Department of Information and Communication Engineering

ICE

BAUET

Bangladesh Army University of Engineering & Technology
Qadirabad, Dayarampur, Natore-6431
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2nd Edition

Bangladesh Army University of Engineering & Technology

Qadirabad, Natore

Syllabus for Bachelor of Science in

Information and Communication Engineering

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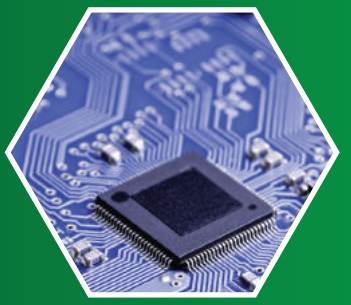

Bangladesh Army University of Engineering & Technology (BAUET)

Qadirabad, Natore

Syllabus for Bachelor of Science in Information and Communication Engineering

Department of Information and Communication Engineering (ICE)
Faculty of Electrical and Computer Engineering (ECE)

Applicable from Session 2019-20

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Preface to Second Edition

The Department of Information and Communication Engineering (ICE) of Bangladesh Army University of Engineering & Technology (BAUET) has started its journey from the academic session 2015-2016 under the faculty of Electrical and Computer Engineering (ECE). The academic focus of this department lies on the intersection of Information Technology based on Electrical, Computer and Communication Engineering. This focus is reflected in the second edition of this syllabus by incorporation of cutting-edge course curriculum in the field of Information Technology and Communication Engineering.

The courses offering listed in this syllabus are prepared by the faculties of the department of ICE, BAUET with the help, cooperation and feedback from some renowned faculties experience from well-reputed universities in national and international. Feedback is also taken from skill industrial professional and ex-students. The curriculum is organized in a way so that students can choose their field of specialization from any of the fields, i.e. Communication Engineering, IT/Software Engineering without sacrificing the fundamental and basic study of core courses. The core and specialized courses got more focus both on Hardware and Software Engineering including Internet and Web Programing, Software Programing, Software Quality Assurance, Mobile Apps and Game, Artificial Intelligence, Cloud Computing, Computer Vision, Computer networking, Network Security, Satellite, Mobile and Telecommunication, Optical Fiber Communication, Microwave, Antenna and Radar Engineering, Digital Signal Processing, Microprocessor, Analog and Digital Electronics. The feature of Outcome-Based Education (OBE) including Integrated Design Project (IDP) has been incorporated in this edition. As a result of this and other major changes in course contents, the laboratory materials have also changed with more design-oriented classes having an emphasis on both practical and simulation components. The department has developed many facilities for such changes to be incorporated effectively and effort is also underway to improve the situation further.

The graduates of the department of ICE have bright prospect to contribute as key personnel in all spheres of activities relating to Engineering and Technology. Hence, followed by the deployment of 'Digital Bangladesh', education in ICE is blooming. Now we are aiming at building an advanced information society with the help of skilled ICE graduates. Therefore, the Department of ICE, BAUET is well prepared for exploring ICE skilled resources to fulfill today and tomorrow's demand of Bangladesh and all over the world.

Rules and regulation given in this syllabus may revise time to time with the administrative policy. Therefore, every concerned are strongly advised to be in touch with the department.

Head,
Department of Information and Communication Engineering (ICE),
Bangladesh Army University of Engineering & Technology (BAUET).

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Chapter 1: General Information

1.1 Introduction

The B.Sc. Engineering courses in Information and Communication Engineering 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, Year-2, Year-3, and Year-4 in succeeding higher Years of study. The academic Year will be divided into two Semesters (1st Semester and 1st SemesterI) each having duration of 22 weeks. Under no circumstances, any student shall be allowed to continue his/her study for B.Sc. Engineering degree for more than six academic years. A student will be required to have 70% 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.

1.2 Vision and Missions of University

Vision of BAUET

The university aspires to transform into a centre of excellence in Science, Engineering andTechnology programs by providing innovative, multi-disciplinary courses and extensive research facility 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 of the country.

Missions of BAUET

- To provide comprehensive education and conduct research in diverse disciplines of science, engineering, technology and engineering management.
- To produce technologically advanced intellectual leaders and professionals with high moral and ethical values to meet the socio- economic development of Bangladesh and global needs.
- To conduct collaborative and research activities with national and international communities for continuous interaction with academia and industry.
- To provide consultancy, advisory and testing services to government, nongovernment, autonomous and individuals for widening practical knowledge and to contribute in sustainable development.

1.3 Vision and Missions of Department

Vision of the Department of ICE

To educate students committed to the innovative and ethical application of science and technology and conduct research to meet the national and global challenges in ICT area.

Missions of the Department of ICE

Department of Information and Communication Engineering (ICE) is working with the following missions in mind.

- To provide high quality state of the art education and knowledge in Information and Communication Engineering, capable of solving real-world complex engineering problems to meet the needs of industry and society.
- To contribute towards the creation of new knowledge through eminence research and innovation in ICE and allied fields to address emerging national and global issues for well-being of the society.
- To enable students in attaining required ethics with an attitude of entrepreneurial skills, ethical values and social consciences.
- To embed leadership qualities amongst the students to follow successful professional career paths and to pursue advanced studies in Communication Engineering and a life-long learner in cutting edge developments in the field of Information Technology.

1.4 Program Educational Objectives (PEOs)

No	PEO Statement
PEO-1	Graduates of the program will have successful professional both in industry and government and/or will be able to successfully pursue advanced degrees.
PEO-2	Graduates will apply analysis, design, optimization and implementation skills in order to formulate and solve Information and Communication Engineering and multidisciplinary complex engineering problems.
PEO-3	Graduates will communicate effectively and work collaboratively maintaining high Year of ethical and professional values for improving the society.
PEO-4	Graduates will take leadership positions in the industry and also initiate businesses offering innovative technical solutions to national and international problems.

1.5 PEO and their Mapping with Mission

Program Educational Objectives (PEOs) are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve. PEOs are assessable based on the attributes and accomplishments of graduates, preferably those who have worked for 3 to 5 year after graduation. Statements and their relationship-/mapping with program mission are presented below.

No.	PEO Statements	Program Missions			
		Statement 1	Statement 2	Statement 3	Statement 4
PEO-1	Graduates of the program will have successful professional career and Impart profound knowledge in humanities and basic sciences along with core engineering concepts for practical understanding.	Yes	Yes	No	No
PEO-2	Graduates will apply analysis, design, optimization and implementation skills in order to formulate and solve Information and Communication Engineering and multidisciplinary problems.	Yes	Yes	No	No
PEO-3	Graduates will be able to establish and run sustainable business enterprises along diverse career paths by creating, selecting, applying appropriate and modern technologies, skills and tools	No	No	Yes	Yes
PEO-4	Graduate will prove his/her ability to work and communicate effectively as a team member and /or leader to complete the task with minimal resources and they develop computing systems for real life problems, Graduates of the program will pursue higher education.	No	No	Yes	Yes

1.6 Program Outcomes

Program Outcomes (POs) represent the knowledge, skills and attitudes the students should have at the end of a four-Year engineering program. ICE program of BAUET has 12 Program Outcomes. They are briefly described in the following table.

PO	Category	Description
PO1	**Engineering Knowledge**	Apply knowledge of mathematics, science, and Information and Communication Engineering for solving engineering problems and modeling.
PO2	**Problem Analysis**	Design and conduct experiments as well as to analyze and interpret experimental or collected data, simulate and fabricate electronic circuits and systems and make own projects utilizing latest software tools and techniques. They also possess the ability to identify, formulate, research literature and analyze complex engineering problems to reach logical conclusions.
PO3	**Design/Development of Solutions**	Design a system, component or process to meet the desired specifications, performance and capabilities; compatible with health, safety, legal, societal and environmental considerations.
PO4	**Conduct investigations of complex problems**	Use research-based knowledge and research methods including design of experiments in analyzing and interpreting data, and synthesizes the data to come to valid conclusion.
PO5	**Modern tool usage**	Apply appropriate techniques, resources and modern attitudes, IT tools (linking hardware and software) including prediction and modeling to complex engineering activities and research.
PO6	**Engineer and Society**	Understand the special duty they owe to protect the public's health, safety and welfare by virtue of their professional status as engineers in society.
PO7	**Environment and sustainability**	Understand and correctly interpret the impact of engineering solutions in global, societal and environmental contexts and demonstrate the knowledge of a need for sustainable development.
PO8	**Ethics**	Understand ethics of life and professions and abide by them.
PO9	**Individual work and teamwork**	Articulate teamwork principles, work with a multi-disciplinary team, and appreciate the role of a leader, leadership principles, and attitudes conducive to effective professional practice of Information and Communication Engineering.
PO10	**Communication**	Communicate and present effectively both orally and in writing, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.
PO11	**Project management and finance**	Demonstrate knowledge and understanding of the engineering finance and management principles as a member and leader in a team to manage projects in multi-disciplinary environments.
PO12	**Life long learning**	Engage in life-long learning, demonstrate knowledge and understanding of contemporary and emerging issues relevant to their domain - demonstrate knowledge and understanding of business practices and principles of management and understand their limitations, develop awareness of legal consequences of engineering solution.

1.7 Relationship between the POs and PEOs

The relationship between the POs and PEOs are following

No.	PO Statement	PEO-1	PEO-2	PEO-3	PEO-4
PO-1	**Engineering knowledge:** Apply knowledge of mathematics, science, and Information and Communication Engineering for solving engineering problems and modeling.	**Yes**	No	No	**Yes**
PO-2	**Problem analysis:** Design and conduct experiments as well as to analyze and interpret experimental or collected data, simulate and fabricate electronic circuits and systems and make own projects utilizing latest software tools and techniques. They also possess the ability to identify, formulate, research literature and analyze complex engineering problems to reach logical conclusions.	**No**	No	**Yes**	No
PO-3	**Design/development of solutions:** Design a system, component or process to meet the desired specifications, performance and capabilities; compatible with health, safety, legal, societal and environmental considerations.	**No**	**Yes**	No	**Yes**
PO-4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments in analyzing and interpreting data, and synthesizes the data to come to valid conclusion.	**Yes**	**Yes**	No	No
PO-5	**Modern tool usage:** Apply appropriate techniques, resources and modern attitudes, IT tools (linking hardware and software) including prediction and modeling to complex engineering activities and research.	**Yes**	No	**No**	No
PO-6	**Engineer and Society:** Understand the special duty they owe to protect the public's health, safety and welfare by virtue of their professional status as engineers in society.	No	**Yes**	No	**No**
PO-7	**Environment and sustainability:** Understand and correctly interpret the impact of engineering solutions in global, societal and environmental contexts and demonstrate the knowledge of a need for sustainable development.	**Yes**	No	**No**	**Yes**
PO-8	**Ethics:** Understand ethics of life and professions and abide by them.	No	**Yes**	**Yes**	**No**
PO-9	**Individual work and teamwork:** Articulate teamwork principles, work with a multi-disciplinary team, and appreciate the role of a leader, leadership principles, and attitudes conducive to effective professional practice of Information and Communication Engineering.	No	**Yes**	No	No
PO-10	**Communication:** Communicate and present effectively both orally and in writing, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.	**Yes**	No	No	No
PO-11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering finance and management principles as a member and leader in a team to manage projects in multi-disciplinary environments.	No	**Yes**	**No**	**Yes**
PO-12	**Life-long learning:** Engage in life-long learning, demonstrate knowledge and understanding of contemporary and emerging issues relevant to their domain - demonstrate knowledge and understanding of business practices and principles of management and understand their limitations, develop awareness of legal consequences of engineering solution.	**Yes**	**Yes**	No	No

1.8 Laboratory Facilities of the Department

The department endeavors to provide its faculty members and students adequate laboratory, library and other facilities. Departmental undergraduate courses are well supported by the following laboratories:

Si. no.	Name of the laboratories
1.	Communication Lab
2.	Switching and Routing Lab
3.	Antenna and Satellite Communication Lab
4.	Computer Architecture & Organization Lab
5.	Geographic Information System Lab
6.	Computer Lab
7.	Electronics and Electromagnetic Lab

Chapter 2: Rules and Regulations for Undergraduate Program

2.1 Overview

The ICE Program of BAUET approved by UGC, introduced the OBE (Outcome Based Education) curriculum for conducting courses from 2019-2020 sessions in all corresponding undergraduate batches. Therefore, the rules and regulations mentioned in this paper will be applicable to students for administering undergraduate curriculum through the course system. This will be introduced with an aim of creating a continuous, even and consistent workload throughout the Semester for the students.

2.2 Degree Offered

The department offers a degree in Bachelor of Science in Information and Communication Engineering.

2.3 Admission Eligibility

SSC/Dakhil and HSC/Alim Examinations: HSC/Alim or equivalent examination in Science Group with Mathematics, Physics and Chemistry scoring minium 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

a. **Year:** 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)
b. **A Year:** Minimum C Grade in 2 subjects including Mathematics, Physics/Chemistry.
c. The sum total of GOA in GCE A and O Year should be 6.
d. The candidares with E grade in any subject will not be considered.

2.4 Number of Semesters in a Year

There will be two Semesters in an academic year.

a) Summer Semester
b) Fall Semester

Duration of Semesters

There will be two Semesters: Summer Semester and Fall Semester. Summer Semester will be of 24 weeks and Fall Semester will be of 28 weeks (Total 52 weeks). An Academic Calender will be provided to all the enrolled students to make them familiar to all academic events. The holiday will also be included in the calender.
Duration of Summer Semester and Fall Semester will be as follows:

Summer 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**

Fall 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 and Survey Practical	4 weeks
Total		**28 weeks**

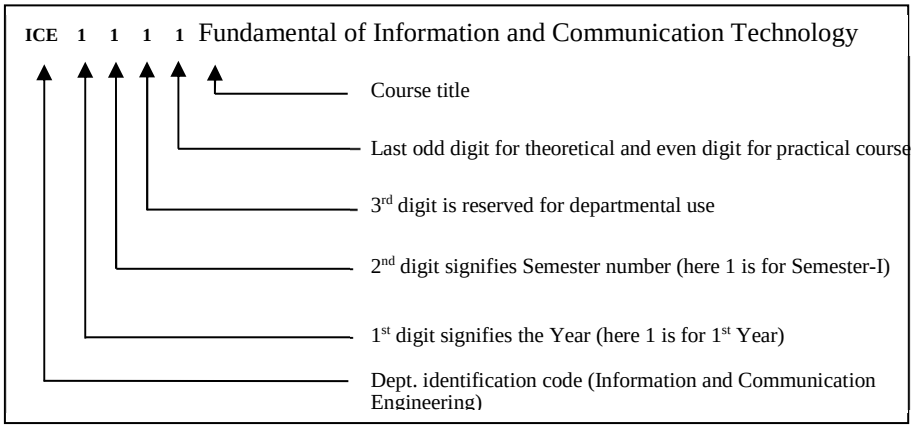
Note: Those who will not be anle to clear any of the courses (only theoretical) of any discipline in a particular Semester will be required to appear at the referred examination (Re-examination) for fulfilling the condition as per policy to clear the subect(s).

2.5 Course Designation System

Each course is designated by a maximum of four-letter code identifying the department offering the course followed by a three-digit number having the following interpretation

a. The left most digit corresponds to the Year in which the course is normally taken by the students. The second digit is reserved for departmental use. It usually identifies a specific area/group of study within the department.
b. The right most digit is an odd number for theoretical courses and an even number for sessional courses.

The course designation system is illustrated as follows



2.6 Assignment of Credits

The assignment of credits to a theoretical course follows a different rule from that of a sessional course.

a. **Theoretical Courses:** One lecture per week per Semester is equivalent to one credit.
b. **Sessional Courses:** Credits for sessional courses is half of the class hours per week per Semester. Credits are also assigned to project and thesis work taken by the students. The number of credits assigned to such work varies from one discipline to another.

2.7 Types of Courses

The types of courses included in the undergraduate curricula are divided into the following groups:

a. Core Courses: In each discipline, a number of courses are identified as core courses, which form the nucleus of the respective bachelor's degree program. A student has to complete all designated core courses of his/her discipline.

b. Prerequisite Courses: A prerequisite course is one which is required to be completed before some other course(s) can be taken.

c. Optional Courses: Apart from the core courses, the students can choose from a set of optional courses. A required number of optional courses from a specified group have to be chosen.

d. Integrated Design Project (IDP)/Capstone Project and Thesis: Integrated design project/ Capstone project with two phases has to complete in the combine duration of two Semester in Year-3, 1st Semester, phase-I (credit hour 1 and contact hour 2) and Year-3, 1st SemesterI, phase-II (credit hour 1 and contact hour 2). The thesis/project will have to be undertaken in Year-4 by students under separate supervisors in partial fulfillment of the requirement of his/her degree. Credits allotted to the thesis will be 4.00 and corresponding 8.00 contact hours where 4.00 contact hours in Year-4, 1st Semester and another 4.00 contact hours in Year-4 1st SemesterI.

2.8 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.

2.9 Teacher-Student Interaction

The new course system encourages students to come in close contact with the teachers. For promotion of a high Year 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.

Student Mentoring

Besides the respective faculty of each subject/program, every student wil 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.

Student Adviser

One adviser is normally appointed for a batch of students by the concerned department. The 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.

2.10 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.

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.

Pre-Conditions for Registration

a. For first Year students, department-wise enrollment/ 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.

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 enrollment prior to the last date of registration.
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.

2.11 Time Limits for Completion of Bachelor's Degree

A student must complete his/her studies within a maximum period of six academic years for completion of B.Sc. Engineering degree.

2.12 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.

The guidelines for attendance marks are as follows:

Category	Marks
For Theory Course	5
For Sessional Courses	10

The attendance marks distribution for the final assessment is as following:

Attendance	Marks	Sessional (10) Marks
90% and above	05%	As per earned percentage (%) of Attendance.
85% to 89%	4.5%	
80% to 84%	04%	
75% to 79%	3.9%	
70% to 74%	03%	
Below 70%	00%	

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.

2.13 The Grading System

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+	4.00
75% to below 80%	A	3.75
70% to below 75%	A-	3.50
65% to below 70%	B+	3.25
60% to below 65%	B	3.00
55% to below 60%	B-	2.75
50% to below 55%	C+	2.50
45% to below 50%	C	2.25
40% to below 45%	D	2.00
Below 40%	F	0.00
Incomplete	I	--
Withdrawal	W	
Project/Thesis Continuation	X	
Due to offence	E	Expelled

2.14 Distribution of Marks

Theory

Thirty percent (30%) marks of theoretical course shall be allotted for continuous assessment, i.e., quizzes, 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 is as follows.

Category	Marks %
Class Perticipation/Observation/Performance	5%
Homework/Assignment/Quizzes	5%
Class tests	20%
Final Examination (Maximum 3 Hours)	70%
Total	**100**

Sessional/Practical examinations

The marks for the Sessional Courses will be distributed according to the type of the sessional course. The distribution of marks for three types of sessional is given below:

Marks Distribution for Project Based Sessionals

Category	Marks %
Lab Test/Project	30%
Quiz Test	20%
Viva voce	10%
Attendance	10%
Report Writing	20%
Lab Performance/Project	10%
Total	**100**

Marks Distribution of Programming Based Sessionals

Category	Marks %
Lab Test – 1	25%
Lab Test – 2	25%
Viva voce	10%
Attendance	10%
Report Writing	10%
Class Performance/Continuous Assesment	20%
Total	**100**

Sessional Course of Communicative Englishder:

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**

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

2.15 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

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

The Cumulative Grade Point Average (CGPA) is the weighted average of the GPA obtained in all the Semesters passed/completed by a student. For example, if a student passes/ completes n Semesters having total credits of $TC_1, TC_2, \dots, TC_n$ and his GPA in these Semesters are GPA_1, GPA_2, GPA_n respectively then

$$CGPA = \frac{\sum_{i=1}^{n} TC_i * GPA_i}{\sum_{i=1}^{n} TC_i}$$

A Numerical Example

Suppose a student has completed nine courses in a Semester and obtained the following grades:

Course	Credit C_i	Grade Points	G_i	C_i*G_i
ICE1111	3.00	A	3.75	11.25
ICE1112	0.75	A+	4.00	3.00
ICE 1121	3.00	A-	3.50	10.5
ICE 1122	1.50	B+	3.25	4.875
PHY 1131	3.00	A	3.75	11.25
PHY 1132	1.50	A	3.75	5.625
MATH 1141	3.00	A	3.75	11.25
HUM 1151	3.00	A-	3.50	10.50
HUM 1152	1.50	B+	3.25	4.875
Total	20.25			73.125

CGPA = 73.125/20.25 = 3.61
Suppose a student has completed four Semesters and obtained the following GPA:

Year	Semester	Earned Credit Hours TC_i	Earned GPA GPA_i	TC_i*GPA_i
1	I	21.75	3.75	81.5625
1	II	20.75	3.61	74.9075
2	I	19.75	3.96	78.210
2	II	21.00	2.98	62.5800
Total		83.00		297.26

$$\text{CGPA} = \frac{297.26}{83.00} = 3.58$$

Grade Conversion (CGPA to percentage of marks)

CGPA of any student may be converted into percentage of marks using following rules:

% of Marks = 79 + 80 × (CGPA – 3.75) for $3.75 \leq \text{CGPA} \leq 4.00$ and % of Marks = 44 + 20 × (CGPA-2.00) for $2.20 \leq \text{CGPA} < 3.75$

2.16 Promotion to the Next Semester

[As per BAUET Exam policy]

2.17 Minimum Earned Credit and CGPA Required for Obtaining a Degree

[As per BAUET Exam policy]

2.18 Consequences of Poor Performance (Referred/Improvement/Backlog)

[As per BAUET Exam policy]

2.19 Semester Withdrawal

[As per BAUET Exam policy]

2.20 Withdrawal from Program

[As per BAUET Exam policy]

2.21 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.

2.22 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.

2.23 Rounding off the Decimal Marks

If there are any decimal marks in any of the examinations like class test, tutorial, Semester 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%).

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

2.25 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.

2.26 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.

2.27 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.

2.28 Recognition of Performance

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 Year, 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 3: Course Curriculum for BSc in ICE

3.1 Semester wise Course Distribution

The list of course offered to the students of BSc in Information and Communication Engineering (ICE) are shown in Semester-wise.

1st Year, 1st Semester						
Si.	**Course Code**	**Course Titles**	**Hours/Week**		**Credits**	**Pre-requisite**
			Theory	**Sessional**		
1	ICE 1111	Fundamental of Information and Communication Technology	3.00	-	3.00	
2	ICE 1112	Fundamental of Information and Communication Technology Sessional	-	2.00	1.00	
3	ICE 1121	Basic Electrical and Electronics Engineering	3.00	-	3.00	
4	ICE 1122	Basic Electrical and Electronics Engineering Sessional	-	3.00	1.50	
5	MATH 1131	Differential and Integral Calculus	3.00	-	3.00	
6	PHY 1141	Engineering Physics	3.00	-	3.00	
7	PHY 1142	Engineering Physics Sessional	-	2.00	1.00	
8	HUM 1151	Technical and Communicative English	2.00	-	2.00	
9	HUM 1152	Technical and Communicative English Sessional	-	2.00	1.00	
10	HUM 1153	Bengali Language and Literature	2.00	-	2.00	
Total			**16.00**	**09.00**	**20.50**	

1st Year, 2nd Semester						
Sl.	**Course Code**	**Course Titles**	**Hours/Week**		**Credits**	**Pre-requisite**
			Theory	**Sessional**		
1	ICE 1211	Structured Programming Language	3.00	-	3.00	
2	ICE 1212	Structured Programming Language Sessional	-	3.00	1.50	
3	ICE 1221	Analog Electronics	3.00	-	3.00	ICE 1121
4	ICE 1222	Analog Electronics Sessional	-	3.00	1.50	ICE 1122
5	MATH 1231	Linear Algebra and Vector Analysis	3.00	-	3.00	
6	MATH 1241	Statistics for Engineers	3.00	-	3.00	
7	CHEM 1251	Engineering Chemistry	3.00	-	3.00	
8	HUM 1255	Bangladesh Studies (History of Independence)	2.00	-	2.00	
Total			**17.00**	**6.00**	**20.00**	

2nd Year, 1st Semester						
Sl.	Course Code	Course Titles	Hours/Week		Credits	Pre-requisite
			Theory	Sessional		
1	ICE 2111	Data Structures and Algorithms	3.00	-	3.00	ICE 1211
2	ICE 2112	Data Structures and Algorithms Sessional	-	3.00	1.50	ICE 1212
3	ICE 2121	Digital Electronics	3.00	-	3.00	
4	ICE 2122	Digital Electronics Sessional	-	3.00	1.50	
5	ICE 2131	Signals and Systems	3.00	-	3.00	
6	ICE 2132	Signals and Systems Sessional	-	3.00	1.50	
7	ICE 2141	Numerical methods	2.00	-	2.00	
8	ICE 2142	Numerical methods Sessional	-	2.00	1.00	
9	ICE 2151	Discrete Mathematics	2.00	-	2.00	
10	MATH 2161	Matrices and Differential Equations	3.00	-	3.00	
Total			**16.00**	**11.00**	**21.50**	

2nd Year, 2nd Semester						
Sl.	Course Code	Course Titles	Hours/Week		Credits	Pre-requisite
			Theory	Sessional		
1	ICE 2211	Analog and Digital Communication	3.00	-	3.00	
2	ICE 2212	Analog and Digital Communication Sessional	-	3.00	1.50	
3	ICE 2221	Computer Networking	3.00	-	3.00	
4	ICE 2222	Computer Networking Sessional	-	3.00	1.50	
5	ICE 2231	Object Oriented Programming Language	3.00	-	3.00	ICE 1211
6	ICE 2232	Object Oriented Programming Language Sessional	-	3.00	1.50	ICE 1212
7	ICE 2241	Electromagnetic Field and Antenna Engineering	3.00	-	3.00	
8	ICE 2242	Electromagnetic Field and Antenna Engineering Sessional	-	3.00	1.50	
9	HUM 2251	Sociology and Economics	3.00	-	3.00	
Total			**15.00**	**12.00**	**21.00**	

3rd Year, 1st Semester						
Sl.	Course Code	Course Titles	Hours/Week		Credits	Pre-requisite
			Theory	Sessional		
1	ICE 3111	Optical Fiber Communication	3.00	-	3.00	
2	ICE 3112	Optical Fiber Communication Sessional	-	3.00	1.50	
3	ICE 3121	Database Management System	3.00	-	3.00	
4	ICE 3122	Database Management System Sessional	-	3.00	1.50	
5	ICE 3131	Advanced Java Programming	3.00	-	3.00	ICE 2231
6	ICE 3132	Advanced Java Programming Sessional	-	3.00	1.50	ICE 2232
7	ICE 3141	Wireless and Mobile Communication	3.00	-	3.00	
8	ICE 3142	Wireless and Mobile Communication Sessional	-	3.00	1.50	
9	HUM 3157	Professional Ethics and Environmental Protection	2.00	-	2.00	
10	ICE 3000	Integrated Design Project (IDP) *	-	2.00	1.00	
Total			**14.00**	**14.00**	**21.00**	

***Note:** Each student has to complete one Integrated Design Project (IDP) in the combined duration of two Semester of Year-3. In course ICE- 3000 (Part-I), a student has to make a proposal defense at the end of the Semester. The defensed Integrated Design Project (IDP) has to be completed in the continuation course ICE-3000 (Part-II) in next Semester.

3rd Year, 2nd Semester						
Sl.	Course Code	Course Titles	Hours/Week		Credits	Pre-requisite
			Theory	Sessional		
1	ICE 3211	Microprocessor and Microcontroller	3.00	-	3.00	
2	ICE 3212	Microprocessor and Microcontroller Sessional	-	3.00	1.50	
3	CSE 3221	Distributed Operating System	3.00	-	3.00	
4	CSE 3222	Distributed Operating System Sessional	-	3.00	1.50	
5	ICE 3231	Digital Signal Processing	3.00	-	3.00	
6	ICE 3232	Digital Signal Processing Sessional	-	3.00	1.50	
7	HUM 3241	Industrial Management and Accountancy	3.00	-	3.00	
8	ICE 3000	Integrated Design Project (IDP)	-	2.00	1.00	
9	ICE 3260	Industrial Training*	-	4 Weeks	1.00	
Total			**12.00**	**11.00**	**18.50**	

***Note:** ICE3260 (Industrial training) in a particular industry as arranged by the department will be conducted at any convenient time after the Semester final examination of Year-3, (1st Semester/II) for a duration of 4 weeks as applicable or decided by the department. Completion of industrial attachment is mandatory for issuing of B.Sc.

degree. Evaluation report from industry is to be submitted at the end of the training and accordingly to be incorporated in the tabulation sheet.

4th Year, 1st Semester						
Sl.	**Course Code**	**Course Titles**	**Hours/Week**		**Credits**	**Pre-requisite**
			Theory	**Sessional**		
1	ICE 4000	Project / Thesis*	-	4.00	2.00	
2	ICE 4121	Network Security	3.00	-	3.00	
3	ICE 4***	Elective I	3.00	-	3.00	
4	ICE 4***	Elective I Sessional	-	3.00	1.50	
5	ICE 4***	Elective II	3.00	-	3.00	
6	ICE 4***	Elective II Sessional	-	3.00	1.50	
7	ICE 4***	Elective III	3.00	-	3.00	
8	ICE 4103	Seminar (Related Topics)		2.00	1.00	
Total			**12.00**	**12.00**	**18.00**	

***Note**: Each student has to complete one Project or Thesis in the combined duration of two Semester of Year-4. In course ICE- 4000 (Part-I), a student has to make a proposal defense at the end of the Semester. The defensed project/thesis has to be completed in the continuation course ICE-4000 (Part-II) in next Semester.

****Note:** Semester digit number depends on theory/sessional course chosen from elective courses.

4th Year, 2nd Semester						
Sl.	**Course Code**	**Course Titles**	**Hours/Week**		**Credits**	**Pre-requisite**
			Theory	**Sessional**		
1	ICE 4000	Project / Thesis**	-	4.00	2.00	
2	ICE 4211	Artificial Intelligence and Neural Computing	3.00	-	3.00	
3	ICE 4212	Artificial Intelligence and Neural Computing Sessional	-	3.00	1.50	
4	ICE 4231	Software Engineering	3.00	-	3.00	
5	ICE 4232	Software Engineering Sessional	-	3.00	1.50	
6	ICE 4***	Elective IV	3.00	-	3.00	
7	ICE 4***	Elective IV Sessional	-	3.00	1.50	
8	ICE 4***	Elective V	3.00	-	3.00	
Total			**12.00**	**13.00**	**18.50**	

***** Note:** Semester digit number depends on theory/sessional course chosen from elective courses.

3.2 List of Elective Courses

Communication Engineering							
Sl.	**Course Code**	**Course Titles**	**Year, Semester**	**Hours/Week**		**Credits**	**Pre-requisite**
				Theory	**Sessional**		
1	ICE4*13	Satellite Communication and Radar	Year-4, 1st Semester/II	3.00	-	3.00	
2	ICE4*14	Satellite Communication and Radar Sessional	Year-4, 1st Semester/II	-	3.00	1.50	
3	ICE4*15	Telecommunication and Switching	Year-4, 1st Semester/II	3.00	-	3.00	
4	ICE4*17	Communication Theory	Year-4, 1st Semester/II	3.00	-	3.00	
5	ICE4*19	Multimedia System & Application	Year-4, 1st Semester/II	3.00	-	3.00	
6	ICE4*23	Information Theory and Coding	Year-4, 1st Semester/II	3.00	-	3.00	
7	ICE4*25	Microwave Engineering	Year-4, 1st Semester/II	3.00	-	3.00	ICE 2241
8	ICE4*26	Microwave Engineering Sessional	Year-4, 1st Semester/II	-	3.00	1.50	ICE 2242

*** Note:** Semester digit number depends on 1st Semester/ 1st SemesterI course chosen for Year-4.

IT/Software Engineering							
Sl.	**Course Code**	**Course Titles**	**Year, Semester**	**Hours/Week**		**Credits**	**Pre-requisite**
				Theory	**Sessional**		
1	ICE4*29	Cloud Computing	4th Year, 1st/2nd Semester	3.00	-	3.00	
2	ICE4*33	Software Quality Assurance	4th Year, 1st/2nd Semester	3.00	-	3.00	
3	ICE4*35	Human Computing Interfacing	4th Year, 1st/2nd Semester	3.00	-	3.00	
4	ICE4*37	Speech Processing and Speech Recognition	4th Year, 1st/2nd Semester	3.00	-	3.00	
5	ICE4*38	Speech Processing and Speech Recognition Sessional	4th Year, 1st/2nd Semester	-	3.00	1.50	
6	ICE4*39	Big Data Analytics and Social Networking	4th Year, 1st/2nd Semester	3.00	-	3.00	
7	ICE4*41	Mobile Application Development	4th Year, 1st/2nd Semester	3.00	-	3.00	
8	ICE4*42	Mobile Application Development Sessional	4th Year,	-	3.00	1.50	

			1st/2nd Semester				
9	ICE4*43	Data Mining	4th Year, 1st/2nd Semester	3.00	-	3.00	
10	ICE4*45	Internet and Web Programming	4th Year, 1st/2nd Semester	3.00	-	3.00	
10	ICE 4*46	Internet and Web Programming Sessional	4th Year, 1st/2nd Semester	-	3.00	1.50	
11	ICE4*47	Machine Learning	4th Year, 1st/2nd Semester	3.00	-	3.00	
12	ICE4*51	Natural Language Processing	4th Year, 1st/2nd Semester	3.00	-	3.00	
13	ICE4*52	Natural Language Processing Sessional	4th Year, 1st/2nd Semester	-	3.00	1.50	
14	ICE4*53	Computer Graphics and Animation	4th Year, 1st/2nd Semester	-	3.00	1.50	

*** Note:** Semester digit number depends on 1st Semester/ 1st SemesterI course chosen for Year-4.

Interdisciplinary							
Sl.	**Course Code**	**Course Titles**	**Year, Semester**	**Hours/Week**		**Credits**	**Pre-requisite**
				Theory	**Sessional**		
1	ICE4*55	Management Information System	4th Year, 1st/2nd Semester	3.00	-	3.00	
	ICE4*57	Bio Medical Engineering	4th Year, 1st/2nd Semester	3.00	-	3.00	
2	ICE4*59	Mechatronics and Robotics Engineering	4th Year, 1st/2nd Semester	3.00	-	3.00	
3	ICE4*61	Digital Image Processing and Pattern Recognition	4th Year, 1st/2nd Semester	3.00	-	3.00	
4	ICE4*62	Digital Image Processing and Pattern Recognition Sessional	4th Year, 1st/2nd Semester	-	3.00	1.50	
5	ICE4*63	Internet of Thing (IoT)	4th Year, 1st/2nd Semester	3.00	-		
6	ICE4*64	Internet of Thing (IoT) Sessional	4th Year, 1st/2nd Semester	-	3.00	1.50	

*** Note:** Semester digit number depends on 1st Semester/1st SemesterI course chosen for Year-4.

3.3 Summary of Credit Distribution

Year /Semester	**Hum**	**Math**	**Basic Science**	**Engineering Courses**		**Optional Courses**	**Total Credits**
				Theory	**Sessional**		
1st Year, 1st Semester	05.00	03.00	04.00	6.00	02.50	-	20.50
1st Year, 2nd Semester	02.00	06.00	03.00	06.00	03.00	-	20.00
2nd Year, 1st Semester	-	03.00	-	13.00	05.50	-	21.50
2nd Year, 2nd Semester	03.00	-	-	12.00	06.00	-	21.00
3rd Year, 1st Semester	02.00	-	-	12.00	07.00	-	21.00
3rd Year,2nd Semester	03.00	-	-	09.00	06.50	-	18.50
4th Year, 1st Semester	-	-	-	09.00	06.00	03.00	18.00
4th Year, 2nd Semester	-	-	-	09.00	06.50	03.00	18.50
Percentag	9.43%	7.55%	4.40%	47.80%	27.04%	3.78%	100.00%
Total Credit Hr	**15**	**12**	**7**	**76**	**43**	**6**	**159**

3.4 Summary of Course Credit and Contact Hours

Year/ Semester	**No of Courses**		**Hours/Week**		**Total Contact Hours**	**Credits**		**Total Credits**
	Theory	**Sessional**	**Theory**	**Sessional**		**Theory**	**Sessional**	
1st Year, 1st Semester	06	04	16.00	09.00	25.00	16.00	04.50	20.50
1st Year, 2nd Semester	06	02	17.00	06.00	23.00	17.00	03.00	20.00
2nd Year, 1st Semester	06	04	16.00	11.00	27.00	16.00	05.50	21.50
2nd Year, 2nd Semester	05	04	15.00	12.00	27.00	15.00	06.00	21.00
3rd Year, 1st Semester	05	05	14.00	14.00	28.00	14.00	07.00	21.00
3rd Year,2nd Semester	04	05	12.00	11.00	23.00	12.00	06.50	18.50
4th Year, 1st Semester	04	04	12.00	12.00	24.00	12.00	06.00	18.00
4th Year, 2nd Semester	04	04	12.00	13.00	25.00	12.00	06.50	18.50
Total	**40**	**32**	**114**	**88**	**202**	**114**	**45**	**159**

Chapter 4: Year and Semesterwise Course Outline

4.1 Course Outline of 1st Year, 1st Semester

ICE1111: Fundamental of Information and Communication Technology
Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Concept of ICT: Data, Information & Knowledge, Data processing cycle, Information Technology (IT), Communication Technology (CT), Convergence of IT & CT.

ICT for World and Bangladesh Perspective: Concept and Components of Global Village, Virtual Reality in everyday life, Artificial Intelligence (AI), Robotics, Cryosurgery, Biometrics, Bioinformatics, Genetic Engineering, Nanotechnology, ICT and Economic Development.

Ethics of ICT usages: Ethical Use of ICT, Cybercrime & way of prevention, Impact of ICT on social life.

Introduction to Computer: Evolution of Computers, Generations of Computer, Classifications of Computer, Fundamental units of a Digital Computer, Parts of a Computer System.

Input Devices: Keyboard, Pointing Devices, Scanning Devices, Optical Input Devices, Digital Camera Media Input Devices; Output Devices: Display Monitor, Printers, Plotters, Voice Output Systems, Projectors, Semesterinals.

Memory and Computer Organization: Computer Memory, Classification of Memory, RAM, ROM, Storage Systems, Magnetic Storage Devices: Magnetic Tapes, Magnetic Disks (HDD); Optical Storage Devices: CD-ROM, DVD-ROM; Magneto-optical Storage Devices, Flash Memory, Cache Memory, Smart Card; Motherboard, Central Processing Unit (CPU), Internal Communications.

Software Fundamentals: Software, Classification of Software, System Software: Operating System (OS), Types of OS, Concept of DOS, MS-DOS, WINDOWS, MacOS, UNIX, LINUX; Network OS, Embedded OS, Symbian, Android, iOS; Application Software: Word Processing Program, Spreadsheet Program, Presentation Program, Utility Programs, Device Drivers, Booting Process of a Computer.

Networking Basics: Computer Networks, Classification of Computer Networks, LAN, WAN, CAN, MAN, HAN, Server based Network, Client-Server Network, Peer-Peer Network, Network Topologies, Network Media, and Network Devices.

Data Communications & Internet: Communication System, Basic Elements of Data Communication, Data Transmission Mode, Wireless Communication System, Wireless Access Point: Bluetooth, Wi-Fi, Wi-Fi Hotspot, Wi-Max; Concept of Mobile Communication System, GSM & CDMA, Internet, Intranet, Extranet, WAP, WWW, VOIP, E-Commerce.

Database and Programming Concept: Database Management System (DBMS), RDBMS, Relationships, Normalization, Computer Program, Code, Machine Code, Programming Languages, Compilers and Interpreters, Algorithm, Flowchart, Pseudo code, Categories of Programming Languages.

Reference Book:

1	Fundamentals of Computers	E Balagurusamy, McGraw Hill Education
2	Fundamentals of Computers	V. Rajaraman, Phi; 6th edition
3	Information Technology, The Breaking Wave	Dennis P. Curtin, MC Graw Hill India

ICE 1112: Fundamental of Information and Communication Technology Sessional

Credit 1.00, Contact Hours 2.00

Pre-Requisite: None

Course Contents:

This course consists of Microsoft office work so students will perform experiments to computing, presentation, calculation software, and introduction to computer hardware learned in ICE 1101. Students will also design some database management activities.

ICE1121: Basic Electrical and Electronics Engineering

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Introduction to series-parallel circuits: Series Resistors, Series Circuits, Power Distribution in a Series Circuit, Voltage Sources in Series, Kirchhoff's Voltage Law, Voltage Division in a Series Circuit, Parallel Resistors, Parallel Circuits, Power Distribution in a Parallel Circuit, Kirchhoff's Current Law, Current Divider Rule, Voltage Sources in Parallel, Open and Short Circuits, Series-Parallel Networks, Reduce and Return Approach, Block Diagram Approach.

Method of Analysis: Current Sources, Source Conversions, Current Sources in Parallel, Current Sources in Series, Branch-Current Analysis, Mesh Analysis, Nodal Analysis, Star- (T-π) and –Delta (π-T) Conversions.

Network Theorems: Introduction, Superposition Theorem, Thévenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, and Reciprocity Theorem.

AC Circuit Analysis: Instantaneous current, voltage and power for RLC circuits, Effective current and voltage, average power, Phasor representation of sinusoidal quantities, Single phase circuit, Introduction of three phase circuits; Power factor and power equation.

Semiconductor and Diodes: 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 Transistor and FET: Transistor construction and operation, CE, CB and CC configurations and their I/O characteristics, transistor amplifying action, operating point, load line, stabilization, biasing, hybrid equivalent model, types of FET, Construction, Characteristics curve, Principle of operation, Channel ohmic and pinch-off region, Depletion type and Enhancement type MOSFET.

Reference Book:

1	Introductory Circuit Analysis	Prentice Hall of India Private Ltd-R.L. Boylestad
2	Fundamentals of Electric Circuits	McGraw Hill-C. K. Alexander
3	Introduction to Electrical Engineering	Prentice Hall of India Private Ltd.-Robert P. Ward

ICE1122: Basic Electrical and Electronics Engineering Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

In this course students will get a hand on experience about electrical circuits. They will observe the uses of electrical circuits practically. They will also simulate and analyze different electrical circuits.

MATH 1131: Differential and Integral Calculus

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Functions: Domain, Range, Inverse function and graphs of functions, Limits, Continuity, IndeSemesterinate form.

Ordinary Differentiation: Differentiability, Differentiation, Successive differentiation and Leibnitz theorem.

Expansions of functions: Rolle's theorem, Mean value theorem, Taylor's and Maclaurin's formulae. Maxima and minima of functions of one variable.

Partial Differentiation: Euler's theorem, Tangents and normal, Asymptotes.

Indefinite Integrals: Method of substitution, Integration by parts, Special trigonometric functions and rational fractions.

Definite Integrals: Fundamental theorem, General properties, Evaluations of definite integrals and reduction formulas.

Multiple Integrals: DeSemesterination of lengths, Areas and Volumes.

Reference Book:

1	A Textbook on Differential Calculus	Mohammad &Bhattacharjee; Students' Publication.
2	Differential Calculus	M. L. Khanna; JoiProkash Nath and Company.
3	Differential Calculus	Shanti Narayan; S. Chand and Company Ltd.
4	A Textbook on Integral Calculus	Mohammad & Bhattacharjee; Students' Publication.
5	Integral Calculus	Das and Mukherjee; U.N. Dhur and Sons Pvt. Ltd, Calcutta.
6	Integral Calculus	M. L. Khanna; Joi Prokash Nath and Company.

PHY 1141: Engineering Physics

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Heat & Thermodynamics: Principle of temperature measurements: Platinum resistance thermometer, Thermo-electric thermometer, Pyrometer; Kinetic theory of gases, Mean free path, equipartition of energy, Brownian motion, Van der Waal's equation of state, review of the First Law of thermodynamics and its application, reversible and irreversible processes, Second Law of thermodynamics, Carnot cycle; Efficiency of heat engines, Carnot's theorem, entropy and disorder, Gibbs Phase Rule, Third Law of thermodynamics.

Waves & Oscillations: Differential equation of a simple harmonic oscillator, total energy and average energy, Lissajous' figures, spring-mass system, damped oscillation, forced oscillation, resonance, differential equation of

a progressive wave, power and intensity of sound, stationary wave, group velocity and phase velocity, architectural acoustics, reverberation and Sabine's formula.

Physical Optics: Theories of light; Interference of light, Young's double slit experiment, Fresnel Bi-prism, Newton's rings, interferometers, diffraction of light, Fresnel and Fraunhoffer diffraction, diffraction by single slit, diffraction from a circular aperture, resolving power of optical instruments, Polarization, Production and analysis of polarized light, Brewster's law, Malus law, Polarization by double refraction, Nicol prism, Optical activity, Polarimeters.

Structure of Matter: Crystalline & non-crystalline solids, single crystal and polycrystalline solids, unit cell, crystal systems, co-ordinations number, crystal planes and directions, sodium chloride and CsCl structure, packing factor, Miller indices, relation between interlunar spacing and Miller indices, Bragg's Law, Methods of deSemesterination of Miller indices, Bonds in solids, interatomic distances, Introduction to band theory, distinction between metal, semiconductor and insulator.

Reference Book:

1	Physics (part II)	D. Halliday and R. Resnick
2	Solid State Physics	N. Singh
3	Heat and Thermodynamics	Brijlal and N Subrahmanyam
4	A Textbook of Sound	Brijlal and N Subrahmanyam
5	Properties of Matter	Brijlal and N Subrahmanyam
6	A Textbook of Optics	Brijlal and N Subrahmanyam

PHY1142: Engineering Physics Sessional

Credit 1.00, Contact Hours 2.00, Pre-Requisite: None

Course Contents:

Laboratory works based on PHY1141.

HUM1151: Technical and Communicative English

Credit 2.00, Contact Hours 2.00, Pre-Requisite: None

Course Contents:

Grammar: Grammatical principles, modals, phrases & idioms, prefixes & suffixes, sentence structures, why & yes/ no questions, conditional sentences.

Vocabulary: Technical & scientific vocabulary, defining Semesters.

Spoken English: Introduction to phonetic symbols, dialogue, responding to particular situations, extempore speech.

Reading: Comprehension of technical & non-technical materials-skimming, scanning, inferring & responding to context.

Technical Writing: Paragraph & composition writing on scientific & other themes, report writing, research paper writing, library references.

Professional communication: Business letter, job application, memos, quotations, tender notice.

Reference Book:

1	A Practical English Grammar	A. J. Thomson & A. V. Martinet
2	Oxford Handbook of Commercial Correspondence	A. Ashley
3	Technical Writing	John M. Lennon
4	J. Swales	Writing Scientific English
5	Complete Course in English	Robert J. Dixson
6	Essentials of Business Communications	Rajendra Pal & J. S. Korlahalli

HUM1152: Technical and Communicative English Sessional

Credit 1.00, Contact Hours 2.00, Pre-Requisite: None

Course Content:

- Introducing yourself and others; using greetings, Describing people/place/things
- Asking and answering questions, expressing likings and disliking; (food, fashion etc.)
- Discussing everyday routines and habits, making requests/offers/invitations/excuses/ apologies/ complaints, asking and giving directions
- Describing personality, discussing, and making plans(for a holiday or an outing to the cinema)
- Reading Newspapers and presenting their opinions
- Practicing storytelling, Narrating personal experiences
- Introducing presentation skills
- Extempore talk
- Telephone conversations (role play in group or pair)
- Practicing different professional conversation (role play of doctor-patient conversation, teacher – student conversation)
- Problem solving, peer interviews/job interviews

Activities: this course is mostly activity based. Students will often be engaged in interactive discussion. The tasks and activities include pair work, group work, brainstorming, guesswork, describing picture/graph/diagrams, word puzzle, making jokes, storytelling, and role play, responding to reading and listening texts.

HUM1153: Bengali Language and Literature

Credit 2.00, Contact Hours 2.00, Pre-Requisite: None

Course Content:

প্রথম খন্ড- ভাষা

১. বাংলা ধ্বনি/বাগ্‌ধ্বনি (Phone/Speech Sound); বর্ণ (Letter); অক্ষর (Syllable)
২. বাংলা ধ্বনির উচ্চারণ স্থান ও রীতি (Point of Articulation & Manner of Articulation)
৩. বাংলা উচ্চারণ-প্রমিত (Standard),আঞ্চলিক(Dialectal),বৈচিত্র(Variation)
৪. অপিনিহিত, অভিশ্রুতি, স্বরসঙ্গতি, শ্বাসাঘাত(Stress accent),স্বরভঙ্গি/স্বরতরঙ্গ(Intonation)
৫. বাংলা ও ইংরেজির তুলনা
৬. বাংলা লিখন দক্ষতা: সাধু/ চলিত রীতি। বিরামচিহ্ন প্রয়োগ। প্রমিত বাংলা বানানের নিয়ম (বাংলা একাডেমি)
৭. ব্যবহারিক বাংলা: সংক্ষিপ্ত আলোচনা

একুশে ফেব্রুয়ারি, মুক্তিযুদ্ধ, বাংলাভাষা, বিশ্বায়ন, বাংলার উৎসব, ষড়ঋতু, বাংলা নববর্ষ, আধুনিক তথ্য-প্রযুক্তি, সংস্কৃতি, মানবতা ও নৈতিকতা।

দ্বিতীয় খন্ড-সাহিত্য

কবিতা

১. আবদুল হাকিম- নূরনামা
২. মাইকেল মধু সূধন দত্ত- বঙ্গভাষা
৩. লালনসাঈ- খাঁচার ভেতর অচিনপাখি

৪. রবীন্দ্রনাথ ঠাকুর- নির্ঝরের স্বপ্নভাঙ্গা
৫. কাজী নজরুল ইসলাম- আজ বৃষ্টি-সুখের উল্লাসে
৬. জীবনানন্দ দাশ- রূপসী বাংলা
৭. হাসান হাফিজুর রহমান- অমর একুশে
৮. আলা উদ্দিন আল আজাদ- স্মৃতিস্তম্ভ
৯. শামসুর রাহমান- তোমাকে পাওয়ার জন্য হে স্বাধীনতা
১০. সৈয়দ শামসুল হক-পরিচয়

প্রবন্ধ

১. বঙ্কিম চন্দ্র চট্টোপাধ্যায়- বাঙ্গালা ভাষা
২. রবীন্দ্রনাথ ঠাকুর- সভ্যতার সংকট
৩. হরপ্রসাদ শাস্ত্রী- তৈল
৪. প্রমথ চৌধুরী- যৌবনে দাও রাজটিকা
৫. কাজী নজরুল ইসলাম- বর্তমান বিশ্বসাহিত্য
৬. মুহম্মদ আবদুল হাই- আমাদের বাংলা উচ্চারণ
৭. কবীর চৌধুরী- আমাদের আত্মপরিচয়

ছোট গল্প অন্যান্য রচনা

১. রবীন্দ্রনাথ ঠাকুর- পোস্ট মাস্টার
২. রোকেয়া সাখাওয়াত হোসেন- অবরোধবাসিনী
৩. বিভূতিভূষণ বন্দোপাধ্যায়- পুঁইমাচা
৪. সৈয়দ ওয়ালীউল্লাহ- নয়নচারা
৫. জাহানারা ইমাম- একাত্তরের দিনগুলি
৬. হাসান আজিজুল হক- ঘরগেরস্থি
৭. আখতারুজ্জামান ইলিয়াস- অপঘাত

নাটক

১. কবর- মুনির চৌধুরী

4.2 Course Outline of 1st Year, 2nd Semester

ICE1211: Structured Programming Language

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Introduction: Definition of Software, its classification, Problem solving steps, Introduction of C and its structure, history and Characteristics, Introduction to keywords, constants and identifiers, Fundamental of C variable and data types, Rules of constants, Introduction to arithmetic, relational and logical operators, Introduction to expressions, managing data input, managing data output.

Control statements: Decision making and branching. If and if… else statements, other control statements, switch and the conditional operator, Decision making and looping. While looping, do…while and for looping statements, jump statement goto, break and continue.

Array: Introduction to arrays. One-dimensional array, some sample programs, two-dimensional array, some sample programs, String handling in C and some examples.

String: Introduction to character Arrays and String, Declaring and Initializing String variables, Reading Strings from Semesterinal, Writing String to Screen, Putting String Together, Comparison of Two Strings, String Handling Functions, Table of Strings.

Function: Need for multifunction programs, Definition of Function, return values, types and some examples, Function Calls, Function Declaration, Calling functions and arguments, Nesting of Function, Recursions, passing arrays to functions, Passing string to function, The Scope, Visibility and Lifetime of Variables, Storage class.

Structure: Definition of Structure, Union, Structure union applications, Declaring Structure Variables, Accessing Structures Members, Arrays within Structure, Self-referential Structure, Array of structure and some examples.

Pointer: Understanding pointers, Pointers and arrays, Pointers and functions, pointers and structures, Some special features of C (Macros, Enumerations), Bitwise operations.

File management: File management concept in C, Defining, opening, and closing a file, Input/output operations in file, Error handling and command line arguments, Introduction to graphics, drawing some geometric objects.

Reference Book:

1	Theory and Problems of Programming with C	Byron S. Gottfried, Schaums Outline.
2	Teach Yourself C	Herbert Schild, McGraw-Hill Osborne Media.
3	How to Program	Deitel H. M. and Deitel.

ICE1212: Structured Programming Language Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Sessional based on ICE1211 (Structured Programming Language).

ICE1221: Analog Electronics

Credit 3.00, Contact Hours 3.00, Pre-Requisite: ICE1121

Course Contents:

Low-Frequency Response: Effect of emitter bypass capacitor, effect of coupling capacitor, cascading of CE stage; Mid-frequency gain, low-frequency response of cascaded stages, Transformer coupled amplifier.

Power Amplifiers: Definition, classification of power amplifiers, performance quantities of power amplifiers, series fed class A amplifier, transformer coupled class A Amplifier, Class B operation and amplifier circuits, Push-Pull amplifier.

Filters: Properties of symmetrical networks, Characteristics impedance, Filter- fundamentals, Different types of filters, Constant -K and m- Derived filters, Design conditions.

Optoelectronic Devices: PN photo diode, Phototransistor, Solar cell, Photoconductive cell, Photovoltaic sensors, LED, LCD, Alphanumeric Display, Photo couplers, high-speed optical detectors.

Micro-Electronics: Micro Electronic Technology, Planer processor, Bipolar Transistor fabrication, FET fabrication, CMOS technology, Monolithic diodes, Metal semiconductor contact; IC resistor and capacitor, IC packing; characteristics of IC components, Microelectronic circuit layout, printed circuit board.

High-Frequency Response: High frequency model for CE amplifier, CE short circuit current gain, High frequency current gain with resistive load, High frequency response of cascaded CE stages, Transformer coupled amplifier, Transistor Noises.

Operational Amplifier: Difference amplifier, CMRR, Ideal operational amplifier, Inverting amplifier, Non-inverting amplifier, Differential amplifier, General-purpose IC operational amplifier, Integrator, Differentiator, Precision Rectifier.

Feedback and Oscillators: Concept of Feedback, negative feedback, positive feedback, voltage and current feedback, virtual feedback, effect of feedback on impedance, gain, bandwidth and distortion, condition of

oscillation and stabilization, Hartley oscillator, Colpitt's oscillator. Phase shift and Wein-bridge oscillators, Resonant circuit oscillators.

Reference Book:

1	Electronic Devices and Circuits Theory	R L Boylestad, Pearson; 11th edition.
2	Handbook of Electronics	Gupta & Kumar, Pragati Prakashan.
3	Principle of Electronics-	A. P. Malvino, McGraw-Hill

ICE1222: Analog Electronics Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: ICE 1122

Course Contents:

In this course students will get a hands-on experience about electronics circuits. They will observe the uses of electronic circuits practically.

MATH 1231: Linear Algebra and Vector Analysis

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Algebra: Algebra of sets, De Morgan's rule, relation & function, DeSemesterinants, Properties and Cramer's rule, Theory of Equations, Theorem, and relation between roots and coefficients, Solution of cubic equations, De Moiver' theorem, Deduction from De Moiver's theorem, Functions of complex arguments, Gregory's series, Summation of series, Hyperbolic functions.

Vector: Vector Addition, Multiplication & Differentiation. Definitions of line, surface and volume integral Gradient of scalar function, Divergence and curl of vector function. Physical significance of gradient, divergence and curl. Integral forms of gradient, divergence and curl, Divergence Theorem, Stoke's theorem, Green's theorem, and Gauss's theorem.

Reference Book:

1	Higher Algebra	H. S. Hall and S. R. Knight, Arihat Publication; 6th edition
2	Vector Analysis	M. R. Spiezel, McGraw-Hill Education
3	Higher Trigonometry	B. C. Das and B. N. Mukherjee, U. N. Dhur & Sons Pvt. Ltd
4	Higher Trigonometry	M. A. Sattar
5	Set Theory	M. R. Spiezel, Schaum's Outline

MATH1241: Statistics for Engineers

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Syllabus: Analysis of statistical data: Location, Dispersion and their measures, Skewness, Kurtosis and their measures, Moment and Cumulants and Practical examples.

Probability: Concept of probability, Sample Space, Events union and Intersection of Events. Probability of events, Loss of probability, Conditional probabilities Bose Einstein Statistics Bay's Theorem Chebysec's Inequality and Practical examples.

Random variables and probability Distribution: Basic concepts, Discrete and continuous random variables, Density and distributional functions, Mathematical expectation and variance, Joint marginal and conditional density functions. Conditional Expectation and conditional variance. Moments and Cumulant generating functions. Characteristic function. Study of Binomial Poisson Normal and Bivariate Normal distribution and Practical examples.

Linear Regression: Correlation, Rank correlation. Partial and Multiple correlations Linear Regression for two Variables, Principle of Least Squares Method, Lines of best fit, Residual Analysis and examples.

Markov Chains: Transition matrix, Higher transition probabilities, Classification of states and chains, Ergodic properties, Evaluation of P^n.

Homogeneous Markov Processes: Poisson process, Simple birth process, Simple death process, Simple birth–death process, Effect of immigration. Queuing process, Single server queues, Equilibrium theory, Queues with many servers, Limiting properties of queues.

Reference Book:

1	Fundamentals of Statistics	S.G. Gupta, HPH (January 1, 2014
2	Probability	S. Lipschutz, Schaum's Outline
3	The Theory of Stochastic Processes Springer	Gikhman, I.I., &A.V. Skorokhod
4	Introductory Statistics	P.G. Hoel

CHEM1251: Engineering Chemistry

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Electrochemistry: Conductors, Electrolytes and Electrolysis; Faradays Laws of Electrolysis and their significance. Ohm's law and electrolytic conductance's; Theories for electrolytic conductance (Arrhenius& Debye-Hükel). Ionic mobility, Kohlrausch's law, Transference Number and its deSemesterination; Activities, activity coefficient and Debye-Hükel limiting law. Electrochemical cells (Electrolytic and Galvanic/Voltaic): Electrode reaction and potentials. Reference electrodes; Reversible and concentration cells, Storage Batteries (or accumulators).

Chemical Equilibrium and Kinetics: Equilibrium and Equilibrium constants, Kc, Kp, Kx. Rate of reaction and rate constants; Le Chatelier principle and its application. Order and molecularity of a reaction; integrated rate expressions & half- lives of zeroeth, first and second order reactions. DeSemesterination of order & temperature dependence of a reaction; energy of activation and Arrhenius equation. Transition-state theory of reaction rates. Characteristics of catalysis, promoters and inhibitors.

Surface Chemistry and Colloids: Adsorption and sorption; Characteristics of physical and chemical adsorptions. Freundlich, Langmuir and Gibb's Adsorption isotherms; The BET equation. Crystalloids, Colloids and their classification, preparation, properties (kinetic, colligative, optical & electrical) and importance, Original pf charge and stability of colloids (sols), Gold number; colloidal electrolytes. Elementary idea about emulsions and gels.

Atomic structure and Periodic Table: Modern concept of atomic structure and Periodic Table; related principles and Laws. Constitution and Periodic properties of elements (ionization potential, electronegativity, electron affinity, atomic and ionic radii).Grouping of elements, their properties and uses. Isotopes and radioactivity.

Electronic Theory of Valency and Chemical Bonding: Different types of bonds (ionic, covalent, co-ordinate, hydrogen and metallic) Classification of solids on the basis of bonding and their properties. Atomic orbitals and their hybridization; valence bond and Molecular orbital theories.

Chemistry of Transition Elements, Lanthanides and Actinides: Definitions, electronic configurations, preparations (nuclear transformations), general properties and uses.

Oxidation-Reduction Reaction: Oxidation, Reduction, Oxidizing and reducing agent, Oxidation state, Valency and oxidation number, balancing of REDOX reaction, Equivalent weight of oxidizing and reducing agents, Unusual Oxidation states, EMF series.

Reference Book:

1	Introduction to Modern Inorganic Chemistry	S. Z. Haider
2	Modern Inorganic Chemistry	R. D. Madan, S. Chand Publishing
3	Advanced Organic Chemistry	B. S. Bahl&ArunBahl, S. Chand Publishing
4	Fundamental concepts of Inorganic Chemistry	S. Gilreath, ACS publications
5	Advanced Inorganic Chemistry	S. Prakash& G. Tuli

HUM1255: Bangladesh Studies (History of Independence)

Credit 2.00, Contact Hours 2.00, Pre-Requisite: None

Course Content:

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 of 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.

Reference Book:

1	Bangladesh in International Politics ,1995	Muhammad ShamsulHuq
2	Constitution, Constitutional Law and Politics: Bangladesh Perspective	Md.Abdul Halim
3	Bangladesh in the Twenty-First Century: Towards an Industrial Society	A M A Muhith
4	Bangladesh Foreign Policy: Realities, Priorities and Challenges, 2012, 2nd Edition	HarunurRashid
5	The Changing Pattern of Bangladesh Foreign Policy: A Comparative Study of Mujib and Zia Regimes	ZaglulHaider
6	Bangladesh Studies and Culture	Sumon Das & M.N. Mohabbat
7	History of Emergence of Bangladesh	Muntasir Mamun & Mahbubur Rahman

4.3 Course Outline of 2nd Year, 1st Semester

ICE2111: Data Structures and Algorithms

Credit 3.00, Contact Hours 3.00, Pre-Requisite: ICE1211

Course Contents:

Introduction: Data types & data structures, data structure operations, Introduction to algorithms, performance analysis.

Arrays, Records and Pointer: Linear arrays, Relationships of arrays, Operation on arrays, Multidimensional arrays, pointer arrays, Record structures, representation of records, Sparse matrices.

Stacks, Queues and Recursion: Fundamentals, Different types of stacks and queues: circular, de-queues, etc., Evaluation of expressions, recursion, direct and indirect recursion, depth of recursion, Implementation of recursive procedures by stacks.

Linked List: Linked lists, Representation of linked list, Traversing & searching a linked list, Doubly linked list & dynamic storage management, Generalized list, Garbage collection & compaction.

Trees and Graphs: Basic Semesterinology, Binary trees, Binary tree representation, Tree traversal, Extended binary tree, Huffman codes/algorithm, Graphs, Graph representation, Shortest path and transitive closure, Traversing a graph.

Sorting & Searching algorithms: Basic strategies of Algorithm design, Time and space analysis of algorithms, Average, best and worst-case analysis, different notations. Sorting, Insertion sort, Shell sort, Heap sort, Radix sort, the general method of divide & conquer method, Merge sort, Quick sort, Selection sort, binary search, spanning trees, single source shortest paths.

Symbol Tables: Static tree tables, Dynamic tree tables, Hash tables overflow handling, Theoretical evaluation of overflow techniques.

Dynamic programming: The general method, multistage graphs, all pairs shortest paths, single source shortest paths problems.

Reference Book:

1	Computer Algorithm	E. Horowitz and S. Sahni
2	Theory and Problems of Data Structures	Seymour Lipschutz
3	Fundamentals of Data Structures	E. Horowitz and S. Sahni
4	Data structures	Reingold
5	Introduction to Algorithms	T. H. Cormen, C. E. Leiserson

ICE2112: Data Structures and Algorithms Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: ICE1212

Course Contents: Sessional works based on ICE2111 (Data Structures and Algorithms).

ICE 2121: Digital Electronics

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Number System: Binary numbers, Number base conversion, Octal and Hexadecimal numbers, Complements, Binary code, Binary storage, Digital Logic.

Boolean Algebra and Logic Gates: Basic definitions, Axiomatic definitions of Boolean algebra, Basic theorem and properties, Boolean functions, De Morgan Theorem, Canonical and standard forms, Electronic logic gate circuits (DDL, DTL, RTL, TTL).

Simplification of Boolean Functions: Map Method, Two and three variable maps, Four variable map, Five and Six variable maps, Sum of Product and Product of sum simplification, NAND & NOR implementation, Don't care conditions, Tabulation Method, DeSemesterination and selection of Prime Implicants.

Combinational Logic: Design Procedure, Adders, Subtractors, Boolean Code conversion, Binary Parallel Adder, Decimal Adder, Magnitude Comparator, Encoder, Decoder, Multiplexer, De-multiplexer, PLA.

Sequential Logic: Flip-Flops, Triggering of Flip-flop, Master-Slave Flip-flop, Analysis of clocked sequential circuits, Flip-flop excitation tables, Design Procedure, Design of counters, Design with state equations.

Applications: Registers, Shift registers, Ripple Counters, Synchronous Counters, RAM, ROM, EPROM, EEPROM, A/D and D/A converters.

Reference Book:

1	Digital Logic and Computer Design	M Morris Mano; Prentice Hall of India Private Ltd.
2	Digital Fundamentals	Thomas L Floyd; Prentice Hall International, Inc.
3	Pulse, Digital and Switching waveforms	Jacob Millman& Herbert Taub; Tata McGraw- Hil.

ICE2122: Digital Electronics Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in ICE 2121. In the second part, students will design simple systems using the principles learned in ICE 2121.

ICE 2131: Signals and Systems

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Introduction: Definition of Signals & Systems; Overview of Specific Systems, Classification of Signals, Basic Operation on Signals, Elementary Signals, Properties of Systems.

Time Domain Representation of LTI System: Impulse Response (IR) representation of LTI system and its properties, Differential and Difference Equation representation of LTI systems, Block Diagram representations, State variable Descriptions for LTI systems.

Fourier Representation of Signals: DT Fourier Series, Fourier Series, DT Fourier Transform, Fourier Transform, Properties of Fourier representation.

Applications of Fourier Representation: Frequency response of LTI systems, FT representation for periodic signals, Convolution and Modulation with mixed signal classes, FT representation for DT signals, Sampling, Reconstruction of Continuous Time signals from samples, DT processing of CT signals, FS representations for Finite Duration non periodic signal.

Laplace Transform: Laplace Transform (LT), Unilateral LT, Inversion of LT, Solving differential equations with initial conditions, Bilateral LT, Transform analysis of systems.

Z-Transform: Z-Transform, Properties of RoC, Properties of Z-Transform, Inversion of Z-Transform, transform analysis of LTI system, Computational Structures for implementing DT systems, unilateral Z-Transform.

Reference Book:

1	Continues and Discrete Signals & Systems	S.S. Soliman& M. D. Srinath; Prentice Hallof India Private Ltd.
2	Signal and System (Continuous & Discrete)	R.E. Ziemer; Pearson Education Asia.
3	Signals & Systems	Simon Haykin& Barry Van Veen.

ICE 2132: Signals and Systems Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in ICE2131. In the second part, students will design simple systems using the principles learned in ICE2131.

ICE 2141: Numerical methods

Credit 2.00, Contact Hours 2.00, Pre-Requisite: None

Course Contents:

Approximations and Errors: Accuracy and precision, Error definitions, Round-off errors, Truncation errors.

Roots of Equations: The bisection method, the false-position method, the iteration method, the Newton-Raphson method.

Interpolation: Newton's forward and backward formula for interpolation with equal distance, Newton's divided-difference interpolating polynomials, Lagrange interpolating polynomials.

Curve Fitting: Linear regression, Linear curve fitting methods, Least square method, Non-linear curve fitting methods, Polynomial of *n*th degree, Power function, Exponential function, Polynomial regression.

Numerical Differentiation and Integration: The trapezoidal rule, Simpson's rules, Integration with unequal segments.

Numerical Solutions of Ordinary Differential Equations: Solution by Taylor's series, Picard's method, Euler's method, Modifications, and improvements of Euler's methods, Runge-Kutta methods.

Reference Book:

1	Introductory Methods of Numerical Analysis	S.S. Sastry, PHI Learning Pvt. Ltd
2	Theory and Problems of Discrete Mathematics, Schanum's outline series	Lipshutz, schaum's outline

ICE 2142: Numerical methods Sessional

Credit 1.00, Contact Hours 2.00, Pre-Requisite: None

Course Contents: Sessional works based on ICE 2141 (Numerical Method).

ICE2151: Discrete Mathematics

Credit 2.00, Contact Hours 2.00, Pre-Requisite: None

Course Contents:

Mathematical Logic: Connectives, Theory of inference for proposition calculus, Predicate calculus, Inference theory of predicate calculus, Method of proof, Mathematical induction.

Sets: Basic concept of set theory, Operation of sets, Ordered pairs and n-tuples.

Relation and Ordering: Relations, Properties of binary relation in a set, Composition of binary relation, Relation matrix and graph of a relation, Partial ordering, Path in relation and di-graph.

Functions: Definition, Composition of function, Inverse function, Binary and array operation.

Graph: Introduction to graph, Graph Semesterinology, representing graph and graph isomorphism, Paths, Reach ability, connectivity, Euler and Hamilton path, Shortest path problems, Graph coloring, Matrix representation of graph.

Reference Book:

1	Theory and Problems of Discrete Mathematics	Schaum's outline series-Lipshutz
2	Elements of Discrete Mathematics	McGraw-Hill, 1985-C.L. Liu
3	Discrete Mathematical Structure	Sharon Ross

MATH2161: Matrices and Differential Equations
Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Pre-requisite: Limits, continuity and differentiability, Differentiation of explicit and implicit function and parametric equations, Successive differentiation of various types of functions.

Course Contents:

Algebra of Matrices: Adjoint, Inverse and rank of matrix-definition, Properties and evaluation.

Elementary Transformations: Echelon: Canonical and normal forms, Solution of system of linear equations, Consistency, and solution of homogeneous and non-homogeneous systems by matrix method, and reduction to equivalent system.

Characteristic Equation: Eigen values, Eigenvectors and Caley-Hamilton theorem, similar matrices and diagonalization

Equations: Solutions of first order and first degree and first-order and higher degree equations with variable coefficients Solution of Higher-Order linear differential equations.

Differential Equations: Series solution of linear differential equation, Series solution of second order equation with variable coefficients, Solutions of partial differential equation, Laplace's equation and transformation, Poisson's equation, Helmholtz's equation, Diffusion equation, Green's function solution, Integral equation.

Reference Book:

1	Differential equations	Dr. B. D. Sharma
2	Differential equations	S.L. Ross.
3	Differential Equations	Frank Ayres.
4	Matrices	M.R. Spiezel.

4.4 Course Outline of 2nd Year 2nd Semester

ICE 2211: Analog and Digital Communication

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Overview of communication systems: Basic principles, fundamental elements, system limitations, message source, bandwidth requirements, transmission media types, bandwidth and transmission capacity.

Noise: Source, characteristics of various types of noise and signal to noise ratio.

Information theory: Measure of information, source encoding, error free communication over a noisy channel, channel capacity of a continuous system and channel capacity of a discrete memory less system.

Communication systems: Analog and digital. Continuous wave modulation: Transmission types, base-band transmission, carrier transmission.

Amplitude modulation: Introduction, double side band, single side band, vestigial side band, quadrature, spectral analysis of each type, envelope, and synchronous detection.

Angle modulation: Instantaneous frequency, frequency modulation (FM) and phase modulation (PM), spectral analysis, demodulation of FM and PM.

Pulse modulation: Sampling theorem, Nyquist criterion, aliasing, instantaneous and natural sampling.

Pulse amplitude modulation: Principle, bandwidth requirements.

Pulse code modulation (PCM): Quantization principle, quantization noise, non-uniform quantization, signal to quantization error ratio, Companded PCM, PSK, FSK, QPSK, BPSK, differential PCM, demodulation of PCM.

Delta modulation (DM): Principle, adaptive DM, line coding – formats and bandwidths.

Digital modulation: Amplitude-shift keying - principle, ON-OFF keying, bandwidth requirements, detection, noise performance.

Phase-shift keying (PSK): Principle, bandwidth requirements, detection, Coherent and Non-coherent Demodulation techniques.

Multiplexing: Frequency division multiplexing (FDM), Time division multiplexing (TDM) - principle, receiver synchronization, frame synchronization, PHD, SONET/SDH, wavelength division multiplexing, multiple-access network – time division multiple access, frequency-division multiple access, code-division multiple access (CDMA), spread spectrum techniques, coding techniques and constraints of CDMA.

Communication system design: Design parameters, channel selection criteria and performance simulation.

Reference Book:

1	Modern Digital and Analog Communication System	B. P. Lathi, OUP; Indian Edition.
2	Communication System	SomonHaykin; John Wiley & Sons, Inc.
3	Data Communications and Networking	Behrouz A. Forouzan

ICE 2212: Analog and Digital Communication Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in ICE 2211. In the second part, students will design simple systems using the principles learned in ICE 2211.

ICE 2221: Computer Networking

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Introduction: Computer networks, Types of Computer networks, Network Topology, Circuit Switching and Packet Switching, protocol and protocol hierarchies, The OSI reference model, TCP/IP protocol suit.
Physical Layer: The theoretical basis for data communication, attenuation and distortion, signal types, bandwidth, propagation delay, public carrier circuits, modulation, encoding, multiplexing, physical layer interfacing standards. Transmission media wired and wireless, Narrowband ISDN, Broadband ISDN and ATM. transmission modes, asynchronous and synchronous transmission, bit - character and frame synchronization.
Data Link Layer: Data link layer design issues, Error detection and correction, Elementary data link protocols, sliding window protocols, Protocol specification and verification, HDLC.
Medium Access Sub-layer: Channel allocation problem, multiple access protocols (MAC), IEEE standards for LANs and MANs, Bridges, and High-Speed LANs, ATM and Frame Relay.

Network layer: Network layer design issues, Routing algorithms, Congestion control algorithms, Internetworking, IP, IP addresses, Network layer protocols; ARP, IPv4, ICMP, IPv6, Routing protocols; OSPF and BGP.
Transport layer: User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Congestion control and Quality of service, Performance issues.
Application Layer: Client-Server Model, Domain Name System (DNS), Electronic mail (SMTP) and File Transfer (FTP), HTTP and WWW.

Reference Book:

1	Computer Networks	A. S. Tanenbaum, Prentice Hall, Indian International Ed.
2	Complete Networking: A Top-down Approach Featuring the Internet	James F. Kurose, Keith W. Ross
3	Data and Communication	Stallings, Pearson; 10th edition
4	Data Communication Networking	B. Forouzan, McGraw-Hill Education
5	Data &Network Communications	Miller, Delmar Cengage Learning

ICE 2222: Computer Networking Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Students will perform experiments to practically verify the theories and concept have learned in the theory course ICE 2221. Students also will verify the theories and concepts learned in ICE2221 using simulation software like Cisco Packet Tracer. In the second part, students will design simple antenna using the principles learned in ICE 2221.

ICE 2231: Object Oriented Programming Language

Credit 3.00, Contact Hours 3.00, Pre-Requisite: ICE1211

Course Contents:

Introduction: Object oriented programming and procedural oriented programming, Encapsulation, Inheritance, Polymorphism, Data abstraction, Data binding, Static and dynamic binding, Message passing.
C++ As an Object-Oriented Language: Declaration and constants, Expression and Statements, Data types, Operator, Functions.
Classes: Structure of classless. Public, Private and Protected members, Array of object, Argumented member function, and non-augmented objects, Nested member class and their object, Pointer objects and pointer members, Object argument of function, Static class-member and static class, Friend function, friend class.
Inheritance: Mode of inheritance, Classifications of inheritance, Virtual inheritance, Array of objects of derived class.
Constructor and Destructors: Default constructor, Argumented constructor, Copy constructor, Dynamic constructor, Constructor function for derived class and their order of execution, Destructor.
Operator and Function Overloading, Unary and binary operator overloading, Run-time and compile time polymorphism, Object pointer and pointer to an object, Virtual function, Dynamic binding.
C++ Data File: C++ file stream classes, Input and output file, Mode of files, File pointer, Random file accessing.
Template and Exception Handling: Function template and class template, Exception Handling.

Reference Book:

1	C++: The Complete Reference	McGraw HillbyH. Schidt.
2	Object Oriented Programming with C++	Prentice Hall India by N. Barkakati.
3	C++: A Beginner's Guide, McGraw Hill	H. Schidt.
4	The C++ Pr	B. Stroustrap.
5	Object Oriented Programming with C++	E Balaguruswamy.

ICE 2232: Object Oriented Programming Language Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: ICE1212

Course Contents:

Sessional works based on ICE 2231 (Object Oriented Programming Language).

ICE 2241: Electromagnetic Field and Antenna Engineering

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Rationale: To learn and familiarize the Electric, Magnetic and Electromagnetic fields along with basic laws, equations, characteristics, and propagation in different medium and also develop the basics of antenna characteristics, losses, radiation patterns and their applications.

Course Contents:

Field Equations: Vector, Coordinate system, Field equations based on laws of Coulomb, Ampere and Faraday, Del Operator, Gradient, Divergence, Curl, Electrostatics, Magneto-statics, Maxwell′s equation, Units and dimensions of field vectors, E-H symmetry.

Propagation of Electromagnetic Waves: Wave equations; plane wave concept; Plane electromagnetic waves in free-space, in conducting, dielectric and in ionized media, intrinsic impedance and propagation constant.

Reflection and Refraction of Electromagnetic Waves: Boundary conditions; Reflection from dielectrics and conductors; Fresnel′s equations; Total reflection; Skin effect; phase and group velocities, Reflection and refraction in the ionosphere.

Transmission Line Waveguide and Antenna: Transmission Line Parameters, Transmission Line Equations, Input Impedance, SWR and Power Smith Chart, Waveguide, Antenna, Radiation mechanism, Current distribution on a thin wire antenna.

Fundamental Parameters of Antenna: Radiation patterns, Radiation power density, Radiation intensity, Directivity, Gain, Antenna efficiency, Half-power beam width, Beam efficiency, Bandwidth, Polarization, Input impedance, Antenna radiation efficiency, Vector effective length, Maximum directivity and maximum effective area, Antenna temperature.

Other Types of Antenna: Cylindrical Dipole, Folded Dipole, Broadband Dipoles, Matching Techniques, Traveling Wave Antennas, Broadband Antennas, Log-Periodic Antennas, Electrically Small Antennas, Aperture Antennas, Micro strip Antennas, Reflector Antennas, Smart Antennas. Array Antenna.

Reference Book:

1	Fundamentals of Engineering Electromagnetics	David K. Cheng, Pearson; 1st edition
2	Elements of Electromagnetics	Sadiku Matthew N O, 5th Edition, Oxford University Press, 2010.
3	Antenna Theory – Analysis and Design	C. A. Balanis, 2nd Edition.
4	Antennas for All Applications	J. D. Kraus, R. J. Marhefka, and A. S. Khan.
5	Antenna and Wave Propagation	K. D. Prasad.

ICE 2242: Electromagnetic Field and Antenna Engineering Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Students will perform experiments to practically verify the theories and concept have learned in the theory course ICE 3141. In the second part, students will design simple systems using the principles learned in ICE 3141.

HUM2251: Sociology and Economics

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Basic Concepts of Economics: Definition and subject matter of Economics; Microeconomics vs macroeconomics; Law of Economics; Central economic problems of every society; Different economic systems; Economics and Engineering.

Theory of Demand, Supply and Consumer Behavior: Law of Demand; Demand schedule and demand curve; Supply law, Supply schedule and supply curve; Shift in demand and supply; Equilibrium in the market; Elasticity of demand and supply.

Production and Costs and Theory of the Firm: Meaning of production; Factors of production; Concepts of total, average, and marginal costs, fixed and variable costs.

Basic Concepts of Macroeconomics: Growth; Unemployment; Inflation; Philips Curve, Business cycle; Circular flow of economics; Two, three and four sector economics, Concepts of GNP, GDP and national income.

Budgets of Bangladesh: The revenue at the capital budget; Income, Expenditure of the government; direct and indirect taxes.

Introducing Sociology: Meaning and Scope of Sociology; The Socio-cultural Context of the Emergence of Sociology: Industrial Revolution, French Revolution (1789), Colonial to Anti-colonial Revolution in Asia; Globalization and the Changing World: Types of Societies, Secularization and Religious Fundamentalism, Crime and Deviance.

Globalization: Politics, Government and Media; Sociological Theory: Karl Marx, Emile Durkheim, Max Weber, Ulric Beck; Types of Family and Marriage, Domestic Violence, Migration and Gender Socialization.

Introducing Ethics: Definition and Scope of Ethics; Functional Importance of Norms and Values: Historical Background of Ethics, Relationship between Norms and Values and Social Function of Education; Population and World Resource: Unemployment, Rural and Urban Migration to Diasporas' Relation.

Reference Book:

1	Economics	Semuelson and Nordhous, McGraw Hill Education
2	Modern Economic Theory	Dewett, K. K..
3	Sociology, London, The Polity press, 2009	Giddens, Anthony
4	Sociology	Shankar Rao
5	Sociological Theory	Ritzer, George, McGraw Hill Education

4.5 Course Outline of 3rd Year, 1st Semester

ICE 3111: Optical Fiber Communication

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course contents:

Optical Communication System: The general system, Advantages and Application of optical fiber communication materials, Types of fibers, cylindrical fiber, Single mode fiber, Multimode fiber, Transmission characteristics of optical fibers-Attenuation, Dispersion.

Optics Review: Ray theory transmission, Light propagation principle in optical fiber, Electromagnetic mode theory for optical propagation.

Optical Communication Equipment's: Principles, Technology, Characteristics of Optical receiver noise consideration, Preparation of optical fibers, Optical fiber cables, Fiber splices, Fiber connectors, Fiber couplers and Splices, Integrated Optics.

Optical Sources: LEDs and Lasers, Spectral width Efficiency, Modulation characteristics, Material, and fabrication.

Optical Detector: Types of detector, Principle of detection, detector characteristics, Cut-off wavelength and detector response.

Couplers and fiber components: Types of coupling, Lensing Schemes, Splicing techniques, Misalignment, Fiber optic couplers, Optical Amplifiers, Switches, Bragg grating, Attenuator, Circulator, Isolator and Resonance cavity.

Optical Networks: Fiber Optic Data Buses and LANs, Protocol and Architecture, Wavelength Division Multiplexing (WDM), Dense Wavelength Division Multiplexing (DWDM) and SONET/SDH.

System Design: Noise and SNR analysis, Analog and digital system design.

Reference Book:

1	Fiber Optic Communication	Palaise, Pearson; 5th edition
2	Optical Fiber Communications: Principles & Practice	John M. Senior; Prentice Hall of India.
3	Fiber Optic Communications	D C Agrawal; Wheeler Publishing
4	Fiber Optic Communication System	Gerd Keiser; McGraw-Hill International.

ICE 3112: Optical Fiber Communication Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Sessional works based on ICE 3111.

ICE3121: Database Management System

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:
Introduction: Database, data, database management system, Database system versus file system, Data model, Database language, Database user administration, Database system structure, Storage manager, Overview of Physical storage medium.

Entity-Relationship Model: Entity sets, Relationship sets, Mapping Cardinalities, Keys, Attributes, Entity relationship diagram, Weak entity sets, Specialization, Generalization, Structure of Relational databases, Database Schema.

The Relational Algebra and SQL: Selection, projection, Union, Set difference, Cartesian-product, Rename, Set-intersection, Natural-join, Division, Assignment, projection, Aggregate functions, Deletion, Insertion, Updating, Views, Nested sub-queries, Set membership, Set comparison.

Integrity and Security and Relational Database Design: Domain constraint, Integrity, Assertions, Triggers, Authorization, Authentication, Security, Privileges, Roles, Audit trails, Encryption-Decryption Algorithm, Normalization, Decomposition, Functional Dependencies, Closure of a set of Functional dependencies.

Database Design and E-R model: The Entity Relationship Model, Constraints, Entity Relationship Diagram, Entity Relationship Design Issues, Weak Entity Set, Extended E-R Features.

Storage and File Structure: Physical Storage Media, Magnetic Disk, RAID, Storage Access, File Organization, Organization of Record in Files, Data Dictionary Storage.

Transaction: ACID properties, Transaction state diagram, Implementation of atomicity and durability, concurrent executions, Serializability, Recoverability, Implementation in isolation.

Concurrency control and Recovery System: Lock based protocols, Timestamp based protocols, Deadlock handling, Failure classification, Storage structure, Recovery, and atomicity.

Reference Book:

1	Database System Concept	H. F. Korth, McGraw-Hill
2	SQL, PL/SQL	Ivan Bayross
3	Access 2000 Developers Handbook	Litwin, Paul, Sybex; Volume 1: Desktop edition

ICE3122: Database Management System Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: None

Course Contents:
Sessional based on ICE 3121 (Database Management System).

ICE3131: Advanced Java Programming

Credit 3.00, Contact Hours 3.00, Pre-Requisite: ICE2231

Course Contents:
Introduction to Java Programming: History of Java, Java features and advantages, Class, Object, Abstraction, Encapsulation, Polymorphism, packages, creating classes with Java, Concept of constructors, Using JDK, Data types, Arrays, Operators, and control flow.

Inheritance and interfaces: Inheritance, Super classes, sub classes, protected members, constructors in sub classes, the Object class, abstract classes, and methods- final methods Interfaces, defining an interface, implementing interface, differences between classes and interfaces and extending interfaces, Object cloning, inner classes, Array Lists.

Multithreading and generic programming: Thread, Multi-Thread, Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, and thread groups. Generic Programming – Generic classes, generic methods, Bounded Types, Restrictions and Limitations.

Exploring Core: Java, Files and IO Streams, Object Serialization, Swing, Java GUI Programming and Event Handling, Java Networking, RMI, Reflection, Collections, Generics, Java Auto boxing and Annotations.

Introducing J2EE: Enterprise Java, Basic Application Structure, Using Web Containers, Creating Servlet, Configuring Servlet, Understanding HTTP methods, Using Parameters and Accepting Form Submissions, Using Init parameters, File Uploading, JDBC, Java server pages (JSP).

Spring Framework and Hibernate: Understanding Inversion of Control (IoC), Aspect Oriented Programming (AOP) and Dependency Injection, MVC pattern for Web Applications, Spring Framework, Understanding

Application Context, Bootstrapping Spring framework, Configuring Spring framework, Data Persistence, Object/relational Mapping, Hibernate ORM, Mapping Entities to Tables.

Reference Book:

1	The Complete Reference Java 2	P. Naughton and H. Schildt, Osborne Publishing;
2	The Complete Reference, Java-2	Patrick Naughton, Herbert Schildt
3	Programming with Java	E. Balagurusamy, McGraw Hill Education
4	Teach Yourself Java-2 in 21 days	SAMS publications, Sams; 2nd edition

ICE3132: Advanced Java Programming Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: ICE2232

Course Content:

Sessional works based on ICE3131 (Advanced Java Programming).

ICE 3141: Wireless and Mobile Communication

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Introduction: Wireless systems and standards, Introduction to wireless communication, Advantages and disadvantages of wireless communication, Application of wireless communication, Advantages and disadvantages of mobile communication, Applications of mobile communication, Introduction to radio paging, Modulation techniques for mobile radio, Cordless systems, Cellular Telephone call incoming and outgoing system.

History and Modern Wireless Communication Systems: AMPS, Second Generation cellular Networks, Third Generation cellular Networks, Fourth Generation cellular Networks.

The Cellular Concept: Basic Elements of a Cellular Radio System/Network, Principles of Operations, Frequency Spectrum and its Management, Radio Planning, Overview of Cellular Standard Systems, Digital Cellular Systems, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, Trunking and Grade of Service, Improving Coverage and Capacity in Cellular Systems.

Mobile Radio Propagation: Free space Propagation Model, Propagation Mechanisms, Ground Reflection Model, Knife- edge Diffraction Model, Outdoor and Indoor propagation model.

Fading and Multipath: Factors influencing fading, Time dispersion parameters, Coherence bandwidth, Doppler spread, Coherence Time, Flat fading, Frequency Selective Fading, Slow fading, Fast fading, Rayleigh Fading Distribution, Ricean fading distribution etc.
Wireless network: Wireless Networking, PSTN Network, Traffic routing in wireless networks, Wireless vs fixed telephone networks, Wireless data service, Common channel signaling, ISDN and broadband ISDN, Signaling system no.7(SS7), Personal communication services (PCS), UMTS, LTE.
Cellular Mobile communication Radio Systems: Basic elements of Cellular radio systems/network, GSM transmission process (Segmentation, Speech coding, Channel coding, Interleaving, Burst formatting), Cell selections, Physical and logical channels, Overview of cellular standard systems, Frequency spectrum and Management, Radio planning.

Reference Book:

1	Wireless communications	Rappaport. T.S Pearson Education, 2003.
2	Principles of Mobile Communication	Gordon L. Stuber Springer International Ltd. 2001
3	Wireless Communications	Andrea Goldsmith Cambridge University Press, 2007.
4	Mobile Cellular Telecommunication (Analog Digital Systems)	William C.Y Lee

ICE3142: Wireless and Mobile Communication Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

This course consists of how students will perform experiments to GSM Module and Use software tools to simulate and analyze the performance of Mobile communication systems based on ICE3141.

HUM3157: Professional Ethics and Environmental Protection

Credit 2.00, Contact Hours 2.00, Pre-Requisite: None

Course Contents:

Engineering Ethics: Introduction to Ethics. Theories of Ethics. Principles of Engineering Ethics.
Ethical expectation: Employers and employees, inter-professional relationship, Standards and codes: Fundamental Canons, NSPE codes, IEEE codes of conduct, ACM codes; Institutionalization of ethical conduct. Ethical Dilemmas, Choices (Whistle Blowing).
Computer Ethics: Computer Crime and Cyber Security, Privacy and Confidentiality issue in CSE, Legal Framework in CSE-Copyright laws, ICT Act, Right To Information (RTI), Patents, Royalty etc. Ethical Challenges for CSE Engineers with the advancement of Technology; Case studies related to ethical issues in ICT and other Engineering disciplines.

Engineering Ethics and professionalism: Responsible Professionals, Professions, and Corporations, The Origins of Ethical Thought, Ethics and the Law, Moral Reasoning and Codes of Ethics: Ethical decision-making strategies, Ethical dilemmas, Codes of ethics, Case studies Moral Frameworks for Engineering Ethics: Ethical theories, Personal commitments, and professional life.
Ethical Problem-Solving Techniques: Analysis of Issues in Ethical Problems, An Application of Problem-Solving Methods Engineering as Social Experimentation: Engineering as Experimentation, Engineers as Responsible Experimenters Risk, Safety, and Accidents: Assessment of safety and risk, Design considerations, uncertainty, Risk-benefit analysis, safe-exit and fail-safe systems Engineers.
Responsibilities and Rights: Employee/employer rights and responsibilities, Confidentiality, and conflict of interest, Whistle-blowing, Case studies on whistle-blowing Honesty and Research Integrity: Truthfulness, Trustworthiness, Research Integrity, Protecting Research Subjects.
Environmental Ethics: The Internet and Free Speech, Power Relationships, Property, Privacy, Additional Issues Environmental Ethics: Engineering, ecology, economics, Sustainable development.
Ethical frameworks Global Issues: Multinational corporations, globalization of engineering, Technology transfer, appropriate technology Cautious Optimism and Moral Leadership: Cautious optimism as a technology development attitude, Moral leadership in engineering.

Reference Book:

1	Engineering Ethics	Charles B. Fledder mann, Fourth Edition, 2012.
2	Introduction to Engineering Ethics	Mike W. Martin, Roland Schinzinger, Second Edition, 2010
3	Introduction to Engineering Ethics	Schinzinger and Martin; McGraw Hill. 3rd Edition

ICE 3000: Integrated Design Project (IDP)

Credit 1.00, Contact Hours 2.00, Pre-Requisite: None

Course Contents:

This course is the first part to Capstone Project. The course aims to synergies all the basic engineering knowledge gained previously to solve real electrical engineering problems in an integrated and comprehensive manner.

Students will be first exposed to the importance of good design concepts that considers important characteristics considering public health and safety, society and culture, environment and sustainability, authorities' requirements, as well as project cost effectiveness. Students will work in groups to observe existing project to evaluate the pros and cons of project characteristics. Information and Communication engineering is an engineering stream that comprises study and understanding about software and communication.

4.6 Course Outline of 3rd Year, 2nd Semester

ICE 3211: Microprocessor and Microcontroller

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Design Methodology: Introduction, combinational circuits, sequential circuits, the register Year, register-Year components, design method, the processor-Year, processor-Year components, design techniques.

Arithmetic Logic Unit: Fixed-point arithmetic, addition, subtraction, multiplication and division ALU design basic ALU organization, floating-point arithmetic, and arithmetic processor.

Control Design: Introduction; Instruction sequencing, instruction interpretation, Hardwired control, multiplier control unit, CPU control unit, micro programmed control; microinstruction, micro programmed sequencer.

Microcontroller: Introduction to microcontroller, architecture of microcontroller, Interface circuits, Interrupt signals and routines.

Microprocessors: Evolution of microprocessors, microprocessor organization, 8086 microprocessors, microprocessor applications, series of Intel and Pentium microprocessors.

Processor basics: CPU organization, information and number formats, instruction set, instruction format and instruction types, addressing modes.

System Organization: Basic concepts, Bus control, Arbitration, Programmed I/O, DMA and Interrupts, I/O processors, I/O interface circuit.

Pipelining and Vector Processing: Parallel processing, Pipelining, Arithmetic Pipelining Instruction Pipeline, Vector Processing, Vector Operations, Array Processors.

Reference Book:

1	Assembly Language Programming and Organization of IBMPC	Ytha Yu and Charles Marut, International Edition, McGraw Hill, Inc.
2	The Intel Microprocessors – Architecture Programming and Interfacing	Barry B Brey, Pearson Education, Inc., Upper Saddle River, New Jersey 07458.
3	Digital Computer Electronics	Albert P. Malvino and JeraldA. Brown, 3rd Edition.
4	Microprocessor Architecture, Programming and Applications	R. Gaonkar

ICE 3212: Microprocessor and Microcontroller Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Practical System orientation on basis of the course ICE 3211: Intel 8086 microprocessor: architecture, addressing modes, instruction sets, assembly language programming, system design and interrupt. Interfacing: programmable

peripheral interface, programmable timer, serial communication interface, programmable interrupt controller, direct memory access, keyboard, display device and other I/O device interface.

CSE3221: Distributed Operating System

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Principle of operating systems and Operating system structure: Definition of operating system, Different kinds of operating systems (Desktop, Multiprocessor, Distributed, Clustered, Real time, Handheld systems), Operating-System Services, User Operating-System Interface, System Calls, Types of System Calls, System Programs, Operating-System Design and Implementation, Operating-System Structure, Virtual Machines.

Concurrency control, Recovery System and Distribute databases: Lock-Based Protocols, Granting of locks, Two-phase locking protocol, Graph based protocol, Tree protocol, Timestamp based protocols, Deadlock detection and recovery. Failure classification, Storage types, Checkpoints. Distributed data, Replication and Fragmentation.

Multiprocessing and time sharing, Process coordination, Deadlocks: Multiple-Processor Scheduling, Thread Scheduling, Algorithm Evaluation, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

Memory management: Background, Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation, Demand Paging, Page Replacement, Thrashing, Demand Paging, Page Replacement.

File systems: File Concept, Access Methods, Directory Structure, File-System Mounting, File Sharing, File-System Implementation, Directory Implementation, Allocation Methods

Protection and security: Protection, Principles of Protection, Domain of Protection, Access Matrix, Access Control, Revocation of Access Rights, The Security Problem, Program Threats, System and Network Threats, Cryptography as a Security Tool, User Authentication, Implementing Security Defenses, Fire walling to Protect Systems and Networks.

Reference Book:

1	Operating System Concepts	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne
2	Modern Operating Systems	Andrew S. Tanenbaum
3	Distributed Operating Systems	Andrew S. Tanenbaum
4	Mastering LINUX	Denis

CSE3222: Distributed Operating System Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: None

Course Content:

Introduction of Linux Operating System, Installation of Linux in various modes, Installation of windows application programs on Linux, Installation of Linux application programs on Windows, Basic Command Line commands, Linux Kernels and Office Environments, Orientation with Shell Programming, Making own kernel, Harding Windows, Harding Linux.

ICE3231: Digital Signal Processing

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Introduction to digital signal processing (DSP): Discrete-time signals and systems, analog to digital conversion, impulse response, finite impulse response (FIR) and infinite impulse response (IIR) of discrete-time systems, difference equation, convolution, transient and steady state response.

Discrete Fourier Transform: Frequency-domain sampling, Discrete Fourier Transform (DFT), Properties of DFT, Linear filtering and frequency analysis of signals using DFT, Discrete Cosine Transform.

Efficient Computation of DFT: Fast Fourier Transform (FFT) algorithms, Applications of FFT algorithms, Linear filtering approach to the computation of DFT, Quantization effects in the computation of DFT.

Digital Filters: Causality, Symmetric and Antisymmetric Finite Impulse Response (FIR) filters, Linear-phase FIR filters, FIR differentiator, Hilbert transformer, Infinite Impulse Response (IIR) filter design methods, Frequency transformations.

Multirate Signal Processing: Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion (SRC), Filter design for SRC: Direct Form FIR Digital Filter Structure, Cascade Form FIR Digital Filter Structure, Polyphase FIR Structure, Multistage Implementation of SRC, SRC of band pass signal, SRC by arbitrary factor, Multirate signal processing applications.

Optimum Filters and Spectrum Estimation: FIR Wiener Filter, IIR Wiener Filter, Discrete Kalman Filter, Nonparametric Methods: The Periodogram method, Bartletts method, Welch's method, Blackman-Turkey method, Parametric Methods: Autocorrelation method, Co-variance method, Modified Co-variance method, Burg method, Frequency Estimations.

Adaptive Filtering: Introduction, FIR Adaptive Filters, Adaptive Recursive Filters, Recursive Least Squares: Exponentially Weighted RLS, Sliding window RLS (WRLS).

Reference Book:

1	Digital Signal Processing	JohnG.Proakis, Dimitris K Manolakis; Pearson Education.
2	Digital Signal Processing	Emmanuel C. Ifeachor& Barrie w. Servis; Addision Wesley Publishing Company.
3	Signal and System (Continuous & Discrete)	Rodger E. Ziemer, W. H. Tranter & D. R. Fannin; Pearson Education.

ICE3232: Digital Signal Processing Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in ICE3241. In the second part, students will design simple systems using the principles learned in ICE3241.

HUM3241: Industrial Management and Accountancy

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Business and Industry: Basic concept of business and Industry, objectives of business, types of Business, types of industry, business and society, business environment, and ethical issues of business.

Management and Organization of Industrial Establishment: Concept of management, management principles and functions: planning, organizing, leading, and controlling, Years of management, manager and roles of

management, scientific management and core management skills, corporate activities, corporate social responsibility, concept of business management, organizational structure of industrial organization.

Management and Marketing Strategy: Concept of strategy, strategy formulation, SWOT analysis, PPM, competitive superiority, customer satisfaction, alliance, merger and acquisition, integration, concept of market and marketing, market research, sales/product planning, sales promotion, customer satisfaction survey, business strategy and goal evaluation, business management system, strategy formulation in IT industry, strategy IT industry, technological development strategy, and planning.

Human Resource Management and Industrial Relations: Concept of HRM, HRM functions and model, recruitment, selection, industrial relations and disputes. grievance, handling of grievances, labor welfare, workers' participation in management, motivation employees in the industry, leadership, payment of industrial workers, job satisfaction and job enrichment, training, and trade union, and collective bargaining.

Health, Safety, and Industrial Environment: Classification of accidents, causes of accidents, effects of accidents, safety consciousness & publicity, safety procedures, safety measures, basics of environmental pollution, various management techniques for control of environmental pollution, various control acts for air, water, solid waste and noise.

Managing Industrial Project: Concept of project and project management, project life cycle, project scope management, project proposal, scheduling and budgeting, procurement, project monitoring and evaluation.

Service Management: Concept of service and service management, service management in IT industry, ITIL system diagram, ITIL framework, service support, service delivery, facility management, system audit and internal control.

Materials Management: Material in industry, inventory control model, ABC analysis, safety stock, reorder, Year, economic ordering quantity, stores equipment, stores records, purchasing procedures, purchase records, bin card, cardex, material handling, manual lifting, hoist, cranes, conveyors, trucks, fork trucks.

Operations research and Industrial Engineering: Concept of operation research, charts and diagram of understanding operations, methods of job analysis and operational planning, methods of decision making, problem solving methods, concept of standardization, standardization organizations and specifications, examples of standardization.

Accountings: History, scope and nature of accounting, purpose of accounting, accounting equation, meaning and classification of account, double entry system, rules for deSemesterining debit and credit, accounting cycle journal, ledger and trial balance.

Cost Concepts and Cost-Volume-Profit Relationship: Meaning of cost, different types of costs, contribution margin and ratio analysis, break-even analysis, CVP relationship in Graphical Form and target net profit analysis.

Reference Book:

1	Business Organization and Management.	M. C. Shukla
2	Accounting Principles.	Hermanson Etar
3	Managerial Accounting	Ray H. Garrison
4	OP Harkut.: Industrial Management	VK Sharma

ICE3260: Industrial Training

Credit 1.00, Contact Hours 4 weeks, Pre-Requisite: None

Course Contents:

Four weeks training in an assigned company or industry on any one of the Trending technologies according to the industry standards. This is done by making students work on live projects which equip them with the required skill needed for the corporate world.

4.7 Course Outline of 4th Year, 1st Semester

ICE 4000: Project/Thesis

Credit 2.00, Contact Hours 4.00, Pre-Requisite: None

Course Contents:

Students may choose to write alone or in groups of up to 4 students.

Types of thesis:

Students can choose topics containing theoretical, empirical and/or practical aspects. But irrespective of the topic chosen, the use of relevant theory and literature is fundamental to the thesis.

An empirical paper: The idea is to gather knowledge on a specific topic and to relate theory to empirical observations, e.g., by using existing data, by using questionnaires or experiments.

A case study: A case study approach involves an analysis of a specific occurrence or process in an actual company or another type of organization. The purpose of a case study is to provide descriptions, analyses, and suggested solutions to problems in relation to the case in hand. Case studies will involve the use of quantitative and/or qualitative methods for data collection.

A theoretical paper: This type of thesis builds on a theoretical model or a generic problem. Often a theoretical thesis is based on existing literature studies in which a theoretical problem is analyzed. This type of thesis is the least common.

No type of thesis is superior to others and no topics guarantee a high grade. The grade is based solely on whether the topic is thoroughly analyzed, the results clearly presented and whether you are able to demonstrate your knowledge of current theories and analyses, competent application of methods as well as independent critical judgment.

ICE 4121: Network Security

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Introduction of Classical Encryption Techniques: Security Trends, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for Network Security, Symmetric Cipher Model, Substitution Techniques – Caesar cipher, Monoalphabetic ciphers, Play fair cipher, Hill cipher, Polyalphabetic cipher, One-time pad, Transposition Techniques.

Block Cipher: Block Cipher Principles, The Data Encryption Standard, The Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles, Block Cipher Modes of Operation, Modular Arithmetic, Euclid's Algorithm, Finite Fields, Polynomial Arithmetic.

Advanced & Contemporary Symmetric Cipher: Evaluation Criteria For AES, The AES Cipher, Multiple Encryption and Triple DES, Stream Ciphers and RC4.

Confidentiality Using Symmetric Encryption: Placement of Encryption Function, Traffic Confidentiality, Key Distribution, Random Number Generation.

Public-Key Encryption: Introduction to number theory, Principles of Public-Key Cryptosystems, Applications for Public-Key Cryptosystems, Requirements for Public-Key Cryptography, the RSA Algorithm.

Key Management and Elliptic Curve Cryptography (ECC): Key Management, Diffie-Hellman Key Exchange, Elliptic Curve Arithmetic, ECC-Key exchange using ECC, Elliptic Curve Encryption/Decryption.

MAC and Hash Function: Authentication Requirement, Authentication Functions, Message Authentication Code, Hash Functions, Security of Hash Functions and MACs, MD5 Message Digest Algorithm, Secure Hash Algorithm, RIPEMD-160, HMAC.

Hash Algorithm, Digital Signatures and Authentication Protocols: Secure Hash Algorithm, HMAC, HMAC Design Objectives, Digital Signature, Authentication Protocols, Digital Signature Standard, Mutual Authentication, One-Way Authentication, Digital Signature Standard.

Reference Book:

1	Cryptography and Network Security: Principles and Practice	William Stallings., Pearson; 7th edition
2	Applied Cryptography	Bruce Schneier.
3	Codes and Cryptography	Dominic Welsh, Oxford University Press
4	Mathematical Cryptology for Computer Scientists and Mathematicians	Patterson, Wayne, Rowman & Littlefield Publishers
5	Cryptography: A Primer	Konheim, Alan G. Wiley; 1st edition.

ICE 4103: Seminar (Related Topics)

Credit 1.00, Contact Hours 2.00, Pre-Requisite: None

Seminar on related topics published in reputed journals.

4.8 Course Outline of 4th Year, 2nd Semester

ICE 4211: Artificial Intelligence and Neural Computing

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Introduction: Nature and goals of AI, Historical background, Comparison of conventional and neural computation, overview of network architectures and learning paradigms.

Knowledge Acquisition and Representation: Knowledge acquisition, Survey of types of knowledge, Survey of available representation, Conceptual graph, Frames, Scripts, cases and particularized knowledge, case-based reasoning.

Reasoning and Problem Solving: Derivation of consequences from facts, Different characterizations of reasoning, Reasoning with uncertainty, Probabilistic reasoning, Use of states and transitions, searching of state spaces, Breath first, Depth-first, and related types of search, Brief revision of propositional and predicate calculus, Connection of logic with programming, Forward and backward chaining, Resolution.

Overview of AI Programming Language: Prolog, Visual Prolog, LISP etc.

Introduction to Selected Topics in AI: Game Playing, Natural language processing, Expert system, Genetic algorithm, Robotics and Fuzzy logic.

Neural Networks: Definition, Benefit, Human Brain, Models of Neuron, Types of Activation Function, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks.

Learning Process: Error-Correction Learning, Memory Based Learning, Hebbian Learning, Competitive Learning, Boltzmann Learning, Statistical Learning Theory.

Perceptron: Perceptron, Perceptron Convergence Theorem, Multilayer Perceptron, Back-Propagation Algorithm, XOR Problem, Decision Rule, Differentiation, Hessian Matrix, Generalization, Cross-Validation, Network Pruning Technique, Convolutional Network.

Reference Book:

1	Artificial Intelligence A Modern Approach	S. Russel and P. Norving.
2	Neural Networks A Comprehensive Foundation	Simon Haykin, Prentice Hall; Subsequent edition
3	Artificial Intelligence	E. Ritch and K. Knight., McGraw-Hill Education; 2nd edition
4	Logical Fundamentals of AI	Generserth, Michael R, and Nilsson Nills.

ICE 4212: Artificial Intelligence and Neural Computing Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

In this course students will get hands on experience about different programming paradigm in Prolog concerned with AI.

ICE4231: Software Engineering

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Software Engineering Paradigms: Definition of S/W Eng.; The classical life cycle; prototyping fourth generation technique; The product and the process, measurement, matrices.

Software Project Planning: Project planning objectives; S/W slope; Resources; Metrics for S/W productivity and quality; S/W project estimation; Decomposition techniques; Empirical Estimation Models; Automated Estimation tools; S/W project scheduling.

Requirements Analysis Fundamentals: Analysis principle; Software Prototyping Specification; Requirement Analysis Methodologies; Structured and object-oriented analysis; Data Flow-oriented Analysis methods.

Software Design Fundamentals: Design process; Design fundamentals: S/W architecture, program structure, Data structure, S/W procedure, Modularity, abstraction; Effective modular design; Procedural design; Data flow-oriented Design; Top-down and bottom-up design; Design Process considerations; Transform analysis; Transaction analysis; Data structure-oriented design: Logical construction of programs and systems, Data structured systems development; object-oriented design; Design concepts; Methods; strategy. Real-time Design; Coding style: Code documentation, Data declaration, statement construction, Input/output.

Software reliability and availability models: Software quality factors; software review; software quality metrics; Software reliability; Software quality assurance approach.

Software Testing Techniques: Testing fundamentals; White box testing; Basis path testing; Loop testing; Black Box testing.

Software Testing Strategies: Verification and validation; Organization for software testing; Unit testing; Integration testing; Validation testing; System testing; The art of debugging.

Software Maintenance and configuration management: Definition; Maintenance Characteristics; Maintainability; Maintenance tasks; Software configuration management.

Reference Book:

1	Software Engineering	Ian Sommerville.
2	Software Engineering Prentice Hall	Roger S. pressman.
3	Systems Analysis and Design	Elias M. Awad.
4	Software Engineering	Ian Sommerville.

ICE4232: Software Engineering Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: None

Course Content:

Course Content are based on ICE4231 (Software Engineering).

Chapter 5: Course Outline of Elective Courses

5.1 Course Outline in the field of Communication Engineering

ICE 4*13: Satellite Communication and Radar

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Communication Satellite: COMSAT**,** Orbit and Description, Orbital geometry and mechanics, Azimuth and elevation, coverage angle and slant range, eclipse effect, placement of satellite.

Overview of Satellite System Engineering: Advantages and disadvantages of satellite Communication, Satellite communication bands, Spacecraft, Introduction to Spacecraft Subsystem, (AOCS), Telemetry, Tracking and command (TT&C), Spacecraft Antennas, Basic Antenna Types and Relationships, Spacecraft, Antennas in Practice, Frequency Reuse, Equipment Reliability and Space Qualification, Reliability redundancy.

Earth Station: Earth station antenna, High power amplifier, Low-noise amplifier, Up-converter, Down-converter.

Satellite Link: Basic link analysis, interference analysis, rain-induced attenuation, system availability, satellite link design.

VSAT Networks: Technology and recent advancements, Mobile Satellite Networks, Bangabandhu satellite (BS1).

RADAR: Introduction to Radar, Radar Equation CZ, Operating Principle of Radar with Block Diagram, CW and FM Radar, Tracking Radar, Antennas for Radar, Radar Receivers, Radar Transmitting System, Duplexer, Usable Frequencies for Radar, Radar Applications.

Reference Book:

1	Digital Satellite Communications	Tri T. Ha, Second Ed. McGraw-Hill.
2	Satellite Communications	Timothy Pratt, Second Ed. Wiley.
3	Electronic Communication Systems	Kennedy
4	Introduction to Radar systems	Tata McGraw Hill

ICE 4*14: Satellite Communication and Radar Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Sessional works based on ICE4*13.

ICE 4*15: Telecommunication and Switching

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Introduction: Simple telephone communication, Basic switching system, Transmission bridge, Subscriber line circuit, CB cord circuit, Junction working, Principle, evolution, networks, exchange, and international regulatory bodies.

Switching system: Introduction to analog system, digital switching systems – space division switching, blocking probability and multistage switching, time division switching and two-dimensional switching.

Telephone Apparatus: Microphone, speakers, ringer, pulse tone dialing mechanism, side-tone mechanism, local and central batteries, and advanced features.

Strowger Switching Systems: Relay dial telephone, Signaling tones, Strowger switching component, Step-by-step switching, Design parameters, 100-line switching system, 1000-line blocking exchange, 10,000-line exchange.

Crossbar Switching: principle of common control, Touch tone dial telephone, principles of crossbar switching, Crossbar switching configuration, Cross point Semesterinology, Crossbar exchange organization.

Electronic Switching: Concept of TDM, Basic time division space switching, Basic time division time switching, Time multiplexed space switching, Time multiplexed time switching, Combination switching, Three-stage combination switching, n-stage combination switching.

Traffic analysis: Traffic characterization, grades of service, network blocking probabilities, delay system and queuing.

Telephone Network: Subscriber Loop Systems, Switching Hierarchy and Routing, Transmission Plan, Transmission Systems.

Modern telephone services and network: Subscriber loop Systems, Switching Hierarchy and Routing, Transmission plan, Transmission systems, Numbering and charging plan, Signaling techniques in-channel and Common channel signaling, SS7 signaling, Publics Switched Telephone network architecture, Introduction to ISDN, New services, Network and protocol architecture, Transmission standards, User network Interfaces.

Reference Book:

1	Digital switching systems	Syed R. Ali; McGraw Hill international.
2	Digital Telephony	John Bellamy; John Wiley & sons, Inc.
3	Telecommunication Switching Systems and Networks	Thiagarajan Viswanathan; Prentice Hall of India.

ICE 4*17: Communication Theory

Credit 3.00, Contact Hours 3.00, Pre-requisite: None.

Course Contents:

Overview of communication systems: Basic principles, fundamental elements, system limitations, message source, bandwidth requirements, transmission media types, bandwidth and transmission capacity.

Noise: Source, characteristics of various types of noise and signal to noise ratio.

Information theory: Measure of information, source encoding, error free communication over a noisy channel, channel capacity of a continuous system and channel capacity of a discrete memory less system.

Communication systems: Analog and digital. Continuous wave modulation: Transmission types, base-band transmission, carrier transmission.

Amplitude modulation: Introduction, double side band, single side band, vestigial side band, quadrature, spectral analysis of each type, envelope and synchronous detection.

Angle modulation: Instantaneous frequency, frequency modulation (FM) and phase modulation (PM), spectral analysis, demodulation of FM and PM.

Pulse modulation: Sampling theorem, Nyquist criterion, aliasing, instantaneous and natural sampling.

Pulse amplitude modulation: Principle, bandwidth requirements.

Pulse code modulation (PCM): Quantization principle, quantization noise, non-uniform quantization, signal to quantization error ratio, Companded PCM, PSK, FSK, QPSK, BPSK, differential PCM, demodulation of PCM.

Delta modulation (DM): Principle, adaptive DM, line coding – formats and bandwidths.

Digital modulation: Amplitude-shift keying - principle, ON-OFF keying, bandwidth requirements, detection, noise performance.

Phase-shift keying (PSK): Principle, bandwidth requirements, detection. Coherent and Non-coherent Demodulation techniques.
Multiplexing: Frequency division multiplexing (FDM), Time division multiplexing (TDM) - principle, receiver synchronization, frame synchronization, PHD, SONET/SDH, wavelength division multiplexing, multiple-access network – time division multiple access, frequency-division multiple access, code-division multiple access (CDMA), spread spectrum techniques, coding techniques and constraints of CDMA.
Communication system design: Design parameters, channel selection criteria and performance simulation.

Reference Books:

1	Understanding Communication Theory: A Beginner's Guide	Stephen M. Croucher
2	Communication System	Somon Haykin, John Wiley & Sons, Inc.

ICE 4*19: Multimedia System & Application

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Introduction: Coding and compression standards; Architecture issues in multimedia; Operating systems issues in multimedia - real-time OS issues, synchronization, interrupt handling.

Database issues in multimedia: Indexing and storing multimedia data, disk placement, disk scheduling, searching for a multimedia document.

Networking issues in multimedia: Quality-of-service guarantees, resource reservation, traffic specification, shaping, and monitoring, admission control; Multicasting issues; Session directories; Protocols for controlling sessions; Security issues in multimedia-digital water making, partial encryption schemes for video streams.

Multimedia applications: Audio and video conferencing, video on demand, voice VoIP.

Reference Book:

1	Multimedia Systems	Ralf Steinmetz, Klara Nahrstedt
2	Multimedia Database Management Systems, Academic Publishers	B. Prabhakaram, Kluwer
3	Fundamentals of Multimedia, Pearson prentice Hall	Ze-Nim Li, and Mark S. Dres

ICE 4*23: Information Theory and Coding

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Entropy, Relative Entropy, and Mutual Information: Entropy; Joint Entropy and Conditional Entropy; Relative Entropy and Mutual Information; Relationship between Entropy and Mutual Information; Chain Rules for Entropy; Relative Entropy and Mutual Information; Jensen's Inequality and Its Consequences; Log Sum Inequality and Its Applications; Data-Processing Inequality; Sufficient Statistics; Fano's Inequality.

Asymptotic Equipartition Property: Asymptotic Equipartition Property Theorem; Consequences of the AEP: Data Compression; High-Probability Sets and the Typical Set.

Entropy Rates of a Stochastic Process: Markov Chains; Entropy Rate; Entropy Rate of a Random Walk on a Weighted Graph; Functions of Markov Chains.

Source Coding and Data Compression: Kraft Inequality; McMillan's Theorem; Optimal Codes; Bounds on the Optimal Code Length; Kraft Inequality for Uniquely Decodable Codes; Huffman Codes; Shannon–Fano–Elias

Coding; Universal Codes and Channel Capacity, Run-Length Coding; Arithmetic Coding, Higher-Order Modeling, The Lempel-Ziv Algorithm.

Channel Capacity: Noiseless Binary Channel; Noisy Channel with No overlapping Outputs; Binary Symmetric Channel; Binary Erasure Channel; Symmetric Channels; Properties of Channel Capacity; Preview of the Channel Coding Theorem; Jointly Typical Sequences; Channel Coding Theorem; Zero-Error Codes; Fano's Inequality and the Converse to the Coding Theorem; Equality in the Converse to the Channel Coding Theorem; Hamming Codes; Feedback Capacity; Source–Channel Separation Theorem.

Reference Book:

1	Elements of Information Theory	TM Gover, JM Thomos
2	Information Theory, Coding and Cryptography	R Bose, McGraw Hill

ICE 4*25: Microwave Engineering

Credit 3.00, Contact Hours 3.00, Pre-requisite: ICE 2241

Course Contents:

Transmission lines: Microwave Transmission Lines, Transmission Line Analogy, Voltage and current in ideal transmission lines, Reflection, Transmission, Standing wave, Impedance Matching Techniques, Smith Chart and Its Applications.

Waveguides: Waves Propagation in Guided Media; Propagation through Parallel-Plate Wave Guides, Rectangular and Circular Wave Guides, Dominant and degenerate modes, Field patterns, Cavity Resonators.

Microwave Tubes: Microwave systems, Classification of microwave tubes, Klystron amplifier, Reentrant cavities, Velocity Modulation, Space Charge wave, Multicavity Klystron Amplifier, Reflex Klystron Oscillator. Magnetron, Travelling Wave Tube (TWT) Amplifier, Backward Wave Oscillator (BWO), Waveguide Components.

Solid State Microwave Devices: Gunn diode, Energy band structure of Gunn diode, Gunn oscillator, Different modes of Gunn diode oscillator, Application of Gunn diode, PIN diode as modulator, Solid state devices used as microwave amplifier, Applications of solid-state microwave devices. Industrial applications of Microwaves, Microwave Heating, Microwave Radiation Hazards.

Reference Book:

1	D. M. Pozar, Microwave Engineering, Second Edition	John Wiley & Sons, 1998.
2	Microwave Devices and Circuits	Samuel Y. Liao; Prentice Hall of India.
3	Foundations for Microwave Engineering–	E. Colliong; McGraw-Hill International.

ICE 4*26: Microwave Engineering Sessional
Credit 1.50, Contact Hours 3.00, Pre-requisite: ICE 2242

Course Contents:
In this course students will perform experiments to verify practically the theories and concepts learned in Microwave Engineering course (ICE 4***).

5.2 Course Outline in the Field of IT/Software Engineering

ICE4*29: Cloud Computing

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Introduction to Cloud Computing: Introduction, Component of CC, Comparing CC with Virtualization, Grids, Utility Computing, client-server model, Pto P Computing, Impact of CC on Business, Key Drivers for Cloud Computing, Cloud computing Service delivery model, Cloud Types – Private, Public and Hybrid, when to avoid public cloud, Cloud API

Virtualization: Introduction & benefit of Virtualization, Implementation Years of Virtualization, VMM Deisgn Requirements and Providers, Virtualization at OS Year, Middleware support for Virtualization, Virtualization structure/tools and mechanisms: Hypervisor and Xen Architecture, Binary Translation with full Virtualization, Para Virtualization with Compiler Support, Virtualization of CPU, Memory and I/O Devices, Hardware support for Virtualization in intel x86 processor – CPU Virtualization – Memory Virtualization and I/O Virtualization – Virtualization in Multicore processors.

Cloud computing Services: SaaS, IaaS, PaaS, Leveraging PaaS for Productivity, Languages for PaaS, DBaaS (Database as a services), SaaS (Software as a service), Comparison of various cloud computing providers/ Softwares.

Cloud Computing and Business Value: Key Business Drivers for CC, Cloud computing and outsourcing, Types of Scalability, Security issues in Cloud Computing, time to Market Benefits, Distribution over Internet, Three Years of Business value from Cloud computing.

Open-Source Cloud Implementation and Administration: Eucalyptus and Open Stack Architecture Features, Components, Various mode of operations, Installation and configuration process of both open source, Cloud Administration and Management Task, Creating User Interface (Web Interface) of Private cloud.

Cloud Deployment Techniques: Factors for Successful Cloud Deployment, Network Requirements, Potential Problem areas in a cloud Network and their Mitigation, Cloud Network Topologies, Automation and Self, service feature in a cloud, cloud performance.

Security: Security for Virtualization Platform, Host security for SaaS, PaaS and IaaS, Data Security, Data Security Concerns, Data Confidentiality and Encryption, Data Availability, Data Integrity, Cloud Storage Gateways, Cloud Firewall.

Cloud Programming: Programming Support for Google Apps engine: GFS, Big Tables, Googles NO SQL System, Chubby, Google Distributed Lock Service, Programming Support for Amazon EC2: Amazon S3, EBS and Simple DB etc.

Reference Book:

1	Cloud Application Architectures	George Reese, O'Reilly Media, Inc
2	Cloud Computing Principles and Paradigms	Rajkumar Buyya
3	Distributed Systems	George Coulouris

ICE4*33: Software Quality Assurance

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Introduction: Objective and Need for testing, Psychology of testing, Impracticality of Testing All data; Impracticality of Testing All Paths; No-Absolute Proof of Correctness, Defect, Difference between defect and bug, Life cycle of defect, Testing economics - White box, Black box, Grey box testing, SDLC and Testing - Verification & Validation, Software Technical Reviews

Testing & Coverage: White box testing techniques, Statement coverage, Branch Coverage, Condition coverage, Decision/Condition coverage, Multiple condition coverage, Dataflow coverage, Mutation testing, Automated code

coverage analysis, Black box testing techniques, Boundary value analysis, Robustness testing, Equivalence partitioning, Syntax testing, Finite state testing

Software Testing: Years of Testing, Regression Testing, Requirements Tracing, Requirement Traceability Matrix, V & V Standards, Identification of V & V Goals and Techniques: Requirements, Specifications, Designs, Implementations, Changes, Organizational Responsibilities, Test Automation: Why and How?

Software Quality: Software Quality Assurance, test optimization, Eleven Step Testing Process (Assess Project Management Development Estimate and Status, Develop Test Plan, Requirements Phase Testing, Design Phase Testing, Program Phase Testing, Execute Test and Record Results, Acceptance Test, Report test results, testing software installation, Test software changes, Evaluate Test Effectiveness),Testing Security.

Software Tools: Software Reusability, Software Metrics, Software Testing Tools, Defect Tracking Tools, Defect Management Tools, Challenges, Error-Oriented Testing and Analysis, Simulation and Prototyping, Differences from testing non-OO Software, Class testing strategies, Class Modality, Message Sequence Specification.

Reference Book:

1	Effective Methods for Software Testing	William Perry, Wiley; 3rd edition
2	Software Testing	Louise Tamres, Addison-Wesley
3	Testing Object-Oriented Systems	Models- Robert V. Binder, Addison-Wesley Professional

ICE 4*35: Human Computer Interfacing

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Introduction: Goals of human-computer interaction and its relevance to the applications of interactive computer systems.

Psychological Aspects: Cognitive psychology. Sensory channels. Human limitations and expectations in perceptual processes. Visual perception. Auditory perception. Haptic perception. Human memory: sensory, short-Semester, long Semester. Individual differences. Mental models. Metaphors. Human error: slip and mistake. Devices for Human-Computer Interaction: Text input devices. Positioning and pointing devices. 3D devices. Devices for visual, auditory, and haptic output. Interfaces and devices for disabled users.

Models and Paradigms of Human-Computer Interaction: Characterizing different phases of interaction. Ergonomic aspects of interaction. Interaction styles: from command language to 3D interfaces. Window interfaces (WIMP). Menu and icon design. Interaction paradigms. Human-Computer Interaction and the Software Life-Cycle: Analysis of usability requirements. Usability principles. User-centered design. Usability engineering. Prototyping techniques. Envisioning design techniques. Design rationale.

Environment. User, Task Analysis: Characterizing the context of interaction with socio-technical models. The USTM/CUSTOM technique. Task analysis. The HTA technique. Predictive models: GOMS, KLM.

Formal Methods in Human-Computer Interaction: State transition network and other diagrammatic notations, Textual notations, Design and analysis of dialogue with state transition network.

Guidelines and Standard for User Interfaces: Definition. Choosing and using guidelines. Examples of guidelines: MITRE, Apple, Microsoft. IBM guidelines for 3D interfaces. The ISO 9241 standard.

Tools for User Interface Implementation: Windowing System. Programming techniques. Toolkit. Case study: The Java toolkit. User Interface Management Systems. Usability Evaluation: Goals of evaluation. Recording tools. Observing the user. Collecting opinions. Interviews. Questionnaires. Experiments. Predictive evaluation. Cognitive walkthrough. Interpretive evaluation.

Help: Assisting the user. Requirements for help systems. Main approaches. Adaptive and adaptable interfaces.

Computer-Supported Cooperative Work: Groupware. Computer-mediated communication. E-mail and textual communication systems. Videoconference. Virtual collaborative environments. Workflow systems. Experimental and organizational aspects.

Recent Paradigms of Human-Computer Interaction: Ubiquitous computing. Virtual reality. Types of virtual reality. Multi-sensory (or multi-modal) interfaces. Information visualization. Hypertext. Multimedia and Hypermedia interfaces. WWW interfaces. Design of usable Web pages.

Reference Book:

1	Designing the user Interface, third edition, Adison-Wesley Publishing Company, New York	B. Shneiderman
2	Human Computer Interaction, Third Edition, Prentice Hall	A. Dix, J. Finlay, G. Abowd and R. Beale.
3	Towards computers that recognize and respond to emotion	IBM System Journal, Vol. 39, 705-719.- R. Picard
4	Emphatic Communities: Reaching Out Across the Web, Interactions	Vol 2, 32-43- J. Preece
5	The Ecological Approach to Visual Perception, Houghton-Mifflin	J. J. Gibson

ICE 4*37: Speech Processing and Speech Recognition

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Introduction to Speech Signal: Production, Perception and Characterization; Speech production models: Acoustic theory of speech production, discrete-time speech model, lossless model of the vocal tract; Signal Processing and Analysis; Speech perception, digital processing of speech signals; Short-Semester processing of speech, linear prediction analysis, spectral analysis.

Speech coding: LPC, MRA, enhancement, human auditory system, Pattern Comparison Techniques: Distortion Measures, Spectral Distortion Measures, Time Alignment and Normalization.

Recognition System Design and Implementation: Source Coding, Template Training, Performance Analysis; Continuous Speech Recognition: Sub-word Units, Statistical Modeling, and Context Dependent Units; Task oriented Models. Quality assessment, speech synthesis; Speaker recognition and verification systems.

Reference Book:

1	Fundamentals of Speech Recognition	Lawrence Rabinere, Biing, Pearson College Div; United States Ed edition
2	Speech Recognition and Processing	John F. Buydos.

ICE 4*38: Speech Processing and Speech Recognition Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in ICE 4*37. In the second part, students will design simple systems using the principles learned in ICE 4*37.

ICE 4*39: Big Data Analytics and Social Networking

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Big Data Concepts and Environment: Big Data Overview-Big Data Challenges and Opportunities- Data analytics lifecycle overview –Phases of Data Analytics: Discovery, Data preparation, Model planning, Model building, Communicate results, Operationalize – Case Study.

Overview of Hadoop and HDFS: Introduction to Hadoop - The Distributed File System: HDFS, GPFS – The Design of HDFS –HDFS-Concepts-Blocks, Name Nodes and Data Nodes; Components of Hadoop- Hadoop Cluster Architecture-Batch Processing- Serialization - Hadoop ecosystem of tools-NoSQL.

Map Reduce: MapReduce Basics - Functional Programming Roots - Mappers and Reducers - The Execution Framework-MapReduce Algorithm Design –Shuffling, Grouping, Sorting-Custom Partitioners and Combiners-MapReduce Formats and Feat.

Algorithms for Handling Big Data: Random Forest Algorithm, Unstructured Data Analytics, Randomized Matrix Algorithms in Parallel and Distributed Environments, Mahout: Probabilistic Hashing for Efficient Search and Learning on Massive Data, Dirichlet process clustering, Latent Dirichlet Allocation, Singular value decomposition, Parallel Frequent Pattern mining, Complementary Naive Bayes classifier, Random forest decision tree-based classifier.

Lambda Architecture: Different layers of Lambda Architecture, Data storage on the batch layer. Serving Layer-Requirements for a serving layer database, Indexing strategies. Speed Layer- Storing and Computing Real time views, Queuing and Streaming – Illustration using Cassandra data model.

Big Data Clustering: K-means Algorithms - K-Means Basics - Initializing Clusters for K-Means -Picking the Right Value of k - The Algorithm of Bradley, Fayyad, and Reina - Processing Data in the BFR Algorithm.

Social Network Analytics: Introduction to Social Networks and Social Network Sites, Social network analytics algorithms, Social event and trend modeling, Phenomenology of social media,

Influence and Centrality in Social Networks, Social ties and information diffusion, Social Spam and Malicious Behavior, Predicting the future with social media

Big Data Analytics for Social Network: Twitter streaming APIs for data collection, Distributed framework for social sentiment analysis, Online social events analysis and monitoring, Privacy in a Networked World, Social tagging and folksonomies, Geospatial social data mining

Reference Book:

1	Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data.	Paul C. Zikopoulos, Chris Eaton, Dirk deRoos, Thomas Deutsch, George Lapis
2	Data-Intensive Text Processing with MapReduce, Jimmy, Morgan &Claypool Synthesis, 2010	Lin and Chris Dyer
3	Mining of Massive Datasets, Cambridge University Press, 2014.	Anand Rajaraman and Jeffrey David Ullman
4	The Definitive guide, O'Reilly Media, 2015.	Tom White, Hadoop

ICE 4*41: Mobile Application Development

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Introduction to Android Operating System: Android OS design and Features – Android development framework, SDK features, Installing and running applications on Eclipse platform, Creating AVDs, Types of Android applications, Best practices in Android programming, Android tools. Android application components – Android Manifest file, Externalizing resources like values, themes, layouts, Menus etc, Resources for different devices and languages, Runtime Configuration Changes Android Application Lifecycle – Activities, Activity lifecycle, activity states, monitoring state changes.

Android User Interface: Measurements – Device and pixel density independent measuring units Layouts – Linear, Relative, Grid and Table Layouts User Interface (UI) Components – Editable and non-editable Text Views, Buttons, Radio and Toggle Buttons, Checkboxes, Spinners, Dialog and pickers Event Handling – Handling clicks or changes of various UI components Fragments – Creating fragments, Lifecycle of fragments, Fragment states, Adding fragments to Activity, adding, removing and replacing fragments with fragment transactions, interfacing between fragments and Activities, Multi-screen Activities.

Intents and Broadcasts: Intent – Using intents to launch Activities, Explicitly starting new Activity, Implicit Intents, Passing data to Intents, Getting results from Activities, Native Actions, using Intent to dial a number or to send SMS Broadcast Receivers – Using Intent filters to service implicit Intents, Resolving Intent filters, finding and using Intents received within an Activity Notifications – Creating and Displaying notifications, Displaying Toasts.

Persistent Storage: Files – Using application specific folders and files, creating files, reading data from files, listing contents of a directory Shared Preferences – Creating shared preferences, saving and retrieving data using Shared Preference Database – Introduction to SQLite database, creating and opening a database, creating tables, inserting retrieving and deleting data, Registering Content Providers, Using content Providers (insert, delete, retrieve and update).

Reference Book:

1	Web Engineering: The Discipline of Systematic Development of Web Applications-Wiley	GertiKappel (Editor), Birgit Prýýl (Editor), Siegfried Reich (Editor).
2	Internet and World Wide Web How to Program-Prentice Hall.	Harvey M. Deitel, Paul J. Deitel and Andrew B. Goldberg.
3	Programming the World Wide Web-Addison Wesley.	Robert W. Sebesta
4	Web Engineering: Principles and Techniques	Idea Group Publishing, WoojongSuh (Editor).

ICE4*42: Mobile Application Development Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Sessional works based on ICE 4*41 (Mobile Application Development).

ICE 4*43: Data Mining

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Introduction to Data Mining: What is data mining, Related technologies - Machine Learning, DBMS, OLAP, Statistics, Data Mining Goals, Stages of the Data Mining, Process Data Mining, Techniques, Knowledge Representation Methods, Applications, Example: weather data

Data Warehouse and OLAP: Data Warehouse and DBMS, Multidimensional data model, OLAP operations Example: loan data set.

Data preprocessing: Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies, Installing Weka 3 Data Mining System, Experiments with Weka - filters, discretization.

Data mining knowledge representation: Task relevant data, Background knowledge, Interestingness measures, Representing input data and output knowledge, Visualization techniques, Experiments with Weka– visualization.

Attribute-oriented analysis: Attribute generalization, Attribute relevance, Class comparison, Statistical measures, Experiments with Weka - using filters and statistics.

Data mining algorithms: Association rules: Motivation and Semesterinology, Example: mining weather data, Basic idea: item sets, Generating item sets and rules efficiently, Correlation analysis, Experiments with Weka - mining association rules.

Data mining algorithms: Classification: Basic learning/mining tasks, Inferring rudimentary rules: 1R algorithm, Decision trees, Covering rules, Experiments with Weka - decision trees, rules.

Data mining algorithms: Prediction The prediction task, Statistical (Bayesian) classification, Bayesian networks, Instance-based methods (nearest neighbor), Linear models, Experiments with Weka– Prediction.

Reference Book:

1	Data Mining and Data Warehousing, University Science Press Sumit Prakash Tayal.	Bharat Bhushan Agarwal, University Science Press, 2009
2	Data Warehousing, Data Mining, and OLAP, McGraw-Hill	Alex Berson and Stephen J. Smith.

ICE 4*45: Internet and Web Programming

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Introduction to Web Technologies: Introduction to Web servers like Apache 1.1, IIS XAMPP (Bundle Server), WAMP (Bundle Server), Handling HTTP Request and Response, installations of above servers, HTML and CSS: HTML 5.0, XHTML, CSS 3. Internet

Java Script: An introduction to JavaScript–JavaScript DOM Model-Date and Objects, - Regular Expressions-Exception Handling-Validation-Built-in objects-Event Handling- DHTML with JavaScript. Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions Session Handling- Understanding Cookies. Installing and Configuring Apache Tomcat Web Server; -DATABASE CONNECTIVITY: JDBC perspectives, JDBC program example - JSP: Understanding Java Server Pages-JSP Standard Tag Library (JSTL)-Creating HTML forms by embedding JSP code.

Introduction to PHP: The problem with other Technologies (Servlets and JSP), Downloading, installing, configuring PHP, Programming in a Web environment and the anatomy of a PHP Page. Overview of PHP Data types and Concepts: Variables and data types, Operators, Expressions and Statements, Strings, Arrays and Functions. PHP Advanced Concepts: Using Cookies, Using HTTP Headers, Using Sessions, Authenticating users, Using Environment and Configuration variables, Working with Date and Time.

Creating and Using Forms: Understanding Common Form Issues, GET vs. POST, Validating form input, Working with multiple forms, and Preventing Multiple Submissions ofa form. XML: Basic XML- Document Type Definition XML Schema DOM and Presenting XML, XML Parsers and Validation, XSL and XSLT Transformation, News Feed (RSS and ATOM).

AJAX: Ajax Client Server Architecture-XML Http Request Object-Call Back Methods; Web Services: Introduction- Java web services Basics – Creating, Publishing, Testing and Describing a Web services (WSDL)-Consuming a web service, Database Driven web service from an application– SOAP.

Reference Book:

1	Web Engineering: The Discipline of Systematic Development of Web Applications	Wiley.by G. Kappel, B. Pryyll, S. Reich.
2	Internet and World Wide Web How to Program, Prentice Hall	M. H. Deitel, J. P. Deitel and B. A. Goldberg.

3	Beginning PHP and MySQL, 3rd Edition	Jason Gilmore, Apress Publications (Dream tech.).
4	PHP 5 Recipes A problem Solution Approach	Lee Babin, Nathan A Good, Frank M. Kromann and Jon Stephens.
5	Internet and World Wide Web - How to Program	Deitel and Deitel and Nieto,

ICE4*46: Internet and Web Programming Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Sessional works based on ICE 4*45 (Internet and Web Programming).

ICE 4*47: Machine Learning

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Introduction: Machine learning, Supervised, unsupervised and reinforcement learning, Unsupervised learning algorithms.

Concept Learning: Decision tree learning, Attribute based and relational supervised learning algorithms, Artificial Neural network-based learning algorithms, Bayesian learning, Evaluating Hypothesis, Genetic algorithm and genetic programming, Reinforcement learning algorithms, Computational learning theory.

Reference Book:

1	Machine Learning, McGraw-Hill	Tom Michael Mitchell
2	Introduction to Machine Learning	Ethem Alpaydin

ICE 4*51: Natural Language Processing

Credit 3.00, Contact Hours 3.00, Pre-requisite: None.

Course Contents:

Introduction: Brief history of NLP research, current applications, generic NLP system architecture, and knowledge based *versus* probabilistic approaches.

Finite-state techniques: Inflectional and derivational morphology, finite-state automata in NLP, finite-state, transducers.

Prediction and part-of-speech tagging: Corpora, simple N-grams, word prediction, stochastic tagging, evaluating system performance.

Parsing and generation: Generative grammar, context-free grammars, parsing and generation with context-free, grammars, weights and probabilities.

Parsing with constraint-based grammars: Constraint-based grammar, unification.

Compositional and lexical semantics: Simple compositional semantics in constraint-based grammar. Semantic relations, WordNet, word senses, word sense disambiguation.

Discourse and dialogue: Anaphora resolution, discourse relations.

Applications: Machine translation, email response, spoken dialogue systems.

Reference Book:

1	The Language Instinct	Pinker, S, Brilliance Audio; Unabridged edition
2	Speech and Language Processing	Jurafsky, Daniel and James Martin
3	Linguistics: a very short introduction	Matthews, Peter, OUP Oxford; 1st edition

ICE 4*52: Natural Language Processing Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in ICE4*51. In the second part, students will design simple NLP systems using the principles learned in ICE4*51.

ICE 4*53: Computer Graphics and Animation

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Content:

Introduction to computer graphics: brief history, applications, hardware and software and the fundamental ideas behind modern computer graphics.

Two-dimensional graphics: device-independent programming; graphics primitives and attributes.

Interactive graphics: physical input devices, event-driven input; user interface. Transformations; translation, rotation, scaling, shear.

Three-dimensional graphics: 3D curves and surfaces; projections. 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 Indeo; 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.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, presentation, class tests, final exam.

Reference Book:

1	Theory and Problems of Computer Graphics 3rd Edition, 2000.	Zhigang Xiang, Roy, A. Plastock; McGraw Hill

2	Computer Graphics C Version 3rd Edition, 2004	Donald Hearn, M. Pauline Baker; Pearson Prentice Hall
3	Computer Graphics Principle and Practice 3rd Edition, 2013	Donald Hearn, M. Pauline Baker; Addison-Wesley Professional

5.3 Outline of Interdisciplinary Courses

ICE4*55: Management Information System

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Computer System: Introduction to computer technology, Computer System Concepts, Types of Computer Systems, Memory (Primary Storage, Secondary Storage. Cache). CPU-Central Processing Unit. Hardware (input Devices, output Devices. Software and its Classification. Types of Computer System.

Foundation of Information System : Data, Data processing, Information, Information System, Characteristics of Information System, Need of Information Systems in Business, Fundamental Resources of Information System, Potential Risks for Information System, Types of Information System (TPS.MIS.DSS.ESS), objectives of MIS, Characteristics, Applications of MIS, Benefits and Limitations of MIS, Approaches of MIS Development, Implementations of MIS, System Development Life Cycle (SDLC) and its Stages, Success and Failure of MIS.

Telecommunication and Network: Networking in the Enterprise, The Concept of a Network, The Business value of Telecommunications Networks, Types of Telecommunications Networks, Telecommunications Media, Network Topologies, Trends in Telecommunications.

Data Resource Management and DSS: Fundamental Data Concepts, Database structures, Database Development, Types of Databases, Technical Foundation of Database Management, Data warehouses and Data Mining, Decision Support in Business. Decision Structures, Decision Support Trends, Decision Support Systems, Online Analytical Processing, Using Decision support systems.

Business Applications: E-business systems, Customer Relationship Management (CRM), Three Phases of CRM, Benefits and Challenges of CRM, Trends in CRM, Enterprise Resource Planning (ERP)- Benefits and Challenges, Trends in ERP, Supply Chain Management (SCM), Roles of SCM. Benefits and Challenges of SCM, Trends in SCM, E-commerce Systems, E-Commerce and its scope, Essential E-Commerce Processes, Electronic Payment Processes.

Functional Applications of Hospitality Information System: Introduction to Hospitality Information System, Characteristics of Hospitality Information System, Computer Reservation System (CRS), Global Distribution System (GDS), Property Management Systems (PMS), Point of sales Systems (POS).

Reference Book:

1	Management Information systems	O'Brien, J. A, Marakas, G. M, McGraw Hill, New Work
2	Management Information Systems	Kenneth. C. L Jane P. L
3	Hospitality Information System & E-commerce John Wiley & Sons	Tesone. D. F

ICE 4*57: Bio-medical Engineering

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

General Introduction: The cell, body fluids, Musculoskeletal system, respiratory system, gastrointestinal system, Nervous system, endocrine system and circulatory system, Electro conduction system of the heart and heart problems.

Origin of Bio potentials: electrical activity of Excitable cells: the resting state, The active state, Volume conductor fields, Functional organization of the peripheral nervous system: Reflex are &Junctional transmission, Action potential.

Signal and Accusation: Electroneurogram (ENG), Electrocardiogram(ECG), Electroencephalography (EEG) and Electromyogram (EMG), Signals, their Origin and Applications and significance in medical Diagnosis, Electrodes for Recording ENG, ECG, EEG and EMG Signals.

Bio-Instrumentation: Biomedical signal Amplifiers, ECG preamplifier, DC ECGA amplifier, Signal Conditioners, A/D and D/A converter Interfaces to PC, Computerized Automatic Analysis, Bio-telemetry, and Monitoring Biological Parameters from Distance, Transducers for Physiological Parameter Reading, their Characteristics. Measurement of Body Temperature, Blood Pressure and HeartBeat, The standard lead system, Defibrillator protection circuit, Electro surgery Unit filtering, Multichannel physiological monitoring system, Common problems encountered and remedial techniques.

Diagnostic Methods: Ultrasound, CT and MRI, Merits of these Methods, Surgical Diathermy Machines, Defibrillators, Pacemakers, Ventilators, Intensive Care units, Lasers and Applications of Lasers in Medical Diagnostics and Therapy, Prosthesis and Prosthetic Devices, Patient Safety, Electrical Shock Hazards Incorporation of Safety Aspects in Biomedical Instrumentation, Introduction to Bio Sensors.

Cardiac Pacemakers: Lead wires and electrodes, Synchronous Pacemakers, rate responsive peacemaking, Defibrillators, cardioverters, Electrosurgical unit, Therapeutic applications of laser, Lithotripsy Haemodialysis.

Reference Book:

1	Medical Instrumentation: Application and Design	John G Webster, Editor
2	Introduction to biomedical Equipment Technology	Joseph J. Carr& John M. Brown

ICE 4*59: Mechatronics and Robotics Engineering

Credit 3.00, Contact Hours 3.00, Pre-requisite: None.

Course Contents:

Introduction to Mechatronics: Fundamentals of Mechatronics, Components of Mechatronics, Applications of Mechatronics, Relationship amongst Different Disciplines.

System Modeling and Control: Building Blocks of Electrical, Mechanical, Fluid and Thermal Systems, Electromechanical Systems, Open and Closed Loop Systems, Analogue and Digital Control Systems.

Sensors and Transducers: Sensors for Displacement, Proximity, Motion, Sound, Light, Temperature, Force, Pressure, Fluid Year, Fluid Flow etc.

Signal Conversion and Processing: Basic principles of potentiometer, Wheatstone bridge, op-amps, signal conditioning and data acquisition.

Actuation Systems: Basics of Pneumatic and Hydraulic Actuation Systems, Mechanical Actuation Systems, Electrical Actuation Systems.

Introduction to Robotics: Definition and Classification of Robots, Basic components of robot systems, Laws of Robotics, Applications of Robots, Basic Components of Robot Systems.

Mechanical Design of Robots: Links and Joints, Kinematic Chain, Mechanisms and Machines, Degrees of Freedom, Robot End Effectors.

Spatial Descriptions and Transformations: Description of Position, Orientation and Frames, Homogeneous Transformations.

Manipulator Kinematics: Link Parameters and Link Co-ordinate Systems, D-H Homogeneous, Transformation Matrices, Forward and Inverse Kinematics of Serial Manipulators.

Robot Control Architecture: Trajectory Planning, Control of Manipulators, Motor Control, Robot Sensors, Low Year Robot Vision, Robot Programming.

Reference Book:

1	Introduction to Mechatronics and Measurement Systems	Michael B., Histand and David G. Alciatore, McGraw-Hill.
2	Mechatronics Engineering	Sastry, Tata McGraw Hill.
3	Modeling and Control of Robot Manipulators	Sciavicco and Siciliano, McGraw-Hill
4	Introduction to Robotics: Mechanics and Control	John J. Craig, Pearson Prentice Hall.

ICE 4*61: Digital Image Processing and Pattern Recognition

Credit 3.00, Contact Hours 3.00, Pre-Requisite: None

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 Year 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:

1	Digital Image Processing, Prentice-Hall Publication	Rafeal C. Gonzalez & Richard E. Woods.
2	Fundamentals of Digital Image Processing, Academic Press	A. K. Jain.
3	Feature Extraction and Image Processing, Academic Press Aguado.	Mark S. Nixon & Albert S.
4	Digital Image Processing, Wiley-Inter-science	William K. Pratt.

ICE 4*62: Digital Image Processing and Pattern Recognition Sessional

Credit 1.50, Contact Hours 3.00, Pre-requisite: None

Course Content:
Sessional based on ICE 4*61.

ICE 4*63: Internet of Thing (IoT)
Credit 3.00, Contact Hours 3.00, Pre-Requisite: None
Course Contents:

Introduction to Internet of Things: Definition & Characteristics of IoT, Physical Design of IoT, Things in IoT, IoT Protocols, Logical Design of IoT, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies.
IoT Enabling Technologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, Embedded Systems, IoT 1st Year, IoT Year-2, IoT Year-3, IoT Year-4, IoT Year-5.
Domain Specific IoTs I: Home Automation, Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/Gas Detectors, Cities- Smart Parking, Smart Lighting, Structural Health Monitoring, Surveillance, Environment- Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection, River Floods Detection.
Domain Specific IoTs II: Energy- Smart Grids, Renewable Energy Systems, Prognostics, Retail- Inventory Management, Smart Payments, Smart Vending Machines, Logistics- Route Generation &Scheduling, Shipment Monitoring, Remote Vehicle Diagnostics, Agriculture- Smart Irrigation, Green House Control, Industry- Machine Diagnosis & Prognosis, Indoor Air Quality Monitoring, Health & Lifestyle, Wearable Electronics.
IoT and M2M: Introduction to M2M, Difference between IoT and M2M, SDN and NFV for IoT, Software Defined Networking, Network Function Virtualization, IoT System Management with NETCONF-YANG, Need for IoT Systems Management, Network Operator Requirements, NETCONF, YANG.
IoT Platforms Design Methodology: Process Specification, Domain Model Specification, Information Model Specification, Service Specifications, IoT Year Specification, Functional View Specification, Operational View Specification, Device & Component Integration, Case Study on IoT System for Weather Monitoring, IoT Physical Devices & Endpoints, Basic building blocks of an IoT Device, Exemplary Device: Raspberry Pi, pc Duino, Beagle Bone Black, Cubieboard.
IoT Physical Servers & Cloud Offerings: Introduction to Cloud Storage Models & Communication APIs, WAMP - AutoBahn for IoT, Xively Cloud for IoT, Django Architecture, Starting Development with Django, Amazon Web Services for IoT, Amazon EC2, Amazon Auto Scaling, Amazon S3, Amazon RDS, Amazon Dynamo DB, Amazon Kinesis, Amazon SQS, Amazon EMR, Sky Net IoT Messaging Platform.

Reference Book:

1	Internet of Things: A Hands-On Approach Arshdeep Bahga, VPT edition1, 2014.	Vijay Madisetti and
2	Designing for Emerging - UX for Genomics, Robotics, and the Internet of Things Technologies, 2014.	Jonathan Follett, O'Reilly,

ICE 4*64: Internet of Thing (IoT) Sessional

Credit 1.50, Contact Hours 3.00, Pre-Requisite: None

Course Contents:

Students will perform experiments to practically verify the theories and concept have learned in the theory course ICE 4*63(Internet of Thing (IoT). Students also will verify the theories and concepts learned in ICE 4*63 using simulation software or hardware kit.

ERROR: syntaxerror
OFFENDING COMMAND: --nostringval--

STACK:

/Title
()
/Subject
(D:20210624131732+06’00’)
/ModDate
()
/Keywords
(PDFCreator Version 0.9.5)
/Creator
(D:20210624131732+06’00’)
/CreationDate
(Acer)
/Author
-mark-