case studies;

Reference Book(s):

1. Effective Project Management: Traditional, Agile, Extreme Paperback – Illustrated, 4 February 2014 by Robert K. Wysocki (Author)
2. The Art of Project Management Paperback – Import, 6 May 2005 by Scott Berkun (Author)
3. Project Management Absolute Beginner's Guide Paperback – Illustrated, 6 February 2017 by Greg Horine (Author)

BNQF Code:031 **Course Code: CSE-3224**	**Contact Hours/Week: 2.00**
Course Title: Industrial Training**	**Credit Hour:1.00**
Rationale:	
****Note:** CSE-3224 (Industrial Training) will be conducted at any convenient time after the 3rd Year, 2nd Semester final examination for the duration of 04 weeks as applicable or decided by the department. Evaluation report from industry is to be submitted at the end of the training and accordingly to be incorporated in the tabulation sheet.	

Elective Courses

(Department will offer some courses in 6th semester in which student can select one theory courses as **Elective-I** and theory with laboratory course as **Elective-II**)

BNQF Code:0613 **Course Code: CSE-3217**	**Contact Hours/Week: 3.00**
Course Title: Fault Tolerant System	**Credit Hour: 3.00**

Rationale:
This course motivates to implement a feature on a system that enables a system to continue with its operations even when there is a failure on one part of the system and helps in fault isolation through various failure detection mechanisms.
Course Contents: **Introduction**: Introduction of Fault Tolerant Systems and architectures; Goal and Application of Fault Tolerant computing, Fundamental Definitions, Design techniques to achieve fault Tolerance; Reliability Modelling Using Probability Theory;
Detection: Fault detection and location in combinational and sequential circuits; **Test:** Fault test generation for combinational and sequential circuits; **Fault modelling**: Faults in memory, memory test pattern and reliability; **Performance monitoring:** self-checking circuits, burst error correction and triple modular redundancy, **Defect:** defect avoidance, defect circumvention, shield and hardening, yields enhancement, degradation Allowance;

Reference Book(s):

1. Design and Analysis of Fault Tolerant Digital System (1st Edition) - Barry W. Johnson; Addison Wesley(1989)
2. Dependable Computing: A Multilevel Approach – Behrooz Parhami
3. Fault-Tolerant Systems (1st Edition) - Israel Koren, C. Mani Krishna; Morgan Kauffman (2010)

BNQF Code:0611 **Course Code: CSE-3219**	**Contact Hours/Week: 3.00**
Course Title: E-commerce and Web Security	**Credit Hour: 3.00**
Rationale:	
This course introduces students to the basic concepts of E-commerce Business Models and Concepts, The Internet and World Wide Web: E-commerce Infrastructure, Ethical, Social, and Political Issues in E-commerce, E-commerce Marketing concept, Online Security and Payment Systems and the major e-commerce payment mechanisms.	
Course Contents:	
E-commerce Business Models and Concepts: Identify the key components of e-commerce business models, B2C business models, major B2B business models, Recognize business models in other emerging areas of ecommerce, key business concepts and strategies applicable to e-commerce. **The Internet and World Wide Web:** E-commerce Infrastructure: The origins of the Internet, Key technology concepts behind the Internet, Role of Internet protocols and utility programs, Current structure of the Internet, How the World Wide Web works, How Internet and Web features and services support e-commerce. **E-commerce Marketing concept:** Identify the key features of the Internet audience, Basic concepts of consumer behaviour and purchasing decisions, understanding how consumers behave online, Basic marketing concepts needed to understand Internet marketing, Main technologies that support online marketing.	

Ethical, Social, and Political Issues in E-commerce: Main ethical, social, and political issues raised by e commerce, process for analyzing ethical dilemmas, Basic concepts related to privacy, Practices of e-commerce companies that threaten privacy, Different methods used to protect online privacy, Major public safety and welfare issues raised by e-commerce.

Online Security and Payment Systems: Scope of e-commerce crime and security problems, Key dimensions of e-commerce security, Key security threats in the e-commerce environment, how technology helps protect the security of messages sent over the Internet, Tools used to establish secure Internet communications channels, and protect networks, servers, and clients, Features of traditional payment systems, The major e-commerce payment mechanisms.

Reference Book(s):

1. Web Security for E-Commerce- Robert Boncella
2. E-commerce: An Introduction- Amir Manzoor

BNQF Code:0611 **Course Code: CSE-3221**	**Contact Hours/Week: 3.00**
Course Title: Human Computer Interaction	**Credit Hour: 3.00**

Rationale:

The Human Computer Interaction course covers the foundations of Human Computer Interaction (HCI), a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them.

Course Contents:

Introduction to HCI and Interaction design: HCI, Interaction design, The process of design, User focus, Scenarios, Navigation design, Screen design and layout, Iteration and prototyping. **HCI in the software process:** The software life cycle, Usability engineering, Iterative design and prototyping, Design rationale. **Design rules:** Principles to support usability, Standards, Guidelines, Golden rules and heuristics, HCI patterns. **Evaluation techniques:** What is evaluation? What, why, and when to evaluate, Goals of evaluation, Evaluation through expert analysis, Evaluation through user participation, Choosing an evaluation method. Evaluation paradigms and techniques, The D E C I D E framework to guide evaluation. **Observing users**: Participant observation, ethnography, Data collection, and Analyzing, interpreting and presenting data, Qualitative analysis, Feeding the findings back into design. **Asking users and experts**: Interviews, Questionnaires, Inspections, walkthroughs. **Universal design:** Universal design principles, multi-modal interaction, designing for diversity. **Task analysis:** Differences between task analysis and other techniques, Task decomposition, Knowledge-based techniques, Entity-relationship-based techniques, Sources of information and data collection, Uses of task analysis. **Modeling rich interaction:** Status-event analysis, Rich contexts, Low intention and sensor-based interaction. **Ubiquitous computing and augmented realities:** Ubiquitous computing applications research, virtual and augmented reality, Information and data visualization. **Hypertext, multimedia and the world wide web:** Understanding Hypertext, Finding things, Web technology and issues, Static web content, Dynamic web content

Reference Book(s):

1. Human-Computer Interaction (3rd Edition) – Alan Dix, Janet Finlay, Gregory D. Abowd and Russell Beale; Prentice Hall(2003)
2. Interaction Design: Beyond Human Computer Interaction (5th Edition) – Yvonne Rogers, Helen Sharp, Jenny Preece; John Wiley & Sons(2019)
3. Designing the User Interface (5th Edition) - Schneiderman, B. and Plaisant, C.; Addison-Wesley (1998)

BNQF Code:0611 **Course Code: CSE-3223**	**Contact Hours/Week: 3.00**
Course Title: Advanced Algorithms	**Credit Hour: 3.00**
Rationale:	
This course motivates to implement advanced methods of algorithmic design, analysis, and implementation. techniques that include amortization, randomization, word-level parallelism, bit scaling, dynamic programming, network flow, linear programming, fixed-parameter algorithms, approximation algorithms etc. to identify which algorithm will provide efficient result for a specific problem or context.	
Course Contents:	
Randomized Algorithms: Las Vegas and Monte Carlo Algorithms; **Randomized Data Structures:** Skip Lists; Amortized Analysis: Different methods, Applications in Fibonacci Heaps; **Lower Bounds:** Decision Trees, Information Theoretic Lower Bounds, Adversary Arguments; **Approximation Algorithms:** Approximation Schemes, Hardness of Approximation; **Fixed Parameter Tractability:** Parameterized Complexity, Techniques of designing Fixed Parameter Algorithms, Examples; **Online Algorithms:** Competitive Analysis, Online Paging Problem, k-server Problem; External Memory Algorithms; **Advanced Data Structures:** Linear and Non-linear Methods.	

Reference Book(s):

1. An Introduction to Computational Learning Theory - Michael J. Kearns , Umesh Vazirani; The MIT Press(1994)
2. Algorithm Design (1st Edition) - Jon Kleinberg , ÉvaTardos; Pearson(2012)
3. Randomized Algorithms (1st Edition) - Rajeev Motwani , Prabhakar Raghavan; Cambridge University Press(1995)
4. Probability and Computing: Randomized Algorithms and Probabilistic Analysis - Michael Mitzenmacher, Eli Upfal; Cambridge University Press(2005)

BNQF Code:0613 **Course Code: CSE-3225**	**Contact Hours/Week: 3.00**
Course Title: Digital Image Processing	**Credit Hour: 3.00**
Rationale:	
Digital Image Processing course is designed to introduce the fundamentals of image processing and manipulation of television, medical imaging modalities such as X-Ray, Ultrasound (US), MRI, photography, security, astronomy and remote sensing.	
Course Contents:	

Introduction and Fundamental to Digital Image Processing:
What is Digital Image Processing, Origin of Digital Image Processing, Examples that use Digital Image Processing, Fundamental steps in Digital Image Processing, Components of Digital Image Processing System, Image sensing and acquisition, Image sampling, quantization and representation, Basic relationship between pixels.
Image Enhancement in the Spatial Domain & Frequency Domain:
Background, Basic gray level transformation, Histogram processing, Basics of spatial filtering, Smoothing and Sharpening spatial filters, Introduction to Fourier Transform and the frequency domain, Discrete Fourier Transform. Smoothing and Sharpening frequency-domain filters
Image Restoration: Image Degradation/Restoration process, Noise models, Restoration in presence of noise, Inverse filtering, Minimum mean square filtering, Geometric mean filter, Geometric transformations.
Color Image Processing: Color Fundamentals, Color models, Basis of full color image processing, Color transformations.
Image Compression: Fundamentals, Image compression models, Error free compression, Lossy compression.
Morphological Image Processing: Preliminaries, Dilations, and erosion, opening and closing, Some basic morphological algorithms
Image Segmentation: Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region oriented segmentation.
Representation, Description and Recognition: Representation-chain codes, polygonal approximation and skeletons, Boundary descriptors-simple descriptors, shape numbers, Regional descriptors- simple, topological descriptors, Pattern and Pattern classes Recognition based on matching techniques.

Reference Book(s):

1. Digital Image Processing (3rd/2nd Edition) - R. C. Gonzalez and R.E. Woods; Pearson Prentice Hall(2009)
2. Fundamentals of Digital Image Processing, Academic Press-A. K. Jain
3. Digital Image Processing, Wiley-Interscience-William K. Pratt

BNQF Code:0613 **Course Code: CSE-3226**	**Contact Hours/Week: 1.50**
Course Title: Digital Image Processing Laboratory	**Credit Hour: 0.75**

Rationale:

This course is designed to cover the basic theory and principles of digital image processing techniques and basic video processing. The course will give emphasis in image processing techniques like basic point processing, image filtering in spatial/frequency domain and the applications in image enhancement or other related applications. The overall knowledge will be used in some high-level image processing approach like segmentation, compression, clustering, and others.

Course Contents:

Digital Image Fundamentals, Bilevel Image Processing, Binarization of Grey Level Images, Edge Detection, Image Enhancement, Image Segmentation, Image Compression and fundamental of Video processing.

Reference Book(s):

1. Digital Image Processing (3rd/2nd Edition) - R. C. Gonzalez and R.E. Woods;
2. Digital Image Processing using Matlab,- Rafel C. Gonzalez & Richard E. Woods, Prentice-Hall
3. William K. Pratt Digital Image Processing, Wiley-Interscience

BNQF Code:0613 **Course Code: CSE-3227**	**Contact Hours/Week: 3.00**
Course Title: Simulation and Modeling	**Credit Hour: 3.00**
Rationale:	
This course motivates to enable a substitute of physical experimentation that is often utilized when conducting experiments on a real system which is impossible or impractical, often because of cost or time and instead uses mathematical knowledge and computer's computation power to solve real-world problems reasonably and in a time efficient manner.	
Course Contents:	
Simulation modelling basics: systems, models and simulation; Classification of simulation model; Steps in a simulation study; **Concepts in discrete-event simulation:** event scheduling vs. process interaction approaches, Time-advance mechanism, organization of a discrete-event simulation model; Continuous simulation models; Combined discrete-continuous models; Monte Carlo simulation; Simulation of queuing systems. **Building valid and credible simulation models**: validation principles and techniques, statistical procedures for comparing real-world observations and simulated outputs, input modeling; Generating random numbers and random variants; Output analysis. Simulation languages; **Analysis and modeling of some practical systems:** Random Number Generator, Random Variables, Probability Distribution.	

Reference Book(s):

1. Simulation Modeling and Analysis (5th Edition) - Law A. M., Kelton W. D.; McGraw Hill (2014)
2. Computer Aided Modeling and simulation - J. A.Spriet
3. Computer Simulation and Modeling - R. S.Lehman
4. System Simulation - G.Cordon

BNQF Code:0613 **Course Code: CSE-3228**	**Contact Hours/Week: 1.50**
Course Title: Simulation and Modeling Laboratory	**Credit Hour: 0.75**
Rationale:	
This course motivates to design various models to solve real-world problems using mathematics, computer programming language, computation power etc. and analyze the behaviour of a system for different types of dataset to provide a reasonable decision regarding the performance of a system in a cost and time effective manner.	

Course Contents:
Simulation modeling basics: systems, models and simulation, Classification of simulation model, Steps in a simulation study, Single Server Queuing System, Inventory Management System, Monte Carlo Method, Pure Pursuit Problem, Probability Distribution Fitting, Random Number Generation, Hypothesis Testing

Reference Book(s):

1. Discrete-Event System Simulation (5th Edition) - Jerry Banks; Prentice Hall (2009)

BNQF Code:0613 **Course Code: CSE-3229**	**Contact Hours/Week: 3.00**
Course Title: VLSI Design	**Credit Hour: 3.00**

Rationale:

This course is designed to enhance students' understanding of the theory and fundamentals of silicon fabrication, the design principles and logical considerations of designing silicon chips, and finally, to develop an understanding of design considerations and the overall process of VLSI systems and their fabrication. This course is also intended to enable students to contribute to VLSI system designing and to have a better understanding of the different characteristics of such circuits.

Course Contents:

VLSI design methodology: Top-down design approach, Technology trends.
MOS Technology: Introduction to MOS technology, Operation of MOS transistor as a switch and amplifier, MOS, NMOS, CMOS inverters, pass transistor and Pass gates, DC and transient characteristics.
Fabrication Process and Layout: NMOS, CMOS, Bi-CMOS process.
Design Rules: Introduction to BiCMOS Circuits, Complex CMOS Gates, CMOS layout design rules and stick diagrams
CMOS Building Blocks: Adder, Comparator, Multiplier, Counter, and Shifter. Design Methodology and Tools.
Geometric and stick diagrams and Hardware modeling: PLA, FPGA, cell-based and full custom design methods, System-on chip design, Hardware modeling, Logic Networks.
Design style: FPGA and PLDs.

Reference Book(s):

1. Modern 1.Modern VLSI Design: System-on-Chip Design (3rd Edition) - Wayne Wolf; Prentice Hall(2002)
2. CMOS VLSI Design- A Circuit and System Perspective (3rd Edition) - Neil H.E. Weste, David Harris and Ayan Banerjee; Pearson(2009)

BNQF Code:0613 **Course Code: CSE-3230**	**Contact Hours/Week: 1.50**
Course Title: VLSI Design Laboratory	**Credit Hour: 0.75**

Rationale:

This course is designed to be offered alongside 3229 so that students may acquire a better understanding of VLSI and CMOS circuit design principles, logical and mathematical considerations, the overall design process, and the silicon fabrication process using various modern tools, ICs, and simulators.

Course Contents:
Introduction to various simulator software for electronic system design (PSpice, DSCH and Microwind), implementing basic electrical circuits with PSpice, design, and implementation of logic gates and inverter circuits (inverter, AND,OR, NAND, NOR), comparing the I/O and electrical characteristics graphs of logic gates with various simulator software, Designing basic electrical circuits (inverters, AND, OR, NAND, NOR) with microwind and comparing the I/O and electrical characteristic graphs with PSpice, DSCH and Microwind.

Reference Book(s):

1. Modern 1.Modern VLSI Design: System-on-Chip Design (3rd Edition) - Wayne Wolf; Prentice Hall (2002)
2. CMOS VLSI Design- A Circuit and System Perspective (3rd Edition) - Neil H.E. Weste, David Harris and Ayan Banerjee; Pearson (2009)

BNQF Code:0613 **Course Code: CSE-3231**	**Contact Hours/Week: 3.00**
Course Title: Natural Language Processing	**Credit Hour: 3.00**

Rationale:
NLP introduces the basics of statistical natural language processing (NLP) including both linguistics concepts such as morphology and syntax and machine learning techniques relevant for NLP. This course provides a comprehensive introduction to the theory and practice of text-based natural language processing (NLP)—the development of computer programs that can understand, generate, translate, extract information from, and learn natural language in textual form from web pages, books, newspapers, etc.
Course Contents:
Introduction to natural language processing: Introduction to natural language processing, Basic Text Processing, Regular Expression and Text Normalization, Minimum, Edit Distance, Word pronunciation and Spelling **N-gram Language Model:**N-Grams, Evaluating Language Models, Smoothing, Kneser-Ney Smoothing, The Web and Stupid Backoff, Perplexity's Relation to Entropy **Naive Bayes and Sentiment Classification:** Naive Bayes Classifiers, Training the Naive Bayes Classifier, Worked example, Optimizing for Sentiment Analysis, Naive Bayes for other text classification tasks, Naive Bayes as a Language Model, Evaluation: Precision, Recall, F-measure, Test sets and Cross-validation **Simple Word Vector representations**: Lexical Semantics, Vector Semantics, Word2vec, GloVe, Tf-IDf; **POS Tagging:** English Word Classes, Robust Semantic and information retrieval, Hidden Markov and Maximum Entropy Model **GRUs and LSTMs**: for machine translation; Recursive neural networks -- for parsing; Recursive neural networks -- for different tasks (e.g. sentiment analysis) **Formal Grammars of English:** Constituency, Context-Free Grammars, Some Grammar Rules for English, Treebanks, Grammar Equivalence and Normal Form, Lexicalized Grammars

Syntactic Parsing: Ambiguity, CKY Parsing: A Dynamic Programming Approach, Partial Parsing **Statistical Parsing:** Probabilistic Context-Free Grammars , Probabilistic CKY Parsing of PCFGs, Ways to Learn PCFG Rule Probabilities Problems with PCFGs, Improving PCFGs by Splitting Non-Terminals Text coherence, Reference resolution, Information status, Spoken dialogue system, Introduction to TTS system, New approaches for story modelling for understanding, Generation and Summarization, Summing Up: NLP Application

Reference Book(s):

1. Natural Language Understanding 2nd Edition by James Allen
2. Handbook of Natural Language Processing (Chapman & Hall/CRC: Machine
3. Learning & Pattern Recognition) 2nd Edition by Nitin Indurkhya, Fred J. Damerau

BNQF Code:0613 **Course Code: CSE-3232**	**Contact Hours/Week: 1.50**
Course Title: Natural Language Processing Laboratory	**Credit Hour: 0.75**
Rationale:	
This course covers a wide range of tasks in Natural Language Processing from basic to advanced: sentiment analysis, summarization, dialogue state tracking. It enables to recognize NLP tasks in day to-day work, propose approaches, and judge what techniques are likely to work well. The final project is devoted to one of the most remarkable topics in today's NLP.	
Course Contents:	
Language Model, Edit distance, Recurrent neural networks - for language modeling and other tasks, Simple Word Vector representations:,Word2vec,FastText, GloVe, Tf-IDf, Ambiguity, CKY Parsing: A Dynamic Programming Approach, Partial Parsing, Convolutional neural networks -- for sentence classification; Speech recognition;	

Reference Book(s):

1. Natural Language Understanding 2nd Edition by James Allen
2. Handbook of Natural Language Processing (Chapman & Hall/CRC: Machine
3. Learning & Pattern Recognition) 2nd Edition by Nitin Indurkhya, Fred J. Damerau

4th Year 1st Semester

BNQF Code:061 Course Code: CSE-4000	**Contact Hours/Week: 6.00**
Course Title: Final Year Design Project (FYDP)/ Thesis***	**Credit Hour: 3.00**
Rationale:	
FYDP/Thesis work provide students an opportunity to apply the knowledge they have learnt to solve real life problems. FYDPs help students become more resourceful along the way and they learn the nuances of research before they graduate. For some, it even acts as a guide in their career paths.	
Course Contents:	
Will be decided by the department, concern supervisors and students. *****Note:** Each student has to complete one Final Year Design Project (FYDP) or Thesis in the combined duration of two semester of 4th year.	

BNQF Code:0613 Course Code: CSE-4100	**Contact Hours/Week: 3.00**
Course Title: Software Development Project – II*	**Credit Hour:1.50**
Rationale:	
The Individual Software Development Project – I course is designed to make its learners able to solve advanced level industry problems and develop real time projects professionally.	
Course Contents:	
Will be decided by the department, concern supervisor and students	

BNQF Code:0612 **Course Code: CSE-4101**	**Contact Hours/Week: 3.00**
Course Title: Digital Signal Processing	**Credit Hour:3.00**
Rationale:	
Digital Signal Processing course is designed to introduce the fundamental concepts of discrete signal processing and their applications in communications, control and instrumentation.	
Course Contents:	
Introduction: Signals, Systems and Signal Processing, Classification of signals, Concepts of frequency in continuous time and discrete time signals, Analog to digital and digital to analog conversion, Sampling and Quantization. **Discrete Time Signals and Systems:** Discrete time signals, Discrete time systems, Analysis of discrete time linear time invariant systems, Discrete time systems described by different equations, Implementation of discrete time systems, correlation and convolution of discrete time signals. **The Z-transformation:** Introduction, Definition of the z-transformation, z-transformation and ROC of infinite duration sequence, Properties of z-transformation inversion of the z-transform, the one-sided z-transformation. **Frequency Analysis of Signals and Systems:** Frequency analysis of continuous time signals, Frequency analysis of discrete time signals, Properties of Fourier	

transform of discrete time signals, Frequency domain characteristics of linear time invariant system, Linear time invariant systems as frequency selective filters, Inverse systems and deconvolution.
The Discrete Fourier Transform: The DFT, Properties of the DFT, Filtering methods based on the DFT, Frequency analysis of signals using the DFT.
Fast Fourier Transform Algorithms: FFT Algorithms, Applications of FFT algorithm
Digital Filters: Design of FIR and IIR filters.
Adaptive Filters: Adaptive systems, Kalman filters, RLS adaptive filters, The steepest-descent method, The LMS filters. Application areas of the DSP.

Reference Book(s):

1. Digital Signal Processing - John G. Proakis & Dimitris Manolakis
2. Discrete-Time Signal processing - Allan Oppenheim & Ronald Schafer
3. Digital Signal Processing-A practical approach - Emmanuel C. Ifeachor BarrieW.Jervis
4. Signals and Systems - Rodger Ziemer & William Tranter

BNQF Code:0612 **Course Code: CSE-4102**	**Contact Hours/Week: 1.50**
Course Title: Digital Signal Processing Laboratory	**Credit Hour:0.75**
Rationale:	
The Digital Signal Processing Laboratory course is designed to assist better understanding of dealing with signals and processing signals for getting desired output, removing noise associated with signals.	
Course Contents:	
Speech, image & data processing algorithms: Sampling continuous time signals; Z-transform, Inverse Z transform, Frequency domain representation **Fourier series and Fourier Transform:** Equivalent noise; definition of bandwidth; Convolution, Correlation and method of numerical 281 integration; **Computation of the DFT:** Goertzel FFT, Chirp Z-transform algorithms. **Filter design:** FIR and IIR filters; Adaptive filters	

Reference Book(s):

1. Digital Signal Processing - John G. Proakis & Dimitris Manolakis
2. Discrete-Time Signal processing - Allan Oppenheim & Ronald Schafer
3. Digital Signal Processing-A practical approach - Emmanuel C. Ifeachor BarrieW.Jervis
4. Signals and Systems - Rodger Ziemer & William Tranter

BNQF Code:0612 **Course Code: CSE-4103**	**Contact Hours/Week: 3.00**
Course Title: Cellular and Wireless Communication	**Credit Hour:3.00**
Rationale:	
Cellular and Wireless Communication helps to develop an overview on the existing trends of wireless communication and the concepts of cellular communication technology radio transmission etc.	

Course Contents:
Introduction to Cellular Mobile Systems: Cellular Mobile Telephone Systems, A Basic Cellular System, Operation of Cellular Systems, GSM, WCDMA, LTE, GPRS/EDGE, UMTS. **Elements of Cellular Mobile Radio System Design:** General Description of the problem, Concept of Frequency reuse channels, Co-Channel Interference Reduction Factor, Handoff Mechanism, Cell Splitting. **Speech Coding for Wireless Systems Applications:** Introduction to Digital Signal Processing (DSP) Techniques in Wireless Telephone and Broadcast Systems, Speech Coding Techniques for Audio and Voice – Pulse Code Modulation, DPCM, Delta Modulation, Vocoder and Linear Predictive Coding, Performance Comparison of Speech Processing Techniques. **Radio Propagation and Cellular Engineering Concepts:** Fundamental Radio Propagation and System Concepts, Propagation Characteristics, Models of Multipath-faded radio signals – Un modulated Carrier, Envelope and Phase faded, Level Crossing rate and fade Duration, Delay Spread Measurements. **Digital Modulation-Demodulation (Modem) Principles and Architectures:** Coherent Modem – Baseband Modem Equivalence, Coherent and Differentially Coherent Binary Phase Shift Keying Systems, Synchronization – Carrier Recovery and Symbol Timing Recovery, Differential Encoding and Decoding Requirement, Quadrature Phase shift Keying – Coincident and offset Types, Pi/4 DQPSK Modems – Architecture. **Interference In Wireless Digital Communication:** Carrier-to-Interference and Carrier-to-Noise Limited Systems, Cochannel Interference, Adjacent Channel Interference. Externally caused Cochannel Interference, Definitions and performance of Spectral and Power Efficiency, Relationship of the Bit-Energy to Noise-Density Ratio and the Carrier-to-Noise Ratio, Power Efficiency and Bit-Error-Rate performance in an Additive White Gaussian Noise Environment, Concepts of Diversity Branch and Signal paths; Combining and Switching Methods.

Reference Book(s):

1. Fundamentals of Wireless Communication: David Tse and Pramod Viswanath, Cambridge University Press, 2005
2. Wireless and Cellular Telecommunications 3rd Edition -William Lee
3. Wireless Communications: Principles, Designs and Applications-Dr. V K Sachan

BNQF Code:0613 **Course Code: CSE-4105**	**Contact Hours/Week: 3.00**
Course Title: Data Science and Applications	**Credit Hour:3.00**
Rationale:	
This course is intended to provide an introduction into the field of Data Science. Students will develop skills in appropriate technology and basic statistical methods by completing hands-on projects focused on real-world data and addresses the social consequences of data analysis and application.	

Course Contents:
Introduction of Data: Sources of data, data collection and types of data, Sampling from a population, Data errors and appropriateness/Cleaning Data, The role of data in decision making at various levels of society. **Methods of Data Analysis:** Distributions (including measures of central tendency and spread), Expressions, names, and tables, Joins, Arrays, Functions, Modelling/mining the data. **Interpreting results of the data analysis/Data Interpretation:** Correlation, Chance, Decisions and error probabilities, Classification, Confidence intervals, Simulations, Empirical, Categorical, and Numerical Distributions, Assessing Models. **Communicate data-driven insights in multiple media modes:** Data visualization - (including graphs, charts, and histograms - univariate qualitative, univariate quantitative, bivariate), Communication of the Data Science Findings and What It Means, Converting data into actionable information and the role of data in decision making at various levels of society. Ethical Aspects: Accuracy, Misrepresentation, Privacy, Security. **Additional topics:** A/B Testing, Experiments, Hypothesis testing, Regression/Least squares, Prediction intervals, Inference for the true slope, Bootstrap, Bagging, Clustering, Frequent Patterns (Shopping Basket Analysis), Information Retrieval, Anomaly Detection Legal issues surrounding data, Causality and Experiments.

Reference Book(s):

1. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data 1st Edition, Kindle Edition
2. Smarter Data Science: Succeeding with Enterprise-Grade Data and AI Projects, by Neal Fishman, Cole Stryker, and Grady Booch
3. Data Science for Dummies (2nd Edition), by Lillian Pierson

Elective Courses

(Department will offer some courses in 7th semester in which student can select one theory courses as **Elective-III** and theory with laboratory course as **Elective-IV**)

BNQF Code:0611 **Course Code: CSE-4107**	**Contact Hours/Week: 3.00**
Course Title: Computer and Cyber Security	**Credit Hour:3.00**
Rationale:	
The Computer Security course is designed to provide a comprehensive understanding to the modern security system in computer science. The course begins with the history and development of security. Then it deals with various security models, cryptography, security attacks and the fundamental security objectives. This course also motivates to gather brief review of computer crimes and causes, internet, strategies, crime prevention.	

Course Contents:
Security: The Security Environment, Threats, Attackers; **Operating Systems Security:** Secure Systems, Trusted Computing Base; Controlling Access to Resources: Protection Domains, Access Control Lists, Capabilities. **Formal Models of Secure Systems:** Multilevel Security, Covert Channels. **Cryptography:** Overview, Symmetric cipher, Classical encryption technique, Block cipher and the data encryption standard (DES), Triple DES, Introduction to finite fields, Advanced Encryption Standard, Contemporary Symmetric Ciphers, confidentiality using symmetric encryption public, Key encryption and Hash functions, Public-key Cryptography, RSA algorithm, Key management, Diffie-Hellman key exchange, Other Public Key Cryptosystem, Message Authentication and Hash function, Hash Algorithm, Digital Signatures, Trusted Platform Modules. **Authentication:** Authentication using a physical object, Authentication using biometrics. **Exploiting Software:** Buffer Overflow Attacks, Format String Attacks, Dangling Pointers, Null Pointer Dereference Attacks, Integer Overflow Attacks, Command Injection Attacks, Time of Check to Time of Use Attacks. **Insider Attacks:** Logic Bombs, Back Doors, Login Spoofing; Malware: Trojan Horses, Viruses, Worms, Spyware, Rootkits; **Defenses:** Firewalls, Antivirus and Anti-Antivirus Techniques, Code Signing, Jailing, Model-Based Intrusion Detection, Encapsulating Mobile Code, Java Security. **Network Security:** Network Security practice, Authentication application, Wireless Network Security, Electrical Mail security, IP security and Web security; Research on Security and Case Study.

Reference Book(s):

1. Cryptography and Network Security – William Stallings;
2. Cryptography and Network Security- Behrouz A.Forouzan

BNQF Code:0413 **Course Code: CSE-4109**	**Contact Hours/Week: 3.00**
Course Title: Software Testing & Quality Assurance	**Credit Hour:3.00**
Rationale:	
This course has two parts; Software Testing, and Software Quality Assurance. The testing part provides a general introduction to Software Testing. It will address topics in the verification and validation (V&V) of software, White-Box and Black-Box Testing, Unit Testing, Test Planning and Management, Testing Tools, Domain Testing, System Integration Testing, Functional Testing, and Acceptance Testing. The Quality parts will cover the Concepts of Software Quality, Software Quality Metrics, Software Quality Assurance Planning And Implementation, and Quality Process Standards.	
Course Contents:	
Introduction to Software Testing: Concepts and Facts Testing Methods and Techniques (Static vs. dynamic testing, White-box testing, and Black-box testing.)	

Testing Levels: Unit testing, Integration testing, System testing, and Operational Acceptance Testing.

Control Flow Testing (Coverage): Basic Idea, Control Flow Graph, Paths in a Control Flow Graph, All-Path Coverage, Statement Coverage, Branch Coverage, Predicate Coverage, Generating Test Input, and Examples of Test Data Selection.

Testing Types: Functional vs non-functional testing, Installation testing, Compatibility testing, Regression testing, Acceptance testing, Alpha testing, Beta testing, Stress Testing, Software performance testing, Usability testing, Accessibility testing, Security testing, Documentation testing.

Testing Process: Traditional waterfall development model Agile or Extreme development model Top-down and bottom-up

System Test Planning and Automation: Structure of a System Test Plan, Introduction and Feature Description, Test Execution Strategy, Test Effort Estimation, Scheduling and Test Milestones, System Test Automation, Testing tools, Measurement in software testing

Software Quality Assurance: Introduction, Five Views of Software Quality, McCall's Quality Factors and Criteria, Quality Factors, Quality Criteria, Relationship between Quality Factors and Criteria, Quality Metrics, ISO 9126 Quality Characteristics, ISO 9000:2000 Software Quality Standard, Quality Engineering: Activities and Process, Quality Planning: Goal Setting and Strategy Formation, and Quality Assessment and Improvement.

JUnit Tutorial: (a unit testing framework for the Java programming language)

Reference Book(s):

1. Testing Computer Software, by Cem Kaner, Hung Q. Nguyen, Jack Falk
2. Agile Testing: A Practical Guide for Testers and Agile Teams, by Lisa Crispin and Janet Gregory
3. Software Quality Assurance: A Self-Teaching Introduction by Rajiv Chopra
4. Mastering Software Quality Assurance: Best Practices, Tools and Techniques for Software Developers By: Murali Chemuturi Published: 2010

BNQF Code:0611 **Course Code: CSE-4111**	**Contact Hours/Week: 3.00**
Course Title: Parallel and Distributed Systems	**Credit Hour:3.00**

Rationale:

The primary objective of this course is to introduce the fundamentals of parallel and distributed processing, including system architecture, programming model, and performance analysis. It will focus on the basic architectural, programming, and algorithmic concepts in the design and implementation of parallel and distributed applications. The specific topics include, but not limited to, MPI, openMP, middleware, SMP, clusters, peer-to peer, CUDA programming.

Course Contents:

Parallel Processing: Multiple Processor Organizations, Symmetric Multiprocessors, Cache Coherence, Multithreading and Chip Multiprocessors, Clusters, Hybrid, Grid, NUMA, Cloud Computing, Multicore Computers, General-Purpose GPU, Performance Measures: Amdahl's law.

Parallel Programming: Motivation for Parallelism, Concurrency and Synchronization, Data and Work Partitioning, Common Parallelization Strategies, Granularity, Load Balancing, Shared-Memory Programming: pthreads, OpenMP, Distributed-Memory Programming: MPI, GPU Programming: CUDA, OpenCL. Examples: Parallel Search, Parallel Sorting, etc., MapReduce.
Distributed Processing: System Architecture, Communication, Mid-session Recess, Replication & Consistency, Distributed Transactions, Distributed Shared Memory, Synchronization & Coordination, Concurrency issues, Middleware, Fault Tolerance, Security, Naming and Distributed File Systems.

Reference Book(s):

1. Parallel & Distributed Computing Paperback by BASU
2. Parallel and Distributed Computing Alberto Ros

BNQF Code:0613 **Course Code: CSE-4113**	**Contact Hours/Week: 3.00**
Course Title: Bioinformatics	**Credit Hour:3.00**

Rationale:

This course is designed to introduce bioinformatics at a level appropriate for computer science majors having an interest in computational biology. The main course includes (but not limited to) bioinformatics databases, phylogenetics, protein structure prediction, multiple sequence alignment, genome assembly, application of machine learning in computational biology, security and privacy for genomic data, etc.

Course Contents:

Introduction to Bioinformatics: The central dogma of biology: DNA, RNA, **Sequence alignment:** Genomic sequences, Scoring matrices. Pairwise alignment. **Online databases**: BLAST, Advanced BLAST, **Molecular phylogeny**: Sequence alignment with dot matrix, Alignment visualization, Optimal alignment using dynamic programming method, Analyzing and sequencing nucleic acids, **Structure and hierarchy of proteins**: Principles of protein structure, protein secondary structure prediction, Protein tertiary structure prediction, **Introduction to phylogenetics:** drawing tree diagrams, tree building methods, **Constructing phylogenetics tree**: Stepwise clustering, Fitch Margoliash method, Maximum parsimony and maximum likelihood method, Ancestral studies using phylogeny, **DNA replication**: transcription, translation, Multiple sequence alignment, **DNA digital data storage:** DNA-based Archival Storage System. **Human variation and disease**: Sequence variation, phenologs, comparative genomics, and Personalized medicine.

Reference Book(s):

1. An Introduction to Bioinformatics Algorithm (1st Edition)- Neil C. Jones, Pavel A. Pevzner; The MIT Press (2004)
2. Understanding Bioinformatics Marketa Zvelebil , Jeremy O. Baum

BNQF Code:0613 **Course Code: CSE-4115**	**Contact Hours/Week: 3.00**
Course Title: Machine Learning	**Credit Hour:3.00**

Rationale:

The Machine Learning course provides a broad introduction to machine learning and statistical pattern recognition. Topics include: supervised learning (generative/discriminative learning, parametric/nonparametric learning, neural networks, support vector machines); unsupervised learning (clustering, dimensionality reduction, kernel methods); learning theory (bias/variance trade offs, practical advice); reinforcement learning and adaptive control. The course will also discuss recent applications of machine learning, such as to robotic control, data mining, autonomous navigation, bioinformatics, speech recognition, and text and web data processing.

Course Contents:

Introduction: Introduction to Concepts of Supervised learning, Unsupervised Learning, Reinforcement Learning, Feature, Hypothesis, Prediction Model, Evaluation Metrics, Optimization and Brief Review of Required Mathematics.

Classification and regression: Nearest Neighbor algorithm, Linear Discriminant Analysis (LDA), Linear Regression, Logistic Regression.

Decision Tree Learning: ID3, CART, Overfitting Issue, Incorporating Continuous-Valued Attributes, Measures for Selecting Attributes, Handling Training Examples with Missing Attribute Values.

Bayesian Learning: Naïve Bayes classifier, Bayesian Networks.

Support Vector Machine: Maximum Margin Classification, Soft Margin Optimization, Gradient Ascent, Sequential Minimal Optimization, Support Vector Machine for Binary and Multiclass Classification, Hyperparameter Tuning.

Clustering: K-means, K-medoids, Density-based Hierarchical Clustering, Mixture of Gaussians and Expectation Maximization.

Ensemble Methods: Bagging, Boosting: Adaboost, Random Forests.

Artificial Neural Networks: Perceptron Learning Rule, Multilayer Perceptron, Loss Function, Backpropagation, Backpropagation with time, Activation Functions, Loss Functions, Gradient Descent Optimization, Adam, Bias Variance and Error analysis, Regularization (L1, L2, Dropout), Kohenen Self-organizing Maps

Applications: Student should develop a predictive modeling application on imaging, natural language or IoT data.

Reference Book(s):

1. Pattern Recognition and Machine Learning - Christopher M. Bishop; Springer
2. Machine Learning - Tom Mitchell, Mc Graw Hill
3. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Geron Aurelien
4. Fundamentals of Machine Learning for Predictive Data Analytics by John D. Kelleher, Brian Mac Namee, and Aoife D'Arcy

BNQF Code:0613 Course Code: CSE-4116	Contact Hours/Week: 1.50
Course Title: Machine Learning Laboratory	**Credit Hour:0.75**

Rationale:

The Machine Learning Laboratory course is structured to orient different algorithm of machine learning practically to best suit the current need. This course will help understand the iterative aspect of machine learning as models are exposed to new data, they are able to independently adapt. Models learn from previous computations to produce reliable, repeatable decisions and results and helps in implementing the enhanced learning parameters for maximum performance.

Course Contents:

Supervised Learning: Regression, Model Selection and Generalization, Dimensions of a supervised learning algorithm;
Bayesian Decision: Association Rules, Discriminant Functions; Clustering: k-means cluster, Hierarchical cluster, Expectation-Maximization Algorithm, Supervised Learning after Clustering;
Decision Tree: Classification tress, Regression trees, Pruning, Multivariate trees;
Hidden Markov Model: Basic problems of HMM, Evaluation problem, Model Selection in HMM, Find State Sequence; Kernel
Machines: SVM, Victorian Kernels, Multiple Kernel Learning, One-Class Kernel Machine, Kernel Dimensionality Reduction;
Design and Analysis of ML Experiment: Randomization, Interval Estimation, K-Fold Cross-Validated Paired t Test, Binomial Test, Approximate Normal Test.

Reference Book(s):

1. Pattern Recognition and Machine Learning - Christopher M. Bishop; Springer
2. Machine Learning - Tom Mitchell, Mc Graw Hill
3. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Geron Aurelien
4. Fundamentals of Machine Learning for Predictive Data Analytics by John D. Kelleher, Brian Mac Namee, and Aoife D'Arcy

BNQF Code:0613 Course Code: CSE-4117	Contact Hours/Week: 3.00
Course Title: Data Mining and Data Ware-housing	**Credit Hour:3.00**

Rationale:

Data mining techniques are the most important and useful tool for extracting novel, interesting and valid patterns and knowledge from a large amount of data. The objective of data mining processes is to build an efficient descriptive and predictive model of a large data set which will not only explain it but will also be able to generalize to new data sets.

Course Contents:

Introduction and Applications: Relational Databases, Data Warehouses, Transactional Databases, Advanced Data and Information Systems, Characterization and Discrimination, Classification and Prediction, Cluster Analysis, Outlier Analysis, Evolution Analysis, Attributes and its types, Data Visualization,

Measuring Data Similarity and Dissimilarity.

Data Preprocessing: Descriptive Data Summarization, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization and Concept Hierarchy Generation.

Mining Frequent Patterns, Associations, and Correlations: Definitions and background, applications, closed and maximal frequent itemsets, Apriori and FP-growth algorithms, generating association rules from frequent itemsets, mining correlations, and different correlation measures.

Classification, Clustering and Prediction: Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Clustering by Partitioning/ Hierarchical/ Density-based/ Model- based methods, Clustering High-Dimensional Data, Outlier analysis, Prediction, Linear Regression, Nonlinear Regression, Other Regression-Based Methods of prediction, KNN Classifier, Evaluating the Accuracy and error measures of a Classifier or Predictor.

Data Ware-housing: Definitions and background, applications, online transaction processing (OLTP), online analytical processing (OLAP) system, Data Warehousing Multitiered Architecture, Data Warehouse Models: Enterprise Warehouse, Data Mart, and Virtual Warehouse, Metadata Repository, Stars, Snowflakes, and Fact Constellations: Schemas for Multidimensional Data Models, OLAP Operations, Data Warehouse Design and Usage, Data Warehouse Implementation.

Reference Book(s):

1. Data Mining: Concepts and Techniques - Jiawei Han, Micheline Kamber, and Jian Pei, (Morgan Kaufmann)
2. Data Mining and Data Warehousing - Bharat Bhushan Agarwal, Sumit Prakash Tayal
3. Data Warehousing, Data Mining, and OLAP - Alex Berson and Stephen J.Smith

BNQF Code:0613 **Course Code: CSE-4118**	**Contact Hours/Week: 1.50**
Course Title: Data Mining and Data Ware-housing Laboratory	**Credit Hour:0.75**

Rationale:

Data mining techniques are the most important and useful tool for extracting novel, interesting and valid patterns and knowledge from a large amount of data. The objective of data mining processes is to build an efficient descriptive and predictive model of a large data set which will not only explain it but will also be able to generalize to new data sets. Implementing data analysis and prepossessing methods, visualization and decision-making concepts of data warehousing and data mining. For better data analysis, visualization and decision-making concepts of data warehousing and data mining play vital roles.

Course Contents:

Data Mining: Introduction, Data Pre-processing, Data visualization techniques, Mining Frequent Patterns, Associations, Correlations and Apriori algorithm, Classification, Clustering and Prediction,

Data warehousing: Data warehousing and OLAP technology, multidimensional data analysis

Reference Book(s):

1. Data Mining: Concepts and Techniques - Jiawei Han, Micheline Kamber, and Jian Pei, (Morgan Kaufmann)
2. Data Mining and Data Warehousing - Bharat Bhushan Agarwal, Sumit Prakash Tayal
3. Data Warehousing, Data Mining, and OLAP - Alex Berson and Stephen J.Smith

BNQF Code:0613 **Course Code: CSE-4119**	**Contact Hours/Week: 3.00**
Course Title: Digital System Design	**Credit Hour:3.00**
Rationale:	
Digital System Design course deals with design of different components of basic computer and applying knowledge in the initial interfacing of basic computer.	
Course Contents:	
Design using MSI and LSI components; Combinational and sequential circuit design with PLA's, **Design** of memory subsystem using SRAM and DRAM; **Design of various components of a computer:** Accumulator design, Shifter design, ALU, memory and control unit – hardwired and micro-programmed, **Microprocessor based designs**; Design using special purpose controllers. Introduction to Simple As Possible (Microprocessor)- Architecture, Instruction Set, Design, Microprogramming, SAP-1, SAP-2; **Introduction** to Embedded Systems.	

Reference Book(s):

1. "Digital Principles and System Design" by Sanjay Kumar Suman and Bhagyalakshmi
2. "Digital System Design Using Programmable Logic Devices" by Lala Parag K
3. "Digital Systems: Principles and Applications" by Ronald J Tocci and Neal S Widmer

BNQF Code:0613 **Course Code: CSE-4120**	**Contact Hours/Week: 1.50**
Course Title: Digital System Design Laboratory	**Credit Hour:0.75**
Rationale:	
Digital System Design Laboratory course deals with design of different components of basic computer and fully customized microprocessor of basic computer.	
Course Contents:	
Design of various components of a computer: Accumulator design, Shifter design, ALU, memory and control unit - hardwired and micro-programmed, Design fully customized Simple As Possible (Microprocessor): Architecture, Instruction Set, and Control Unit.	

Reference Book(s):

1. "Digital Principles and System Design" by Sanjay Kumar Suman and Bhagyalakshmi
2. "Digital System Design Using Programmable Logic Devices" by Lala Parag K
3. "Digital Systems: Principles and Applications" by Ronald J Tocci and Neal S Widmer

4th Year 2nd Semester

BNQF Code:061 **Course Code: CSE-4000**	**Contact Hours/Week: 6.00**
Course Title: Final Year Design Project (FYDP)/ Thesis***	**Credit Hour:3.00**
Rationale:	
FYDP/Thesis work provide students an opportunity to apply the knowledge they have learnt to solve real life problems. FYDPs help students become more resourceful along the way and they learn the nuances of research before they graduate. For some, it even acts as a guide in their career paths.	
Course Contents:	
Previous course knowledge, Literature review, Self-learning, Interdisciplinary cooperation	

BNQF Code:0613 **Course Code: CSE-4211**	**Contact Hours/Week: 3.00**
Course Title: Computer Graphics and Multimedia Systems	**Credit Hour: 3.00**
Rationale:	
Computer graphics interprets the mathematical foundation of the concepts of computer graphics and apply those concepts in different geometric objects. Analyze different algorithms and techniques of computer graphics and apply those in graphical model and multimedia motivates to study the architecture, different standards of compressing and coding a multimedia.	
Course Contents:	
Introduction: History, Application of Computer Graphics (Computer Aided Design Animation), a Survey of Graphics I/O Devices and Types. Graphics Software Design: Survey of Desired Function, Toward a Universal Graphic Language. Display Files, Databases for Pictorial Applications. Graphics Techniques: Point-Plotting Techniques, Line Drawing, Geometric Transformations, Windowing and Clipping, Raster Graphics. **Hardware for Computer Graphics:** Typical Small and Large System, Graphic Terminals, Plotters, Graphic Display Processors, Device Independent Graphics Systems. **Graphics Software:** A Simple Graphic Package, Segmented Display Files, Geometric Models, Picture Structure. Interactive Graphics: Input Techniques, Event Handling, Three Dimensional Graphics, Curves and Surfaces, 3-D Transformation. Hidden Surface Problem: Back Face Removal, Hidden-Line Removal Curved Surfaces, Describing Points, Lines and Polygons, Some Hints for Building Polygonal Models, Color Perception, RGBA and Color Index Mode, Dithering, Blending, 3-D Blending with the Depth Buffer, Antialiasing, Fog, Fog Equations, the OpenGL ARB. **API Specifies:** Data Types, Function Naming Conventions, Platform Independence, Drawing Shapes with OpenGL, Animation with OpenGL and GLUT.	

Drawing in Space: Lines, Points and Polygons. Co-ordinate Transformations: Understanding Transformations, Matrix Munching Projections, Matrix Manipulation Color Lighting and Materials, Texture Mapping.

Multimedia System Architecture: Objects for Multimedia System: Text; Images and graphics: Basic concepts, Computer image processing; Sound/ Audio: Basic concepts, Music, MIDI, Speech; Video and animation: Basic concepts, Computer-based animation Data

Compression Techniques: JPEG; H.261 (px64); MPEG; Intel's DVI; Microsoft AVI; Audio compression; Fractal compression Multimedia File Standards: RTF; TIFF; RIFF; MIDI; JPEG DIB; AVI video; MPEG.

Multimedia Storage and Retrieval Technology: Magnetic media technology; Optical media technology: Basic technology, CD Digital audio, CD-ROM, its architecture and further development, CD-Write only (CD-WO), CD- Magnetic optical (CD-MO).

Architecture and Multimedia Communication Systems: Pen input; Video and image display systems; Specialized processors: DSP; Memory systems; Multimedia board solutions; Multimedia communication system; Multimedia database system (MDBMS) User Interfaces: General design; Video and Audio at the user interface

Multimedia Applications: Imaging; Image/Voice processing and recognition; Optical character recognition; Communication: Tele-service, Messaging; Entertainment: Virtual reality, Interactive audio and video, Games. Audio and video conferencing, video on demand, voice over IP.

Reference Book(s):

1. Introduction to Computer Graphics, Author: Foley J D and others
2. Computer Graphics, Author: Angel E.
3. Computer Graphics, Author: Hearn D and Baker M P
4. Multimedia systems, Author: Stimetz
5. Multimedia: Computing, Communications & Applications, Author: Ralf Steinmetz and Klara Nahrstedt
6. Multimedia Systems Design, Author: Prabhat K. Andleigh and Kiran Thakrar.
7. The Complete Animation Course: The Principles, Practice and Techniques of Successful Animation by Chris Patmore.

BNQF Code:0613 **Course Code: CSE-4212**	**Contact Hours/Week: 1.50**
Course Title: Computer Graphics and Multimedia Systems Laboratory	**Credit Hour: 0.75**

Rationale:

Apply graphics programming techniques to solve graphics problem related to modelling transformation, rendering, texture mapping, developing 2D and 3D graphical geometric objects and editing audio, video and images.

Course Contents:

Drawing: Introduction to OpenGL, drawing 2D geometric object, drawing 3D geometric object

Transformation: Simple 2D and 2D animation and modelling transformation.

Advanced Topics: Viewing transformation and Texturing and lighting.

Multimedia Applications: Image and Video processing and recognition

Reference Book(s):

1. OpenGL Programming Guide: The Official Guide to Learning OpenGL (8th Edition)- Dave Shreiner, Graham Sellers, John Kessenich and Bill Licea-Kane; Addison Wesley Professional (2013).
2. The Complete Animation Course: The Principles, Practice and Techniques of Successful Animation by Chris Patmore.

BNQF Code:0413 **Course Code: GED-4251**	**Contact Hours/Week: 2.00**
Course Title: Engineering Management and Leadership	**Credit Hour:2.00**

Rationale:

The course is designed to make students understand the overlapping connection between engineering and management in an organization through the study of varied management practices and leadership traits as an engineer.

Course Contents:

Introduction to Leadership and Management: Definition of leadership and management, basic difference between a leader and a manager, relation of leaders and managers with respect to efficiency and effectiveness, qualities of leader and managers with examples from history; **Management Fundamentals:** Definition of management & manager, levels of management, management functions and skills, Mintzberg's managerial roles, Henri Fayol's management principles, strategic management; **Leadership & Motivation**: Motivation, Maslow's hierarchy needs, theory of X & Y, motivators and hygiene factors, goal setting theory, reinforcement theory, equity theory, expectancy theory, Leadership styles, leadership trait theory, managerial grid, contemporary leadership, conflicts negotiation, leadership issues in 21st century, cross cultural leadership, engineer as a leader and some simple case discussions on leadership (positive and toxic leadership) in the class (Interactive Learning); **Organizational Management:** Organization, departmentalization, chain of command, unity of command, cross functional area, authority, centralization and decentralization, traditional & contemporary organization, matrix project structure, learning structure, organizing collaboration; **Planning and goal setting:** Foundation of planning; goals of plan, types of goal, types of goal & plan, goal setting, MBO, well written goal; **Control:** Controlling process, controlling for organizational performance, types of control: (feed-forward, feedback & concurrent), balanced scorecard, contemporary issues in control, workplace concern & workplace violence, **Change and Innovation:** Change and innovation, internal and external for change, changing process, creativity vs innovation; **Attitude:** Components of Attitude, behaviour model and characteristics model; behaviour vs. attitude, job attitude, job involvement, job satisfaction and customer satisfaction; **Personality:** Personality determinants: heredity and environment, Myers-Briggs Type Indicator, Big five personality model, personality traits (core self-evaluation, Machiavellianism, narcissism, self-monitoring, risk taking, proactive personality); **Perception and Individual Decision Making**: Factors influencing perception, attribution theory, errors/biases in attribution, Factors of individual decision making, rational decision making, bounded rationality, satisfice, common errors in decision

making, creativity in decision making; **Understanding Work Team:** Work group, work team, problem solving team, self-managed work team, cross functional team, virtual team, team effectiveness, team challenges; **HR Management:** Process of Human Resource Planning, forecasting demand for labour, staffing, internal supply of labour, performance appraisal; **Operations Management:** Project managing basics, goals and boundary of project, WBS, scheduling a project, Demand and supply forecasting, inventory control; **Information Technology and Management:** Management Information System (MIS), Enterprise Resource Planning (ERP) - For introductory knowledge;

Reference Book(s):

1. The Manager's Path: A Guide for Tech Leaders Navigating Growth and Change 1st Edition by Camille Fournie
2. High Output Management by Andrew S. Grove
3. The Five Dysfunctions of a Team: A Leadership Fable by Patrick Lencioni

Elective Courses

(Department will offer some courses in 8th semester in which student can select one theory courses as **Elective-V** and theory with laboratory course as **Elective-VI**)

BNQF Code:0613 **Course Code: CSE-4213**	**Contact Hours/Week: 3.00**
Course Title: Cloud Computing	**Credit Hour:3.00**

Rationale:

The cloud computing course introduces the emergence of cloud computing and its contribution in providing effective solution for an industrial environment. The course provides a comprehensive discussion on the fundamentals of the technology, architecture, challenges and issues (security, safety) of an overall cloud computing system.

Course Contents:

Fundamentals of cloud computing: Types of cloud computing, enabling technologies-virtualization, Web services, SOA, Web 2.0, cloud computing features, cloud computing platforms.

Comparable technologies: Grid Computing, Utility Computing, The role of grid computing in cloud computing, difference between cloud and utility computing.

Cloud architecture: Cloud scheduling, Scalability, reliability and security of the cloud, Workflow management in cloud, Network infrastructure for cloud computing, Virtualization technologies and its security related issues.

Cloud service Models: Software as a Service (SaaS), Platform as a Service (PaaS), google App Engine, Microsoft Azure etc, Infrastructure as a Service (IaaS), Openstack, EC2 etc, Data as a Service (DaaS);

Cloud computing applications: Virtual private cloud , Scientific services and data management in cloud, Enterprise cloud, Medical information systems;

Big Data Introduction: Variety of Data, Velocity of Data, Veracity of Data, Distributed file system such as Hadoop, Data centric computing such as map-reduce, Distributed database and Cloud business models.

Reference Book(s):

1. Cloud Computing: A Hands-on Approach by Arshdeep Bahga and Vijay Madisetti
2. Handbook of Cloud Computing by Anand Nayyar
3. CLOUD COMPUTING A PRACTICAL APPROACH by Toby Velte , Anthony Velte, Robert Elsenpeter

BNQF Code:0612 **Course Code: CSE-4215**	**Contact Hours/Week: 3.00**
Course Title: Green Computing	**Credit Hour:3.00**
Rationale:	
The objective of this course is to make the students aware about impact of information technology and computing industry on the environment/ecology and how can they contribute in saving the mother earth by aligning their buying/operating/disposal practices in respect of computing and IT gadgets.	
Course Contents:	
The concept, importance and issues involved in Green Computing/ Information Technology; Carbon footprint in manufacturing of computing and IT products; other effluents in IT manufacturing; the concept of design for environment; Carbon footprint in operations of IT/computing gadget; green IT usage; Data centre and server farms design, power, cooling and location; virtualization; BPR for sustainable IT/computing. Disposal practices in e-waste; e-waste recycling, formal vs. informal e-waste recycling; extended producer responsibility; IT for paperless offices; IT for saving travel cost, time and environment; Electronic waste management regulations in Bangladesh; IEEE 1680 standard for green computing.	

Reference Book(s):

1. Green Computing: Tools and Techniques for Saving Energy, Money, and Resources By Bud E. Smith
2. Green Computing Strategies for Competitive Advantage and Business Sustainability Mehdi Khosrow-Pour, D.B.A.

BNQF Code:0612 **Course Code: CSE-4217**	**Contact Hours/Week: 3.00**
Course Title: Network Planning	**Credit Hour:3.00**
Rationale:	
Network planning and design is an iterative process, encompassing topological design, network- synthesis, and network-realization, and is aimed at ensuring that a new telecommunications network or service meets the needs of the subscriber and operator. This course is designed to give undergraduate level of knowledge in network planning and design.	
Course Contents:	
Introduction: Network components, Theoretical Network, Real World Networks. Network Architectural Design: Designing the LAN, Configuring the Network Server and Client, Network Administration, Remote Access, Expanding the Network, Wide Area Network Troubleshooting, Major Protocol Suites. **Network Simulation:** Network Simulation and Optimization, Network Operations, Control and Maintenance, Network Administration, Network Management Database and Tools, Capacity Planning. **Network Optimization:** Network Security and Integrity, Linear Programming and Network Algorithms for Planning, Reliability Theory and Network Planning.	

Reference Book(s):

1. Network planning and design A Complete Guide by Gerardus Blokdyk
2. Cellular Network Planning By Marcelo Sampaio de Alencar, Djalma de Melo Carvalho Filho

BNQF Code:0611 **Course Code: CSE-4219**	**Contact Hours/Week: 3.00**
Course Title: Blockchain and Cryptocurrency Technology	**Credit Hour:3.00**

Rationale:

The course is designed to introduce Blockchain technology and its application to Computer Science. The course begins with the Basic Cryptographic primitives used in Blockchain and then covers, Basic Distributed System concepts, Basic Blockchain (Blockchain 1.0), Blockchain 2.0, Blockchain 3.0, Beyond Cryptocurrency, Limitations of blockchain as a technology.

Course Contents:

Introduction: Need for Distributed Record Keeping, Modeling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Technologies Borrowed in Blockchain – hash pointers, consensus, byzantine fault-tolerant distributed computing, digital cash; **Basic Distributed Computing:** Atomic Broadcast, Consensus, Byzantine Models of fault tolerance; **Basic Crypto primitives:** Hash functions, Puzzle friendly Hash, Collision resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge systems; **Blockchain 1.0:** Bitcoin blockchain, the challenges, and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their use; **Blockchain 2.0:** Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts; **Blockchain 3.0:** Hyper ledger fabric, the plug and play platform and mechanisms in permissioned blockchain; Privacy, **Security issues in Blockchain:** Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains – such as Sybil attacks, selfish mining, 51% attacks - -advent of algorand, and Sharding based consensus algorithms to prevent these.

Reference Book(s):

1. The Basics of Bitcoins and Blockchains: Antony Lewis
2. Mastering Bitcoin: Programming the Open Blockchain By Andreas M. Antonopoulos
3. The Truth Machine: The Blockchain and the Future of Everything by Michael J. Casey and Paul Vigna
4. Blockchain Basics: A Non-Technical Introduction in 25 Steps by Daniel Drescher

BNQF Code:0611 **Course Code: CSE-4221**	**Contact Hours/Week: 3.00**
Course Title: Internet of Things (IoT)	**Credit Hour:3.00**

Rationale:

The Internet of Things (IoT) course introduces the emergence of IoT and its contribution in providing effective solution for an industrial environment. The course provides a comprehensive discussion on the fundamentals of the technology, architecture, challenges and issues (security, safety) of an overall IoT system.

Course Contents:
Evolution of IoT: history and emergence of IoT; **Applications of IoT:** case studies on a number of industries - power, water, healthcare, transportation, oil and gas, construction, agriculture, gene sequencers, mining and race cars. **The IoT landscape:** devices, wireless networks, cloud, sensors, architectures; **Introduction to IoT and embedded systems:** introductory concept of IoT and big data, cloud computing and edge computing; **IoT system architectures:** IoT-oriented standards, protocols and databases; **IoT devices:** the IoT device design space and platform design; **Event-driven system:** IoT event analysis; **IoT network model:** single-hub network and multi-hub network; **Industrial IoT:** industrial 4.0, IoT architecture, applications and basic challenges; **Security and safety:** system security, network security, generic application security, privacy and dependability; **Security testing of IoT systems:** fuzz testing for security – white-box fuzzing, black-box fuzzing, fuzzing industrial control network systems.

Reference Book(s):

1. Internet of Things: A Hands-On Approach Vijay Madisetti and ArshdeepBahga, VPTedition1, 2014.
2. Designing for Emerging- UX for Genomics, Robotics, and the Internet of Things Technologies – Jonathan Follett, O'Reilly, 2014

BNQF Code:0611 **Course Code: CSE-4222**	**Contact Hours/Week: 1.50**
Course Title: Internet of Things (IoT) Laboratory	**Credit Hour:0.75**

Rationale:

The Internet of Things (IoT) Laboratory course provides a practical experience on developing innovative solutions for a variety of industrial context by applying the technology used to design and develop an IoT system. This course further provides hands on experience on different kinds of components that form the architecture of an IoT system, how they communicate, how they store data and the kinds of distributed/embedded system that are required to support the IoT system.

Course Contents:

Applications of IoT: case studies on a number of industries - power, water, healthcare, transportation, oil and gas, construction, agriculture, gene sequencers, mining and race cars. **The IoT landscape:** devices, wireless networks, cloud, sensors, architectures; **Introduction to IoT and embedded systems:** introductory concept of IoT and big data, cloud computing and edge computing; **IoT system architectures:** IoT-oriented standards, protocols and databases;

IoT devices: the IoT device design space and platform design; **Event-driven system:** IoT event analysis; **IoT network model:** single-hub network and multi-hub network; **Security and safety:** system security, network security, generic application security, privacy and dependability; **Orientation and usage of modern tools:** programming in C/C++ (for programming the edge device), programming in Python using such frameworks as TensorFlow (for ML-related tasks), containerized apps deployment using Kubernetes, docker, computer networks, Apache Kafka, ElasticSearch, Kibana, Apache Flink, Linux administration and familiarity with Amazon web technologies.

Reference Book(s):

1. Internet of Things: A Hands-On Approach - Vijay Madisetti and ArshdeepBahga, VPTedition1, 2014.
2. Designing for Emerging- UX for Genomics, Robotics, and the Internet of Things Technologies – Jonathan Follett, O'Reilly, 2014

BNQF Code:0612 **Course Code: CSE-4223**	**Contact Hours/Week: 3.00**
Course Title: Advanced Database Management Systems	**Credit Hour: 3.00**

Rationale:

This course motivates to optimize the basic database transactions, query processing, concurrency control and other functions of database systems using advanced features that includes complex data and also assess various database models and designs to contribute to modern database systems.

Course Contents:

Object oriented database: data model, design, languages; **object relational database:** complex data types, querying with complex data types, design; **distributed database:** levels of distribution transparency, translation of global queries to fragment queries, optimization of access strategies, management of distributed transactions, concurrency control, reliability, administration; **Parallel Database:** different types of parallelism, design of parallel database; multimedia database systems basic concepts, design, optimization of access strategies, management of multimedia database systems, reliability; **database warehousing/ data mining:** basic concepts and algorithms.

Reference Book(s):

1. Database Systems: The Complete Book (2nd Edition) - Hector Garcia-Molina, Jeffrey D. Ullman and Jennifer Widom; Pearson(2008)
2. Concurrency control and Recovery in Database Systems (1st Edition) - P. a Bernstein and N. Goodman; Addison-Weasley (1987)

BNQF Code:0612 **Course Code: CSE-4224**	**Contact Hours/Week: 1.50**
Course Title: Advanced Database Management Systems Laboratory	**Credit Hour:0.75**

Rationale:

This course motivates to design and develop embedded projects using advanced database functions and query based on advanced database models - object oriented database, distributed database, multimedia database etc. to solve real-life problems.

Course Contents:

Introduction: Oracle Installation, Authentication, Security, Table Creation, **SQL:** Simple Query, Data Expressions, Join, Constraints, Advanced Query (GROUP Function etc.), Subqueries, Single-row function, Numeric function, Manipulation function, Conversion function, Nesting of function, Abstract data type, **PL/SQL:** Introduction to PL/SQL, Database Trigger/ Procedure, Packages, Indexing, View.Object oriented database, Distributed database, Management of distributed transactions, concurrency control, reliability, administration, Management of multimedia database systems, reliability; **database ware-housing/data mining:** basic concepts and algorithms.

Reference Book(s):

1. Database Systems: The Complete Book (2nd Edition) - Hector Garcia-Molina, Jeffrey D. Ullman and Jennifer Widom; Pearson(2008)
2. Concurrency control and Recovery in Database Systems (1st Edition) - P. a Bernstein and N. Goodman; Addison-Weasley (1987)

BNQF Code:0611 **Course Code: CSE-4225**	**Contact Hours/Week: 3.00**
Course Title: Pattern Recognition	**Credit Hour: 3.00**
Rationale:	
This course motivates to recognize patterns, regularities and also irregularities in data by using various pattern recognition algorithms and techniques to find useful information for science, business and organizational decisions as well as contributing to the field of machine learning, data mining and artificial Intelligence.	
Course Contents:	
Introduction to pattern recognition: Statistical and Neural Pattern Recognition, Bayesian decision theory; **Classifiers:** Linear classifiers, Nonlinear classifiers; **Estimation Techniques:** Parametric estimation techniques; Non-parametric estimation techniques; **Methods and Models:** Template matching, Dynamic programming methods, correlation methods, Hidden Markov model, Support vector machine, Syntactic pattern recognition, Clustering algorithms, Principle component analysis.	

Reference Book(s):

1. Pattern Recognition and Machine Learning - Christopher M. Bishop; Springer
2. Machine Learning - Tom Mitchell, Mc Graw Hill
3. Pattern Recognition –Sergios Theodoridis and Konstantinos Koutroumbas; Elsevier Inc.

BNQF Code:0611 **Course Code: CSE-4226**	**Contact Hours/Week: 1.50**
Course Title: Pattern Recognition Laboratory	**Credit Hour: 0.75**
Rationale:	
This course motivates to apply various algorithm and techniques - classification, regression, clustering, neural network, decision tree and other estimation techniques which helps to identify different types of pattern in data that can give required solution and suggestions to real-life problems for various applications.	
Course Contents:	
Bayes Classifier, Perceptron Algorithm, Pocket Algorithm, Edit Distance, Basic Sequential Algorithmic Scheme, K-Means Clustering algorithm, Support Vector Machine, Neural Network, Decision Tree.	

Reference Book(s):

1. Pattern Recognition and Machine Learning - Christopher M. Bishop; Springer
2. Machine Learning - Tom Mitchell, Mc Graw Hill
3. Pattern Recognition –Sergios Theodoridis and Konstantinos Koutroumbas; Elsevier Inc.

Chapter-5
Grading/Evaluation System

5.1 Grading Policy:

The total performance of a student in a given course is based on a scheme of continuous assessment. For theory course this continuous assessment is made through a set of quizzes/class tests, observations/class participation, homework/assignment and a semester final examination. The assessment in laboratory courses is made by evaluating performance of the student at work during the class, viva-voce during laboratory hours and quizzes. Each course has a certain number of credits, which describes its corresponding weightages. A letter grade with a specified number of grade points is awarded in each course for which a student is registered. A student's performance is measured by the number of credits completed satisfactorily and by the weighted average of the grade points earned. A minimum Grade Point Average (GPA) is essential for satisfactory progress. A minimum number of earned credits also have to be acquired in order to qualify for the degree. Letter grades and corresponding grade points will be awarded in accordance with the provisions (as per University Grant Commission-UGC grading system) shown below:

Numerical Score	Letter Grade		Grade points
80% and above	A+	A (Plus)	4.00
75% to > 80%	A	A (Regular)	3.75
70% to > 75%	A-	A (Minus)	3.50
65% to > 70%	B+	B (Plus)	3.25
60% to > 65%	B	B (Regular)	3.00
55% to > 60%	B-	B (Minus)	2.75
50% to > 55%	C+	C (Plus)	2.50
45% to > 50%	C	C (Regular)	2.25
40% to > 45%	D	D (Pass)	2.00
below 40%	F	Fail	0.00
Assigned courses are not appeared	I	-	Incomplete
As per academic policy	W	-	Withdrawn
Failed to submit	X	-	Projects/Thesis Continuation
Due to offence	E	-	Expelled

*I-Incomplete; *W-Withdrawn; *X-Projects/Thesis Continuation; *E-Expelled

*The subject in which the student gets F grade shall not be counted towards credit hours requirements and for the calculation of Grade Point Average (GPA). Students failing in a course/ courses due to being expelled, dis-collegiate, absent will be treated as F according to Grading system.

5.2 Distribution of Marks:

Theory Courses:

Thirty percent (30%) marks of theoretical course shall be allotted for continuous assessment, i.e., quiz, class tests, home assignments, class evaluation and class participation and 70% shall be allotted to the Semester Final Examination. The Final examination is conducted centrally by the University. Distribution of marks for a given course if as follows.

Category	Marks %
Class participation/Presentation skill	5
Class performance	5
Homework/Assignment	5
Class tests	15
Final Examination (Maximum 3 Hours)	70
Total	**100**

Laboratory Courses:

Laboratory courses are designed and conducted by the concerned departments. Examination on laboratory/practical subjects will be conducted by the respective department before the commencement of semester final examination. The date of practical examination will be fixed by the respective department. Students will be evaluated in the laboratory courses on the basis of the followings (all or as decided by the Examination Sub- Committee):

Category	Marks (%)
Continuous Assessment (Laboratory Participation)	10
Lab Report	10
Quiz Test	10
Lab Test	20
Project/Online Test	30
Viva Voce	20
Total	**100**

Students failing in laboratory/practical course will have to register that course at his next upcoming convenient semester with a course registration fee fixed by the BAUET authority but within maximum period of six academic years.

For B.Sc. in CSE program, the marks distribution of laboratory courses will be distributed according to the type of the laboratory course. The distributions of marks for three types of laboratory are given below:

5.3 Marks Distribution of Lab/Project Based Laboratory

Category	Marks (%)
Lab test/Project	30
Written test/Quiz	20
Viva voce	10
Attendance	10
Data Sheet/Home Assignments/Report	10
Class Performance /Continuous Evaluation	20
Total	**100**

5.4 Marks Distribution of Programming Based Laboratory

Category	Marks (%)
Online Test – 1	25
Online Test – 2	25
Viva voce	10
Attendance	10
Continuous Evaluation	10
Class Performance	20
Total	**100**

5.5 Marks Distribution of Communicative English

Category	Marks (%)
Class Participation	5
Class Assessment	5
Written Assignment	15
Oral Performance	25
Listening Skill	10
Group Presentation	30
Viva Voce	10
Total	**100**

5.6 Marks Distribution of Software Development Project (CSE-3200 & CSE-4100)

Category	Marks (%)
Committee members from the dept. and the allied dept.(if required)	30
Supervisor or mentor of each team	70
Total	**100**

5.7 Calculation of GPA (Grade Point Average)

Grade Point Average (GPA) is the weighted average of the grade points obtained of all the courses passed/completed by a student. For example, if a student passes/completes n courses in a semester having credits of $C_1, C_2, \dots, C_n$ and his grade points in these courses are $G_1, G_2, \dots, G_n$ respectively then

$$GPA = \frac{\sum_{i=1}^{n} C_i \, x \, G_i}{\sum_{i=1}^{n} C_i}$$

The Cumulative Grade Point Average (CGPA) is the weighted average of the GPA obtained in all semesters passed/completed by a student. For example, if a student passes/ completes n semester having total credits of TC1, TC2, … , TCn and his GPA in these semesters are GPA1, GPA2, … , GPAn respectively then

$$CGPA = \frac{\sum_{i=1}^{n} TC_i \, x \, GPA}{\sum_{i=1}^{n} TC_i}$$

A Numerical Example

Suppose a student has completed 09 (nine) courses in a semester and obtained the following grades:

Course	Credits, C_i	Grade	Grade Points, Gi	C_i*G_i
CSE-1100	1.50	A-	3.50	5.2500
EEE-1161	3.00	A+	4.00	12.0000
EEE-1162	1.50	A	3.75	5.6250
MATH-1141	3.00	B+	3.25	9.7500
PHY-1101	3.00	B-	2.75	8.2500
PHY-1102	0.75	C+	2.50	1.8750
GED-1151	3.00	D	2.00	6.0000
GED-1152	0.75	C	2.25	1.6875
HUM-1153	2.00	B	3.00	6.0000
Total	**18.50**			**56.4375**

GPA= 56.4375/18.50=3.05

Suppose a student has completed 04 (four) semesters and obtained the following GPA:

Year	Semester	Credit Hours Earned, TC_i	GPA Earned, GPA_i	TC_i*GPA_i
1	1	21.00	3.73	78.330
1	2	20.50	3.93	80.565
2	1	19.75	3.96	78.210
2	2	20.25	4.00	81.000
Total	**81.50**			**318.105**

CGPA = 318.105/81.50 =3.90

Chapter-6
Rules and regulations for undergraduate program

6.1 Course Appraisal and Lesson Plan:
All faculty members must have to prepare their respective Course Appraisal and Lesson plan for the entire course before the semester begins. They are advised to leave a copy of the Course Appraisal set to the Head of the Department for review by the Course Committee (i.e. PSAC).

6.2 Teacher-Student Interaction:
The new course system encourages students to come in close contact with the teachers. For promotion of a high level of teacher-student interaction, each student is assigned to an adviser and the student is free to discuss all academic matters with his/her adviser. Students are also encouraged to meet any time with other teachers for help and guidance in academic matters. However, students are not allowed to interact with teachers after the moderation of questions.

6.3 Student Mentoring:
Besides the respective faculty of each subject/program, every student will have a designated mentor. Students will interact with his/her mentor to discuss the academic progress, difficulties and all other issues relating to their performances. There is definite guideline issued, which specifies the modalities and frequency of mentoring, advising and interactions.

6.4 Batch Adviser:
One Batch adviser is normally appointed for a batch of students by the concerned department. The batch adviser advises each student about the courses to be taken in each semester by discussing the academic program of that particular semester with the student. However, it is also the student's responsibility to keep regular contact with his/her adviser who will review and eventually approve the student's specific plan of study and monitor subsequent progress of the student.

6.5 Course Registration:
Any student who uses classroom, laboratory facilities or faculty-time is required to register formally. Upon admission to the BAUET, students are assigned to advisers. These advisers guide the students in choosing and registering courses.

6.6 Registration Procedure:
At the commencement of each semester, each student has to register for courses in consultation with and under the guidance of his/her adviser. The date, time and venue of registration are announced in advance by the Registrar's Office. Counseling and advising are accomplished at this time. It is absolutely essential that all the students be present for registration at the specified time.

6.7 Pre-Conditions for Registration:

a. For 1st Year students, department-wise enrolment/admission is mandatory prior to registration. At the beginning of the first semester, an orientation program will be conducted for them where they are handed over with the registration package on submission of the enrolment slip

b. Any student, other than the new batch, with outstanding dues to the BAUET or a hall of residence is not permitted to register. Each student must clear their dues and obtain a clearance certificate, upon production of which, he/she will be given necessary Course Registration Forms to perform course registration.

c. A student is allowed to register in a particular course subject to the class capacity constraints and satisfaction of pre-requisite courses. However, even if a student fails in a pre-requisite course in any semester, the concerned department may allow him/her to register for a course which depends upon the pre-requisite course provided that his/her attendance and performance in the continuous assessment of the mentioned pre-requisite course is found to be satisfactory.

6.8 Registration Deadline:

Each student must register for the courses to be taken before the commencement of each semester. Late registration is permitted only during the first week of classes. Late registration after this date will not be accepted unless the student submits a written application to the registrar through the concerned Head of the department explaining the reasons for delay. Acceptable reasons may be medical problems with supporting documents or some other academic commitments that prohibit enrolment prior to the last date of registration.

6.9 Penalty for Late Registration:

Students who fail to register during the designated dates for registration are charged a late registration fee of Tk. 400.00 (Four hundred only) for each semester. Penalty for late registration will not be waived.

6.10 Attendance, Conduct and Discipline

BAUET has strict rules regarding the issues of attendance in class and discipline.

Attendance: Following guidelines are to be adjusted to:

a. All students are required to attend 80% of the classes for all courses.
b. In case of sickness 70% attendance may be considered by the VC with proper medical documents provided by the student.
c. Students failing to attend 80% classes are liable to pay a fine of Tk. 2000/- per course.
d. Students not eligible to sit for exam of a particular course due to poor attendance, their concerned course will be deleted form the Admit Card.
e. A student will not be entitled to Vice Chancellor or the Dean's list of the Semester, in case he/she has not attended 90% if the classes. S/he will also not be considered for any Scholarship/Waiver provide by the University.

Conduct and Discipline:
During their stay in BAUET all students are required to abide by the existing rules, regulations and code of conduct. Students are strictly forbidden to form or be members of student organization or political party, club, society etc., other than those set up by BAUET authority in order to enhance student's physical, intellectual, moral and ethical development. Zero tolerance will be shown in regards of sexual abuse and harassment in any forms and drug abuse and addiction in the campus.

6.11 Promotion to the Next Semester:
[As per BAUET Exam policy]

6.12 Minimum Earned Credit and CGPA (Cumulative Grade Point Average) Required for Obtaining a Degree:
[As per BAUET Exam policy]

6.13 Consequences of Poor Performance (Referred/Improvement/Backlog):
[As per BAUET Exam policy]

6.14 Course Repetition:
[As per BAUET Exam policy]

6.15 Class Tests:
The number for class test of a course shall be at least n+1 where n is the number of credits of the course. Class test will be conducted by the subject teacher. Course teacher must announce results within 10 days of holding the examination. Checked scripts will be shown to the students. If a student misses the class test for acceptable reason, the course teacher may make arrangements to take the test of the students.

6.16 Earned Credits
The courses in which a student has obtained 'D' or a higher grade will be counted as credits earned by her/him. Any course in which a student has obtained 'F' grade will not be counted as credits earned by her/him.

6.17 Rounding off the Decimal Marks:
If there is any decimal marks in any of the examinations like class test, tutorial, term paper, viva voce, course final examination, instead of rounding off the decimal figure in the result of every subject/sessional, it is to be rounded off only once during tabulation while converting the total marks to summation of all the subject/sessional marks. To round off, 0.5 and above is to be converted to next higher whole number(Integer) and less than 0.5 is to be converted to previous whole number (For example 58.5% would be 59% and 58.49% would 58%).

6.18 Rounding off the GPA/CGPA:
The GPA/CGPA is not to be rounded off like the total marks of each subject sessional, but it is to be rounded off after two figures of decimal. To round of 3.555

and above after two figure of decimal, it is to be rounded off as 3.56 and 3.554 and below after two figure of decimal, it is to be rounded off as 3.55.

6.19 Number of Grade Sheets:
The number of Grade sheets to be issued is 08 (eight) for a regular student. Backlog, re-registered courses, sessional courses result will be included in that particular semester result in which the student appeared.

6.20 Withdrawal Policy:
[As per BAUET Exam policy]

6.21 Transcript:
Transcripts will be given after approval of the authority of BAUET, academic council and syndicate. Partial transcripts may be given to students with the assigned payment and verification fixed by the authority.

6.22 Certificate:
A copy of provisional before original certificate may be given after approval of the authority of BAUET, academic council and syndicate. Provisional certificates, however, should be surrendered during receiving the original certificate.

6.23 Awards:

a. **Degree with Honors:** Candidates for Bachelor's Degree will be awarded the degree with honors if their overall CGPA is 3.75 and above.
b. **Gold Medal:** Gold medal will be awarded to all students earning CGPA 4 at the end of the entire program.
c. **VC's List:** VC's list will be awarded to all students earning 3.90 and above at the end of each academic level, and all graduating students earning 3.90 and above considering results of entire program.
d. **Dean's List:** Dean's list will be awarded to all students earning CGPA 3.75 - 3.90 at the end of each academic year for 1, 2, 3 and all graduating students earning CGPA 3.75 - 3.90 considering results of entire program.
e. **Other Scholarships and Stipends: This** will be considered by the university authority in due course of time.

**Students must have above 90% attendance to be considered in the Dean's list and VC's list of recognition.
[N.B. Contradiction among the existing Examination Policy, Syllabus and Standing Instruction (SI) will be solved by a team headed by the honorable VC]

Chapter 7
Courses Offered to Other Departments

7.1 Courses Offered to the Department of EEE

Sl.	Course No	Course Title	Hours/Week		Credits	Year/ Semester
			Theory	Sessional		
1.	CSE-1209	Computer Programming	3.00	-	3.00	Y1/S2
2.	CSE-1210	Computer Programming Sessional	-	3.00	1.5	Y1/S2

7.2 Courses Offered to the Department of ME

Sl.	Course No	Course Title	Hours/Week		Credits	Year/ Semester
			Theory	Sessional		
1.	CSE-1271	Computer Programming Language	3.00	-	3.00	Y1/S2
2.	CSE-1272	Computer Programming Language Sessional	-	3.00	1.5	Y1/S2

7.3 Courses Offered to the Department of Business Administration

Sl.	Course No	Course Title	Hours/Week		Credits	Year/ Semester
			Theory	Sessional		
1.	CSE-2103	Computer Applications in Business	4.00	-	4.00	Y1/S2

7.4 Courses Offered to the Department of Law and Justice

Sl.	Course No	Course Title	Hours/Week		Credits	Year/ Semester
			Theory	Sessional		
1.	CSE-1202	Computer and Information Technology	3.00	-	4.00	Y1/S2

7.5 Courses Offered to the Department of English Language and Literature

Sl.	Course No	Course Title	Hours/Week		Credits	Year/ Semester
			Theory	Sessional		
1.	CSE-1222	Computer and Information Technology	3.00	-	3.00	Y1/S1

Appendix-A

Learning Domain

The Learning Domain (LD) consists of three sub-domains i.e. cognitive, affective, and psychomotor and their categories. The students will be evaluated through different methods based on the sub-domains. The attributes of the sub-domains are described in the following tables.

Cognitive sub-domain:

LD	Category	Description
C1	Remembering	Recognizing or recalling knowledge from memory. Remembering is when memory is used to produce definitions, facts, or lists, or recite or retrieve material.
C2	Understanding	Constructing meaning from different types of functions be they have written or graphic messages activities like interpreting, exemplifying classifying, summarizing, inferring, comparing, and explaining.
C3	Applying	Carrying out or using a procedure through executing, or implementing. Applying related and refers to situations where learned material is used through products like models, presentations, interviews or simulations.
C4	Analyzing	Breaking material or concepts into parts, determining how the parts relate or interrelate to one another or to an overall structure or purpose. Mental actions included in this function are differentiating, organizing, and attributing, as well as being able to distinguish between the components or parts. When one is analyzing he/she can illustrate this mental function by creating spreadsheets, surveys, charts, or diagrams, or graphic representations.
C5	Evaluating	Making judgments based on criteria and standards through checking and critiquing. Critiques, recommendations, and reports are some of the products that can be created to demonstrate the processes of evaluation. In the newer taxonomy evaluation comes before creating as it is often a necessary part of the precursory behavior before creating something.
C6	Creating	Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing. Creating requires users to put parts together in a new way or synthesize parts into something new and different a new form or product. This process is the most difficult mental function in the new taxonomy.

Table: Cognitive Domain

Affective sub-domain:

LD	Category	Description
A1	Receiving	This refers to the learner‘s sensitivity to the existence of stimuli– awareness, willingness to receive, or selected attention.
A2	Responding	This refers to the learners ‘active attention to stimuli and his/her motivation to learn – acquiescence, willing responses, or feelings of satisfaction.
A3	Valuing	This refers to the learner‘s beliefs and attitudes of worth – acceptance, preference, or commitment. An acceptance, preference, or commitment to value.
A4	Organization	This refers to the learner‘s internalization of values and beliefs involving (1) the conceptualization of values; and (2) the organization of a value system. As values or beliefs become internalized, the leaner organizes them according to priority.
A5	Characterization	This refers to the learner‘s highest of internalization and relates to behavior that reflects (1) a generalized set of values; and (2) a characterization or a philosophy about life. At this level, the learner is capable of practicing and acting on their values or beliefs.

Table: Affective Domain

Psychomotor sub-domain:

LD	Category	Description
P1	Perception	The ability to use sensory cues to guide motor activity. This ranges from sensory stimulation, through cue selection, to translation.
P2	Set	Readiness to act. It includes mental, physical, and emotional sets. These three sets are dispositions that predetermine a person's response to different situations (sometimes called mindsets).
P3	Guided Response	The early stages in learning a complex skill that includes imitation and trial and error. Adequacy of performance is achieved by practicing.
P4	Mechanism	This is the intermediate stage in learning a complex skill. Learned responses have become habitual and the movements can be performed with some confidence and proficiency.
P5	Complex / Overt Response	The skillful performance of motor acts that involve complex movement patterns. Proficiency is indicated by a quick, accurate, and highly coordinated performance, requiring a minimum of energy. This category includes performing without hesitation and automatic performance. For example, players often utter sounds of satisfaction or expletives as soon as they hit a tennis ball or throw a football because they can tell by the feel of the act what the result will produce.
P6	Adaptation	Skills are well developed and the individual can modify movement patterns to fit special requirements.
P7	Origination	Creating new movement patterns to fit a particular situation or specific problem. Learning outcomes emphasize creativity based on highly developed skills.

Table: Psychomotor Domain
Appendix-B

Equivalence Table

	Old course (2019-2021)				New Course (2022-2024)		
Sl.	**Course cod**	**Course Title**	**Cr.**	**BNQF Code**	**Course Code**	**Course Title**	**Cr.**
1.	CSE-1102	Introduction to Computer Systems Sessional	1.50	0611	SE-1100	Introduction to Computer Systems Laboratory	1.50
2.	PHY-1105	Physics	3.00	0533	HY-1101	Physics	3.00
3.	PHY-1106	Physics Sessional	0.75	0533	HY-1102	Physics Laboratory	0.75
4.	CHEM-1203	Inorganic and Physical Chemistry	3.00	0531	CHEM-1101	Chemistry	2.00
5.	CHEM-1204	Inorganic and Physical Chemistry Sessional	0.75	0531	CHEM-1102	Chemistry Laboratory	0.75
6.	MATH-1141	Differential Calculus and Integral Calculus	3.00	0541	MATH-1141	Differential Calculus and Integral Calculus	3.00
7.	HUM-1151	Technical and Communicative English	2.00		---	----	---
8.	HUM-1152	Technical and Communicative English Sessional	0.75	0232	HUM-1150	Communicative English-I Laboratory	1.50
9.	HUM-1255	Bangladesh Studies (History of Independence)	2.00	0222	ED-1151	Bangladesh Studies: History and Culture	2.00
10.	EEE-1261	Electrical Circuit Analysis	3.00	0713	EE-1161	Electrical Circuit Analysis	3.00
11.	EEE-1262	Electrical Circuit Analysis Sessional	1.50	0713	EE-1162	Electrical Circuit Analysis Laboratory	0.75
12.	CSE-1213	Structured Programming	3.00	0613	SE-1211	Structured Programming	3.00
13.	CSE-1214	Structured Programming Sessional	1.50	0613	SE-1212	Structured Programming Laboratory	1.50

14.	CSE-1211	Discrete Mathematics	3.00	0541	SE-1213	Discrete Mathematics	3.00
15.	MATH-1243	Mathematics-II (Ordinary, Partial Differential Equations and Coordinate Geometry)	3.00	0541	MATH-1241	Ordinary, Partial Differential Equations and Coordinate Geometry	3.00
16.	EEE-2163	Electronic Devices and Circuits	3.00	0714	EE-1261	Electronic Devices and Circuits	3.00
17.	EEE-2164	Electronic Devices and Circuits Laboratory	0.75	0714	EE-1262	Electronic Devices and Circuits Laboratory	0.75
18.	---	---	----	0715	ME-1270	Basic Mechanical Engineering and Drawing Laboratory	1.50
19.	HUM-1152	Technical and Communicative English Sessional	1.50	0232	HUM-1250	Communicative English-II Laboratory	1.50
20.	HUM-3157	Professional Ethics and Environmental Protection	2.00	0223 0521	ED-1251	Society, Ethics and Environment	3.00
21.	CSE-2103	Data Structures and Algorithms-I	3.00	0613	SE-2101	Data Structures and Algorithms-I	3.00
22.	CSE-2104	Data Structures and Algorithms-I Sessional	1.50	0613	SE-2102	Data Structures and Algorithms-I Laboratory	1.50
23.	CSE-2105	Object Oriented Programming	3.00	0613	SE-2103	Object Oriented Programming	3.00
24.	CSE-2106	Object Oriented Programming Sessional	1.50	0613	SE-2104	Object Oriented Programming Laboratory	1.50
25.	CSE-2211	Database Management Systems	3.00	0612	SE-2105	Database Systems	3.00
26.	CSE-2212	Database Management Systems Sessional	1.50	0612	SE-2106	Database Systems Laboratory	1.50
27.	CSE-2101	Digital Logic Design	3.00	0611	SE-2107	Digital Logic Design	3.00
28.	CSE-2102	Digital Logic	0.75	0611	SE-2108	Digital Logic	1.50

		Design Sessional				Design Laboratory	
29.	MATH-2145	Vector Analysis, Matrices and Fourier Analysis	3.00	0541	MATH-2141	Vector Analysis, Matrices and Laplace Transformation	3.00
30.	CSE-2213	Data Structures and Algorithms-II	3.00	0613	CSE-2211	Data Structures and Algorithms-II	3.00
31.	CSE-2214	Data Structures and Algorithms-II Sessional	1.50	0613	CSE-2212	Data Structures and Algorithms-II Laboratory	1.50
32.	CSE-3105	Data and Telecommunication	3.00	0612	CSE-2213	Data Communication	3.00
33.	CSE-3106	Data and Telecommunication Sessional	0.75	0612	CSE-2214	Data Communication Laboratory	0.75
34.	CSE-3213	Computer Architecture	3.00	0611	CSE-2215	Computer Organization and Architecture	3.00
35.	---	---	----	0613	CSE-2216	Java Programming Laboratory	1.00
36.	EEE-2265	Electrical Drives and Instrumentation	3.00	0713	EEE-2261	Electrical Drives and Instrumentation	3.00
37.	EEE-2266	Electrical Drives and Instrumentation Sessional	0.75	0713	EEE-2262	Electrical Drives and Instrumentation Laboratory	0.75
38.	MATH-2247	Complex Variable and Laplace Transformation	3.00	0541	MATH-2241	Complex Variable and Fourier Analysis	3.00
39.	CSE-3103	Software Engineering and Information System Design	3.00	0613	CSE-3101	Software Engineering and Information System Design	3.00
40.	CSE-3104	Software Engineering and Information System Design Sessional	0.75	0613	CSE-3102	Software Engineering and Information System Design Laboratory	1.00
41.	CSE-3211	Computer Network	3.00	0612	CSE-3103	Computer Network	3.00
42.	CSE-3212	Computer Network	1.50	0612	CSE-3104	Computer	1.50

		Sessional				Network Laboratory	
43.	CSE-3107	Operating System	3.00	0613	SE-3105	Operating Systems	3.00
44.	CSE-3108	Operating System Sessional	1.50	0613	SE-3106	Operating Systems Laboratory	1.50
45.	CSE-3110	Web Programming Sessional	1.50	0613	SE-3108	Web Programming Laboratory	1.00
46.	CSE-3101	Numerical Analysis	3.00	0541	MATH-3141	Numerical Analysis	3.00
47.	HUM-3259	Engineering Economics and Sociology	3.00	0311 0314	ED-3151	Engineering Economics and Sociology	3.0
48.	---	---	----	0411 0412 0413	ED-3251	Project Management and Finance	3.00
49.	CSE-3200	Integrated Design Project / Capstone Project (Phase-I)	0.75	0613	SE-3200	Software Development Project – I*	1.50
50.	CSE-4101	Microprocessors, Micro-controllers and Embedded System	3.00	0611	SE-3211	Microprocessors, Micro-controllers and Assembly Language	3.00
51.	CSE-4102	Microprocessors, Micro-controllers and Embedded System Sessional	0.75	0611	SE-3212	Microprocessors, Micro-controllers and Assembly Language Laboratory	0.75
52.	CSE-4201	Artificial Intelligence	3.00	0613	SE-3213	Artificial Intelligence	3.00
53.	CSE-4202	Artificial Intelligence Sessional	0.75	0613	SE-3214	Artificial Intelligence Laboratory	0.75
54.	CSE-4103	Compiler Design	3.00	0611	SE-3215	Automata Theory and Compiler Design	3.00
55.	CSE-4104	Compiler Design Laboratory	0.75	0611	SE-3216	Automata Theory and Compiler Design Laboratory	0.75
56.	MATH-	Applied Statistics	3.00	0542	STAT-	Applied	3.00

	4107	and Queuing Theory			2251	Statistics and Queuing Theory	
57.	----	----	---	0031	SE-3224	Industrial Training**	1.00
58.	CSE-4125	Fault Tolerant System	3.00	0413	SE-3217	Fault Tolerant System	3.00
59.	----	----	----	0611	SE-3219	E-commerce and Web Security	3.00
60.	CSE-4241	Human Computer Interaction	3.00	0611	SE-3221	Human Computer Interaction	3.00
61.	CSE-4242	Human Computer Interaction Sessional	0.75	----	----	----	----
62.	CSE-4121	Advanced Algorithms	3.00	0613	SE-3223	Advanced Algorithms	3.00
63.	CSE-3224	Industrial Training*	1.00	031	SE-3224	Industrial Training*	1.00
64.	CSE-3215	Digital Image Processing	3.00	0613	SE-3225	Digital Image and Video Processing	3.00
65.	CSE-3216	Digital Image Processing Sessional	0.75	0613	SE-3226	Digital Image Processing Laboratory	0.75
66.	CSE-4247	Simulation and Modeling	3.00	0613	SE-3227	Simulation and Modeling	3.00
67.	CSE-4248	Simulation and Modeling Sessional	0.75	0613	SE-3228	Simulation and Modeling Laboratory	0.75
68.	CSE-4139	VLSI Design	3.00	0613	SE-3229	VLSI Design	3.00
69.	---	---	----	0613	SE-3230	VLSI Design Laboratory	0.75
70.	---	---	----	0613	SE-3231	Natural Language Processing	3.00
71.	---	---	----	0613	SE-3232	Natural Language Processing Laboratory	0.75
72.	CSE-4000	Project / Thesis***	3.00	061	SE-4000	Final Year Design Project (FYDP)/ Thesis***	1.50
73.	CSE-4100	Integrated Design	0.75	0613	SE-4100	Software	1.50

		Project / Capstone Project (Phase-II)				Development Project - II	
74.	CSE-4207	Digital Signal Processing	3.00	0612	SE-4101	Digital Signal Processing	3.00
75.	CSE-4208	Digital Signal Processing Sessional	0.75	0612	SE-4102	Digital Signal Processing Laboratory	0.75
76.	---	---	----	0612	SE-4103	Cellular and Wireless Communication	3.00
77.	---	---	----	0613	SE-4105	Data Science and Applications	3.00
78.	CSE-4203	Data and Network Security	3.00	0611	SE-4107	Computer and Cyber Security	3.00
79.	---	---	----	0413	SE-4109	Software Testing and Quality Assurance	3.00
80.	---	---	----	0611	SE-4111	Parallel and Distributed Systems	3.00
81.	CSE-4133	Bioinformatics	3.00	0613	SE-4113	Bioinformatics	3.00
82.	CSE-4137	Machine Learning	3.00	0613	SE-4115	Machine Learning	3.00
83.	---	---	----	0613	SE-4116	Machine Learning Laboratory	0.75
84.	CSE-4249	Data Mining and Data Ware-housing	3.00	0613	SE-4117	Data Mining and Data Ware-housing	3.00
85.	CSE-4250	Data Mining and Data Ware-housing Sessional	0.75	0613	SE-4118	Data Mining and Data Ware-housing Laboratory	0.75
86.	---	---	----	0613	SE-4119	Digital System Design	3.00
87.	---	---	----	0613	SE-4120	Digital System Design Laboratory	0.75
88.	CSE-4000	Project / Thesis***	3.00	061	SE-4000	Final Year Design Project (FYDP)/ Thesis***	6.00
89.	CSE-4205	Computer Graphics	3.00	0613	SE-4211	Computer Graphics and	3.00

						Multimedia Systems	
90.	CSE-4206	Computer Graphics Sessional	1.50	0613	SE-4212	Computer Graphics and Multimedia Systems Laboratory	0.75
91.	HUM-4163	Technology Entrepreneurship and Leadership	3.00	0413	ED-4251	Engineering Management and Leadership	2.00
92.	---	---	----	0613	SE-4113	Cloud Computing	3.00
93.	---	---	----	0612	SE-4215	Green Computing	3.00
94.	---	---	----	0612	SE-4217	Network Planning	3.00
95.	---	---	----	0611	SE-4219	Blockchain and Cryptocurrency Technology	3.00
96.	CSE-4253	Internet of Things (IoT)	3.00	0611	SE-4221	Internet of Things (IoT)	3.00
97.	CSE-4254	Internet of Things (IoT) Sessional	0.75	0611	SE-4222	Internet of Things (IoT) Laboratory	0.75
98.	CSE-4251	Advanced Database Management Systems	3.00	0612	SE-4223	Advanced Database Management Systems	3.00
99.	CSE-4252	Advanced Database Management Systems Sessional	0.75	0612	SE-4224	Advanced Database Management Systems laboratory	0.75
100.	CSE-4243	Pattern Recognition	3.00	0611	CSE-4225	Pattern Recognition	3.00
101.	CSE-4244	Pattern Recognition Sessional	0.75	0611	CSE-4226	Pattern Recognition Laboratory	0.75
102.	CE-1270	Engineering Drawing and CAD Sessional	0.75	---	---	----	---
103.	HUM-1153	Bengali Language and Literature	2.00	---	---	----	---
104.	CSE-2215	Digital Electronics	3.00	---	---	----	---

		and Pulse Technique					
105.	CSE-2216	Digital Electronics and Pulse Technique Sessional	0.75	---	---	----	---
106.	CSE-2218	Advanced Programming Sessional	1.50	---	---	----	---
107.	CSE-3102	Numerical Analysis Sessional	0.75	---	---	----	---
108.	HUM-3261	Financial and Managerial Accounting	2.00	---	---	----	---
109.	CSE-4106	Technical Writing and Presentation Sessional	0.75	---	---	----	---
110.	CSE-4123	Basic Graph Theory	3.00	---	---	----	---
111.	CSE-4127	Object Oriented Software Engineering	3.00	---	---	----	---
112.	CSE-4129	Artificial Neural Networks and Fuzzy Systems	3.00	---	---	----	---
113.	CSE-4131	Computer Vision	3.00	---	---	----	---
114.	CSE-4135	Robotics	3.00	---	---	----	---
115.	CSE-4245	Mobile and Ubiquitous Computing	3.00	---	---	----	---
116.	CSE-4246	Mobile and Ubiquitous Computing Sessional	0.75	---	---	----	---

Department of
Computer Science and Engineering
CSE
Faculty of Electrical and Computer Engineering (ECE)



BAUET
Bangladesh Army University of Engineering & Technology
Qadirabad, Dayarampur, Natore-6431
Web: www.bauet.ac.bd