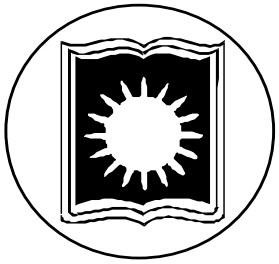
University of Rajshahi

Department of Information and Communication Engineering

Faculty of Engineering



Curriculum for B.Sc. Engineering

Session: 2019-2020

Examination

1st Year – 2020

2nd Year -2021

3rd Year – 2022

4th Year – 2023

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University of Rajshahi
Department of Information and Communication Engineering

Vision

Establishment of quality academic culture in the department for the attainment of intended skills, knowledge and attitude in the field of Information and Communication Engineering (ICE) so that the graduates can cater to the current and future needs of Information and Communication Technology (ICT) oriented industry and academia leading to the socio-economic development of Bangladesh.

Mission

In order to accomplish the vision, the department will

- Establish a unique learning environment to enable the students to face the challenges in the field of Information and Communication Engineering.
- Promote the establishment of centers of excellence in appropriate technological areas to enhance the spirit of innovation and creativity among faculty members and students.
- Provide ethical and value-based education by promoting activities addressing the socio-economic needs.
- Enable students to develop skills to solve complex technological problems and provide a framework for promoting collaborative and multidisciplinary activities.

Program Educational Objectives:

The Program Educational Objective (PEO) of the Department of Information and Communication Engineering (ICE) cater to the requirements of the stakeholders such as students, employers, alumni, faculty etc. The program educational objectives are as follows:

PEO-1: Provide students with sound foundation in mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyze the engineering problems and develop the solutions for real world ICT problems.

PEO-2: Impart analytic and critical thinking skills to develop initiative and innovative ideas for research and development (R&D), industry and societal requirements.

PEO-3: Inculcate professional and ethical attitude in students by providing effective communication skills, leadership skills and team work to challenge the contemporary issues to broader social context.

PEO-4: Provide an academic environment that gives adequate opportunity to the students to cultivate lifelong skills needed for a successful professional career.

Program Learning Outcomes (PLO):

After completion of the B.Sc. Engineering degree in Information and Communication Engineering (ICE) graduates will be able to

PLO-1. **Engineering Knowledge:** Utilize the basic knowledge of mathematics, science and engineering in Information and Communication Technology field.

PLO-2. **Problem Analysis:** Identify, formulate, research and analyze complex Information and Communication Engineering problems to achieve demonstrated conclusions using mathematical principles and engineering sciences.

PLO-3. **Design/Development of Solutions:** Design system components for complex Information and Communication Engineering problem that meet the requirement of public safety and offer solutions to the societal and environmental concerns.

PLO-4. **Investigation:** Conduct investigation to design and conduct experiments, analyze, synthesize and interpret the data pertaining to Information and Communication Engineering problems and arrive at valid conclusions.

PLO-5. **Modern Tool Uses:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools required for Information and Communication Engineering applications.

PLO-6. **The Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

PLO-7. **Environment and Sustainability:** Examine the impact of Information and Communication Engineering solutions in global and environmental context and utilize the knowledge for sustainable development.

PLO-8. **Ethics:** Develop consciousness of professional, ethical and social responsibilities as experts in the field of Information and Communication Engineering.

PLO-9. **Individual Work and Teamwork:** Function effectively as an individual and as a member or leader of diverse teams and in multidisciplinary settings.

PLO-10. **Communication:** Communicate effectively about complex Information and Communication Engineering activities with the engineering community and with society at large in both oral and written.

PLO-11. **Project Management and Finance:** Demonstrate knowledge and understanding of Information and Communication Engineering and management principles and apply these to one's work as a team member or a leader to manage projects in multidisciplinary environments.

PLO-12. **Life-Long Learning:** Recognize the need for and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological change.

Graduate Profile

By the time of graduation, the students should have achieved the graduate attributes (also known as **Program Learning Outcomes, PLO**), as well as, the attributes of the **Knowledge Profile** (K1-K8) as given in the following table:

Table 1: Knowledge Profile

	Attribute
K1	A systematic, theory-based understanding of the natural sciences applicable to the discipline of Information & Communication Engineering
K2	Conceptually based mathematics, numerical analysis, statistics and the formal aspects of computer and information science to support analysis and modeling applicable to the discipline of Information & Communication Engineering
K3	A systematic, theory-based formulation of engineering fundamentals required in the discipline of Information & Communication Engineering

K4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the discipline of Information & Communication Engineering; much is at its forefront
K5	Knowledge that supports engineering design in a practice area of Information & Communication Engineering
K6	Knowledge of engineering practice (technology) in the practice areas in the discipline of Information & Communication Engineering
K7	Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline of Information & Communication Engineering: *ethics and the engineer's professional responsibility to public safety; the impacts of engineering activity; economic, social, cultural, environmental and sustainability*
K8	Engagement with selected knowledge in the research literature of Information & Communication Engineering

The graduates will also acquire the attributes required for the ranges of **Complex Engineering Problem Solving** (P1-P7) and **Complex Engineering Activities** (A1-A5) as given in the following tables, respectively:

Table 2: Range of Complex Engineering Problem Solving

Attribute	**Complex Engineering Problems** have characteristic **P1** and some or all of **P2-P7**
Depth of knowledge required	**(P1)** Cannot be resolved without in-depth engineering knowledge at the level of one or more of **K3, K4, K5, K6** or **K8** which allows a fundamentals-based, first principles analytical approach
Range of conflicting requirements	**(P2)** Involve wide-ranging or conflicting technical, engineering and other issues
Depth of analysis required	**(P3)** Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models
Familiarity of issues	**(P4)** Involve infrequently encountered issues
Extent of applicable codes	**(P5)** Are outside problems encompassed by standards and codes of practice for professional engineering
Extent of stakeholder involvement and conflicting requirements	**(P6)** Involve diverse groups of stakeholders with widely varying needs
Interdependence	**(P7)** Are high level problems including many component parts or sub-problems

Table 3: Range of Complex Engineering Activities

Attribute	**Complex activities** means (engineering) activities or projects that have some or all of the following characteristics
Range of resources	**(A1)** Involve the use of diverse resources (and for this purpose resources include people, money, equipment, materials, information and technologies)
Level of interaction	**(A2)** Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues

Innovation	**(A3)** Involve creative use of engineering principles and research based knowledge in novel ways
Consequences for society and the environment	**(A4)** Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation
Familiarity	**(A5)** Can extend beyond previous experiences by applying principles-based approaches

Mapping PEO Vs PLO

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
PEO1	√	√		√								
PEO2			√		√	√						
PEO3							√	√	√	√	√	
PEO4												√

Mapping PEO Vs Types of Courses

Part – I Odd Semester					
Course Code	**Course Titles**	**PEO-1**	**PEO-2**	**PEO-3**	**PEO-4**
ICE1111	Introduction to Information and Communication Engineering	√	√		
ICE1121	Digital Electronics	√	√	√	
ICE1122	Digital Electronics Lab		√	√	
ICE1131	Electronics-I	√	√		√
ICE1132	Electronics-I Lab		√	√	
MATH1111	Algebra, Trigonometry and Vector Analysis	√			
CHEM1111	Physical and Inorganic Chemistry	√			
ENG1111	Technical and Communicative English	√		√	
Part-I Even Semester					
ICE1211	Electronics-II	√	√		
ICE1212	Electronics-II Lab		√	√	
CSE1291	Programming with C	√	√	√	
CSE1292	Programming with C Lab	√	√		
MATH1211	Differential and Integral Calculus	√	√		
STAT1211	Statistics for Engineers	√	√	√	
PHY1221	Applied Electricity and Magnetism	√	√		
ECON1211	Economics	√		√	
ICE1210	Viva-Voce			√	
Part-II Odd Semester					
EEE2181	Electronic Circuits and Semiconductor Devices	√	√		
EEE2182	Electronic Circuits and		√	√	

	Semiconductor Devices Lab				
ICE2121	Analog Communication and Radio-TV Engineering		√	√	
ICE2122	Analog Communication and Radio-TV Engineering Lab		√	√	
PHY2191	Electromagnetic Fields and Waves	√	√		
MATH2111	Matrices and Differential Equations	√	√		
STAT2111	Basic Theory of Statistics	√			
ACCO2111	Industrial Management and Accountancy	√	√	√	
Part-II Even Semester					
ICE2211	Cellular and Mobile Communication	√	√	√	
ICE2221	Signals and Systems	√			
ICE2222	Signals and Systems Lab		√		
ICE2231	Data Structures and Algorithms	√	√		
ICE2232	Data Structure and Algorithm Lab	√	√		
MATH2221	Discrete Mathematics and Numerical Methods	√	√		
LAW2211	Cyber and Intellectual Property Law	√	√	√	
ICE2210	Viva-Voce			√	
Part-III Odd Semester					
ICE3111	Microwave Communication and Radar	√	√	√	√
ICE3121	Digital Signal Processing	√	√	√	
ICE3122	Digital Signal Processing Lab	√	√		
ICE3131	Java and Network Programming	√	√	√	
ICE3132	Java and Network Programming Lab	√	√		
ICE3141	Antenna Engineering	√	√		√
ICE3142	Antenna Engineering Lab		√	√	
ICE3151	Satellite Communication	√	√	√	√
Part-III Even Semester					
ICE3211	Digital Image Processing	√	√		
ICE3212	Digital Image Processing Lab	√	√		
ICE3221	Digital Communication	√	√	√	
ICE3222	Digital Communication Lab		√	√	
ICE3231	Telecommunication Engineering	√	√		
ICE3241	Optical Fiber Communication	√	√	√	
ICE3242	Optical Fiber Communication Lab		√	√	
CSE3291	Software Engineering	√	√	√	√
ICE3210	Viva-Voce			√	
Part-IV Odd Semester					
ICE4111	Artificial Intelligence and Neural Computing	√	√	√	

ICE4121	Computer Architecture and Microprocessor				
ICE4122	Computer Architecture and Microprocessor Lab		√	√	
ICE4131	Wireless Communication	√	√	√	√
ICE4132	Wireless Communication Lab	√	√		
ICE4141	Database Management Systems	√	√		
ICE4142	Database Management Systems Lab	√	√		
ICE4151	Information System Analysis and Design	√	√	√	
Part-IV Even Semester					
ICE4211	Computer Networks	√	√	√	√
ICE4212	Computer Networks Lab	√	√		
ICE4221	Fundamentals of Cryptography	√	√	√	
ICE4222	Fundamentals of Cryptography Lab	√	√		
ICE4231	Information Theory and Coding	√	√		
ICE4241	Web Engineering	√	√	√	
ICE4242	Web Engineering Lab	√	√		
ICE4210	Viva-Voce			√	
ICE4252	Research Project	√	√	√	√

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 Part-I, Part-II, Part-III and Part-IV in succeeding higher levels of study. The academic year will be divided into two semesters (Odd and Even). 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. The Courses offered for Information and Communication Engineering department will consist of theoretical, practical, viva-voce, quizzes/class tests, attendance, and research project and are of 4000 marks (160 credits). The 3 credits and 2 credits courses carry 75 marks and 50 marks, respectively.

Rules and Regulations for Students of the B.Sc. Engineering Program (Ref. Academic Ordinance Faculty of Engineering)

1. Grading System

1.1. The letter grade system for assessing the performance of the students shall be as follows:

Marks	Letter Grade (LG)	Grade Point (GP)
80% or above	A+	4.00
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.50
65% to less than 70%	B+	3.25
60% to less than 65%	B	3.00
55% to less than 60%	B-	2.75
50 to less than 55%	C+	2.50
45% to less than 50%	C	2.25
40 to less than 45%	D	2.00
less than 40%	F	0.00
Incomplete	I	0.00

A letter grade 'I' (incomplete) shall be awarded for courses in the odd semester which continue through to the even semester.

1.2. A **Grade Point Average (GPA**) shall be calculated for each semester as follows:

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

where, n is the number of courses offered during the semester, C_i, is the number of credits allotted to a particular course and G_i is the grade point earned for that course.

1.3. A **Yearly Grade Point Average (YGPA**) shall be calculated for each academic year as follows:

$$YGPA = \frac{\sum_{j=1}^{2} C_j G_j}{\sum_{j=1}^{n} C_j}$$

where, 2 signifies that there are two (2) semesters in a particular year, C_j is the number of credits allotted to a semester and G_j is the GPA earned for that semester.

1.4. The **Cumulative Grade Point Average** (CGPA) gives the cumulative performance of the students from the 1st year up to the end of the year to which it refers, and will be calculated as follows:

$$\text{CGPA} = \frac{\sum_{k=1}^{m} G_k C_k}{\sum_{k=1}^{m} C_k}$$

where, m is the total number of years being considered, C_k is the total number of credits registered during a year and G_k is the YGPA of that particular year.

1.5. A Cumulative Grade Point Average (CGPA) shall be calculated at the end of each academic year and to be communicated to the students along with the YGPAs. The individual grades of courses obtained by them for the semesters of the academic years will, however, be communicated at the end of individual semester by the Chairman of the Examination Committee.

1.6. YGPA should be three digits after the period. A fourth digit after the period is not allowed at all. For instance, YGPA=3.4999 should be 3.499. However, the CGPA will be two digits after the period. In this case, if the third digit after the period is ≥ 5 then the second digit after the period will be plus 1. For instance, CGPA=3.485 will be 3.49 whereas CGPA=3.354 will be 3.35.

1.7. **Earned Credit:** The courses in which a student obtains minimum 'D' in 'Theoretical courses' and 'C' in 'Laboratory courses & Board Viva-voce' or higher grade will be counted as credits earned by the student. Any course in which a student obtains 'F' grade will not be counted towards his/her earned credit.

2. Attendance

2.1 In order to be eligible for appearing, as a regular candidate, at the semester final examinations, a student shall be required to have **attended at least 70% of the total number of periods** of lectures/tutorials/laboratory classes held during the semester in every **course** as defined in the curricula. The laboratory courses mean all laboratory/project/fieldwork/in-plant training and any other similar courses.

2.2 A student whose attendance **falls short of 70% but not a below 60%** in any **course** as mentioned above may be allowed to appear at the final examinations as **non-collegiate** student and **he/she shall not be eligible for the award of any scholarship or stipend.** A student, appearing at the examination under the benefit of this provision shall have to pay, in addition to the regular fees, the requisite fine prescribed by the syndicate for the purpose.

2.3 Students having **less than 60% attendance** in lecture/tutorial/ laboratory of **any course will not be allowed to appear** at the final examinations of the semester.

3. Conducting Examinations and Rules for Promotion

3.1. The academic year shall be divided into two semesters each having duration of not less than 13 teaching weeks.

3.2. There shall be final examinations conducted by the concerned Examination Committee of the Departments at the end of each semester.

3.3. The results shall be finalized at the end of the even semester of the academic year. A student entering in an odd semester **shall automatically move** on to the next

semester, unless he/she was **barred** from appearing at the final examinations at the end of the semester. Individual **course** grades and **GPA** shall be announced within a date ordinarily no later than three weeks after the end of the semester final examinations.

3.4. **Minimum Passing Grade:** The minimum passing grade in a theoretical course will be D and the minimum passing grade in a laboratory/project/field work/in-plant training/workshop/similar Courses (henceforth referred to as laboratory course) and **Viva voce** will **be C.**

3.5. **Promotion to Higher Class:** In order to be promoted to higher class a student must obtain following requirements:

3.5.1. Yearly Grade Point Average (YGPA) of 2.25 or higher
3.5.2. Credit point loss (F or I Grade) in theoretical courses not more than 10.
3.5.3. Minimum C Grade in the Laboratory course and viva-voce.

3.6. **Course Improvement:** A promoted student may appear for course improvement in the immediate next academic year for maximum 10 credit points to clear his/her F grade or to improve the grades on the courses in which less than B grade (including those of F grade) was obtained in Part-I, Part-II and Part-III examinations. In such case, the student has to give his/her choice of course/courses for course improvement in writing. If the student fails to clear his/her F grades in the first attempt, he/she shall get another (last) chance in the immediate next year to clear the F grades**.** In the case of student's failure to improve his/her course grade at the course improvement examination, the previous grade shall remain valid.

3.7. **Course Exemption:** Students who fail to be promoted to the next higher class shall be exempted from taking the theoretical and laboratory courses where they obtained grades **equal to B or above.** These grades would be counted in calculating GPA in the next year's examination results.

3.8. **Merit Position:** The YGPA obtained by a student in the **semester final examinations** will be considered for determining the **merit position for the award of scholarships, stipends etc**.

3.9. **Class Test: For theoretical** courses of **less than or equal to 2 credits** there shall be at **least three** class tests and at **least four** class tests for **greater than 2 credits in a** semester.

3.10. **Duration of Examination:** Duration of Theoretical **examination of different courses** at the end of semester shall be as follows:

Courses less than or equal to 2 Credits	: 2 Hours
Courses greater than 2 credits but less than or equal to 4 Credits	: 3 Hours

4. Publication of Results

4.1 Award of degree: In order to qualify for the B.Sc. Engg. degree, a student must have to **earn minimum 150 credits and a minimum CGPA of 2.25 within a maximum of six academic years**. The result will be published in accordance with merit.

4.2 Honours: Candidates for Bachelor degree in engineering will be awarded the degree with Honors if their earned credit is 160 and **CGPA is 3.75 or higher.**

4.3 Result Improvement: A candidate obtaining B.Sc. Engg. within 4 or 5 academic years shall be allowed to improve his/her result, of maximum of 10 credit points (courses less than 'B' grade) of the Part-IV theoretical courses in the immediate next regular examination after publication of his/her result. No improvement shall be allowed for laboratory examinations and Board Viva-voce. If a candidate fails to improve CGPA with the block of new GP in total, the previous results shall remain valid.

4.4 Readmission and Course Exemption: If a student fails to obtain the degree within 4 or 5 academic year, he/she will be readmitted in Part-4 and will appear for the exam according to the clause 3.6 (Course Improvement). Course exemption rules will also be valid according to clause 3.7 (Course Exemption).

4.5 Dean's List: As a recognition of excellent performance, the names of students obtaining a YGPA of 3.75 or above in each academic year may be published in the Dean's List in the faculty. Students who have received **'F' grade** in any course during any of the two regular semesters will not be considered for Dean's List in that year.

5. Distribution of Marks

Distribution of the marks as per following table

5.1 Theoretical Courses:

Continuous Assessment (**CA**)	Class Attendance	10%	30%
	Quizzes/Class Test	20%	
Semester Final Examination			70%
		Total	**100%**

5.2 Laboratory

Class Attendance	10%
Quizzes, Viva-Voce and Continuous Assessment	20%
Practical Examination	70%
Total	**100%**

5.3 Project Work/Field Work/Professional Training

Internal Examiner/Supervisor	30%
External Examiner (Any teacher from the panel of examiners)	30%
Presentation and Oral Examination	40%
Total	**100%**

5.4 Basis for awarding marks for class participation and attendance:

Attendance	Marks (%)
90% and above	100
85% to less than 90%	90
80% to less than 85%	80
75% to less than 80%	70

	70% to less than 75%	60
	65% to less than 70%	50
	60% to less than 65%	40
	less than 60%	0

6. Duration of Course and Course Structure

Teaching of the courses is reckoned in terms of credits under the following guidelines

Nature of course	**Contact hour (for 1 credit)**
Theoretical Lecture	: 1 hour/week
Laboratory/Project	: 2 - 3 hours/week

7. Academic Calendar

7.1 The academic year shall be divided into two semesters each having duration of **not less than 13 teaching weeks**.

7.2 There shall be final examinations at the end of each semester conducted by the respective Examination Committee of the Departments.

7.3 **An academic schedule** for the academic year shall be announced for general notification before the start of the academic year, on the approval of the Academic Committee. The schedule may be prepared according to the following guidelines:

Semester-Odd (18 weeks)	Number of weeks
Teaching Preparatory Leave Examination Period	**13(65** working days) **2** **3**
Semester Duration	**18**
Inter Semester Recess	**1**
Semester-Even (20 weeks)	
Teaching Preparatory Leave Examination Period Result Publication	**13(65** working days) **2** **3** **2**
Semester Duration	**20**
Vacation (Summer, Ramadan, and Others)	**13**
Total:	**52**

Distribution of Courses

Courses offered to the undergraduate students of the department of Information and Communication Engineering (ICE)

Overall marks and credits distribution for B.Sc. Engg. (ICE)

Course Type	Marks	Percentage of Total Marks	Credits
Humanities	**200**	**5**	**8**
English	50	1.25	2
Economics	50	1.25	2
Accounting and Management	50	1.25	2
Law	50	1.25	2
Basic Sciences with Lab	**625**	**15.625**	**25**
Mathematics	300	7.5	12
Statistics	100	2.5	4
Physics	150	3.75	6
Chemistry	75	1.875	3
Basic and Major Engineering	**3175**	**79.375**	**127**
(i) Basic Engineering with Lab	**(300)**	**(7.5)**	**(12)**
Computer Science and Engineering	187.5	4.6875	7.5
Electrical and Electronics Engineering	112.5	2.8125	4.5
(ii) Major Engineering	**(2875)**	**(71.875)**	**(115)**
(a) Theoretical	1950	48.75	78
(b) Laboratory with Project	725	18.125	29
(c) Board viva-voce	200	5	8
Total	**4000**	**100**	**160**

Summary of number of courses for the degree of Bachelor of Science (B.Sc.) in Engineering

Year - Semester	Theory		Lab and Others		Total Credits
	No. of Courses	Credit	No. of Courses	Credits	
1st - Odd	**6**	**17**	**2**	**3**	**20**
1st - Even	**6**	**16**	**3**	**5**	**21**
2nd - Odd	**6**	**16**	**2**	**3**	**19**
2nd - Even	**5**	**14**	**3**	**5**	**19**
3rd - Odd	**5**	**15**	**3**	**4.5**	**19.5**

3rd - Even	**5**	**15**	**4**	**6.5**	**21.5**
4th - Odd	**5**	**15**	**3**	**4.5**	**19.5**
4th - Even	**4**	**12**	**5**	**8.5**	**20.5**
Total	**42**	**120**	**25**	**40**	**160**

Semester Wise Course Distribution

Part – I Exam-2020 (Odd Semester)

Course Code	Course Titles	Marks	Credits	Contact Hours/week
ICE1111	Introduction to Information and Communication Engineering	75	3	3
ICE1121	Digital Electronics	75	3	3
ICE1122	Digital Electronics Lab	37.5	1.5	3
ICE1131	Electronics-I	75	3	3
ICE1132	Electronics-I Lab	37.5	1.5	3
MATH1111	Algebra, Trigonometry and Vector Analysis	75	3	3
CHEM1111	Physical and Inorganic Chemistry	75	3	3
ENG1111	Technical and Communicative English	50	2	2
		500	**20**	**23**

Part – I Exam-2020 (Even Semester)

Course Code	Course Titles	Marks	Credits	Contact Hours/week
ICE1211	Electronics-II	75	3	3
ICE1212	Electronics-II Lab	37.5	1.5	3
CSE1291	Programming with C	75	3	3
CSE1292	Programming with C Lab	37.5	1.5	3
MATH1211	Differential and Integral Calculus	75	3	3
STAT1211	Statistics for Engineers	50	2	2
PHY1221	Applied Electricity and Magnetism	75	3	3
ECON1211	Economics	50	2	2
ICE1210	Viva-Voce	50	2	-
		525	**21**	**22**

Part – II Exam-2021 (Odd Semester)

Course Code	Course Titles	Marks	Credits	Contact Hours/week
EEE2181	Electronic Circuits and Semiconductor Devices	75	3	3
EEE2182	Electronic Circuits and Semiconductor Devices Lab	37.5	1.5	3
ICE2121	Analog Communication and Radio-TV Engineering	75	3	3
ICE2122	Analog Communication and Radio-TV Engineering Lab	37.5	1.5	3
PHY2191	Electromagnetic Fields and Waves	75	3	3
MATH2111	Matrices and Differential Equations	75	3	3
STAT2111	Basic Theory of Statistics	50	2	2
ACCO2111	Industrial Management and Accountancy	50	2	2
		475	**19**	**22**

Part – II Exam-2021 (Even Semester)

Course Code	Course Titles	Marks	Credits	Contact Hours/week
ICE2211	Cellular and Mobile Communication	75	3	3
ICE2221	Signals and Systems	75	3	3
ICE2222	Signals and Systems Lab	37.5	1.5	3
ICE2231	Data Structures and Algorithms	75	3	3
ICE2232	Data Structures and Algorithms Lab	37.5	1.5	3
MATH2221	Discrete Mathematics and Numerical Methods	75	3	3
LAW2211	Cyber and Intellectual Property Law	50	2	2
ICE2210	Viva-Voce	50	2	-
		475	**19**	**20**

Part – III Exam-2022 (Odd Semester)

Course Code	Course Titles	Marks	Credits	Contact Hours/week
ICE3111	Microwave Communication and Radar	75	3	3
ICE3121	Digital Signal Processing	75	3	3
ICE3122	Digital Signal Processing Lab	37.5	1.5	3
ICE3131	Java and Network Programming	75	3	3

ICE3132	Java and Network Programming Lab	37.5	1.5	3
ICE3141	Antenna Engineering	75	3	3
ICE3142	Antenna Engineering Lab	37.5	1.5	3
ICE3151	Satellite Communication	75	3	3
		487.5	**19.5**	**24**

Part – III Exam-2022 (Even Semester)

Course Code	Course Titles	Marks	Credits	Contact Hours/ week
ICE3211	Digital Image Processing	75	3	3
ICE3212	Digital Image Processing Lab	37.5	1.5	3
ICE3221	Digital Communication	75	3	3
ICE3222	Digital Communication Lab	37.5	1.5	3
ICE3231	Telecommunication Engineering	75	3	3
ICE3241	Optical Fiber Communication	75	3	3
ICE3242	Optical Fiber Communication Lab	37.5	1.5	3
CSE3291	Software Engineering	75	3	3
ICE3210	Viva-Voce	50	2	-
		537.5	**21.5**	**24**

Part – IV Exam-2023 (Odd Semester)

Course Code	Course Titles	Marks	Credits	Contact Hours/week
ICE4111	Artificial Intelligence and Neural Computing	75	3	3
ICE4121	Computer Architecture and Microprocessor	75	3	3
ICE4122	Computer Architecture and Microprocessor Lab	37.5	1.5	3
ICE4131	Wireless Communication	75	3	3
ICE4132	Wireless Communication Lab	37.5	1.5	3
ICE4141	Database Management Systems	75	3	3
ICE4142	Database Management Systems Lab	37.5	1.5	3
ICE4151	Information System Analysis and Design	75	3	3
		487.5	**19.5**	**24**

Part – IV Exam-2023 (Even Semester)

Course Code	Course Titles	Marks	Credits	Contact Hours/week
ICE4211	Computer Networks	75	3	3
ICE4212	Computer Networks Lab	37.5	1.5	3
ICE4221	Fundamentals of Cryptography	75	3	3
ICE4222	Fundamentals of Cryptography Lab	37.5	1.5	3
ICE4231	Information Theory and Coding	75	3	3
ICE4241	Web Engineering	75	3	3
ICE4242	Web Engineering Lab	37.5	1.5	3
ICE4210	Viva-Voce	50	2	-
ICE4252	Research Project	50	2	-
		512.5	**20.5**	**21**

Course Outline

Part-I (Odd Semester)

ICE1111: Introduction to Information and Communication Engineering
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	None	
Course Objectives	**:**	The main objective of this course is to introduce the fundamental concept of ICT, computer system, networks, internet and programming basic. Also introduce the applications of ICT.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-LPO Mapping**
		CLO-1: Define the basic concept about computer and information	**PLO-1**
		CLO-2: Explain the aspects of ICT and its importance	**PLO-1**
		CLO-3: Describe basic concept of hardware, software and computer networking	**PLO-2, PLO-5**
		CLO-4: Identify the basic design concept of a communication system	**PLO-2, PLO-5**
		CLO-5: Define fundamental concept of programming	**PLO-5**

Course Contents

Section – A

Concepts of ICT: Definition of ICT, Importance of ICT**,** ICT Architecture and ICT Infrastructure, ICT acquisition.

Computer Hardware: Digital Computers, Primary Storage, The Central Processing Unit (CPU), Secondary Storage, Computer Hierarchy, Input and Output Peripherals, Selecting Computer Hardware.

Computer Software Fundamentals: Operating Systems, Other Types of System Software, Personal Application Software, Groupware, Multimedia Software, Middleware and Enterprise Software, Methods for Software Acquisition.

Managerial Support Systems: Managers and Decision Making, Decision Support Systems, Executive Information System**,**

Section – B

Computer Networks: Computer Networks, Types of Networks, Network topologies, Client-server network, Protocols.

Communication Systems: Basic elements of communication system, Wireless network, Wireless Access Point: Bluetooth, WiFi, WiMax, Cellular communication system.

Information System and Internet: Basic Information System, Components of Information System, Transaction Prcessing System, Management Information System, Internet and Intranet, WWW, Web browser, HTML, FTP, E-Commerce, M-Commerce.

Programming Concept: Computer program, Algorithm, Flowchart, Psudocode, Programming languages, Categories of programming languages.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures, paper-and-pencil* exercises as well as interactive participation. The lecture material includes the fundamental areas of ICT, its application details, insight into hardware, software and communication basics. The *paper-and-pencil* exercises include classwork and homework assignments to practice the topics taught in the class room.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3	√	√	√	√
CLO4		√	√	√
CLO5		√	√	√

Text Books:

1. John Wiley & Sons : Introduction to Information Technology
2. P. Norton : Introduction to Computer

Reference Books:

3. Abdullah Zin : Fundamentals of ICT
4. Charles S. Parker : Computer and Their Application
5. R. M. Stair : Principles of Data Processing
6. V.Rajaraman : Fundamentals of Computers
7. Dennis P. Curtin : Information Technology- The Breaking Wave

ICE 1121: Digital Electronics
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	None	
Course Objectives	**:**	The objective of this course is to acquire knowledge of digital logic levels and application knowledge to understand digital electronics circuits. Students will able to perform the analysis and design of various digital electronics circuits and electronic logic gate circuits such as DDL, DTL, RTL, TTL. To gather higher knowledge about digital electronics, the students will also learn combinational logic, sequential logic, resisters, counters, and different types of memories.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Identify the principles of numbering systems and modify the numbers from one base to another	**PLO-1**
		CLO-2: Explain the working principle of the different types of logic gates and apply their real application	**PLO-1, PLO-2**
		CLO-3: Describe the basic operation of Boolean algebra and logic design of digital system	**PLO-1, PLO-3**
		CLO-4: Explain and evaluate the simple straightforward procedure for minimizing Boolean functions	**PLO-1, PLO-3**
		CLO-5: Describe the operation of combinational logic by analyzing several circuit applications	**PLO-4, PLO-5**
		CLO-6: Explain, design, and operation of different types of flip-flops and its applications	**PLO-5**
		CLO-7: Describe the operation and characteristics of synchronous and asynchronous counters and also various types of IC registers	**PLO-7**
		CLO-8: Identify and correctly use the terminology associated with memory systems	**PLO-10**

Course Contents

Section – A

Number System: Binary numbers, Number base conversion, Binary- Decimal- Octal and Hexadecimal numbers, Complements, Binary code, Binary storage.

Logic Gates: Logic Elements, Electronic Logic Gate Circuits, Diode logic, Direct couple transistor logic, Resistor transistor logic, Transistor transistor logic.

Boolean Algebra: Basic definitions, Axioatic definitions of Boolean algebra, Basic theorem and properties, Boolean function, DeMorgan theorm, Canonical and standard forms.

Simplification of Boolean functions: Map method, Two-three-four-five-six variable maps, Sum of product and product of sum simplification, NAND and NOR implementation, Don't care conditions, Tabulation method.

Section – B

Combinational Logic: Design procedure, Adders, Subtractors, Code conversion, Binary parallel adder, Decimal adder, Magnitude comparator, Encoder, Decoder, Multiplexer, De-multiplexer.

Sequential Logic: Design procedure, Flip-flops, Master-slave Flip-flop, Analysis of clocked sequential circuits, Flip-flop excitation tables, Design with state equations.

Registers and Counters: Registers, Shift registers, Design of counters, Ripple counters, Synchronous counters.

Memory and Programmable Logic: Random Access Memory (RAM), Read Only Memory (ROM), EPROM, EEPROM, Programmable Logic Array (PLA)

Teaching-Learning Strategies:
Teaching-Learning strategies for this course consist of *lectures* and *interactive classroom discussions* as well as *paper-and-pencil* exercises. The lecture materials cover the various types of number system, logic gates, combinational logic, sequential logic and also resisters, counters, and different types of memories. The *paper-and-pencil* exercises include class works for *problem-based learning* and homework assignments for *open-ended problem solving.*

Assessment and Evaluation Strategy:
Students will be assessed on basis of their overall performance in the final examination, class tests/assignments, and class attendance/participation. Final grade will be evaluated based on:

- **Four class tests/assignments** due in different times of the semester **(20%)**
- **Class attendance/participation(10%)**
- **A final examination(70%)**

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test/Assignment 1 & 2	**Class Test/Assignment 3 & 4**	**Class Participation/Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3	√		√	√
CLO4	√		√	√
CLO5		√	√	√
CLO6		√	√	√
CLO7		√	√	√
CLO8			√	√

Text Books:

1. M. Morris Mano : Digital Logic and Computer Design
2. V.K. Jain : Switching Theory and Digital Electronics

Reference Books:

3. M. Morris Mano : Digital and Computer Design

4. S.C. Lee : Digital Circuit and Logic Design
5. Tocci & Widmer : Digital Systems

ICE 1122: Digital Electronics Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Lab Objectives: The objectives of this laboratory experiment are to introduce the basic idea about the basic digital logic gate design and construction using diode and transistor. Also using the digital logic IC and measuring their threshold level.

ICE 1131: Electronics-I
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	None	
Course Objectives	**:**	The course will give the basic understanding and knowledge of electrical networks and mathematical methods for analysis of linear and non-linear models. Prepare the student to solve the electrical and electronic circuit with various theorems and methods. Give the basic idea about semiconductor diodes and its applications. To understand the concept of transistor, it's biasing and acts as an amplifier.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Apply various laws and theorems of electrical circuits to solve the problems.	**PLO-1, PLO-2**
		CLO-2: Explain the basic concepts of Semiconductor diodes, it's characteristics, and applications.	**PLO-1, PLO-2**
		CLO-3: Describe the basic characteristics, constructions, operations and applications of transistor.	**PLO-2, PLO-4**
		CLO-4: Interpret the basic concept of transistor amplifiers, and analyze using hybrid parameters.	**PLO-3, PLO-5**

Course Contents

Section-A

Series-Parallel Circuit Analysis: Kirchhoff's laws, Methods of analysis, Branch current, Mesh and nodal analysis, T - Π and Π – T conversion,

Network Theorems: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem.

Semiconductor Basic and Diodes: n-and p-type semiconductors, p-n junction diodes and their volt-ampere characteristics, Rectifier diode, Zener diode.

Diode Applications: Load line analysis and concept of rectifier, Half-wave rectifier, Full-wave rectifier, Voltage regulator using Zener diode, Clippers, Clampers and voltage multiplier circuit.

Section-B

Transistor: Concept and definition, Types, Construction and Operation, Basic transistor configuration (CE, CB, CC) and their input and output characteristics, Transistor amplifying action, Cut-off, Active and Saturation region.

Transistor Biasing and Stabilization: Introduction, transistor biasing, Load line, Operating point, Stabilization, Stability factor, Thermal runway and bias compensation methods.

Basic Transistor Amplifiers: Definition, Concept of amplification and Gain, Classification, Operation, Graphical analysis of CE, CB and CC amplifier, Distortion in amplifiers.

Transistor Circuit Model: Concept of two-port devices and network parameters, Transistor hybrid circuit model, Transistor hybrid or h-parameters, Analysis of CE, CB & CC amplifiers using hybrid or h-parameter.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. These lectures are designed and taught in such a way so that the students feel encouraged and motivated to learn and hence be able to develop their knowledge and skills on designing and analysis of various types of electrical circuits (or networks) and electronics circuits in their real life engineering applications.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3		√	√	√
CLO4		√	√	√

Text Books:

1. R L Boylestad : Introductory Circuit Analysis

2. R L Boylestad : Electronic Devices and Circuits Theory

Reference Book:

3. V.K. Mehata : Principle of electronics
4. Millman and Halkias : Electronic Devices and Circuits
5. Gupta & Kumar : Handbook of Electronics
6. A. P. Malvino : Principle of Electronics

ICE1132: Electronics-I Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Lab Objectives: The objectives of this laboratory are to introduce the basic idea about the measuring devices and components such as multimeter, power supply, signal generator, oscilloscope, resistor, capacitor, inductor, diode and transistor. Be able to understand the concept of practical circuit analysis using Network theorems and also analyze the characteristics of BJT.

MATH1111: Algebra, Trigonometry and Vector Analysis
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	None	
Course Objectives	**:**	The main objective of the course is to introduce the methods of linear algebra, trigonometry, and vector analysis to the students. These methods provide the students a natural aid to the understanding of some physical concept in solving engineering problems.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: comprehense the use of various forms of numbers to solve numerical problems;	**PLO-1**
		CLO-2: explain the characteristics of scalar and vector valued functions and master these in calculations;	**PLO-2**
		CLO-3: provide a physical interpretation of the gradient, divergence, curl and related concepts;	**PLO-4**
		CLO-4: Evaluate the trigonometric function at an angle whose measure is given in degrees and radians;	**PLO-2**
		CLO-5: Manipulate and simplify a trigonometric expression.	**PLO-1**
		CLO-6: solve other problems appropriate for a course in linear algebra, trigonometry and vector analysis;	**PLO-1**

Course Contents

Section – A

Algebra of sets, De Morgan's rule, Relation & function. Determinants: 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.

Section – B

Functions of complex arguments, Gregory's series, Summation of series, Hyperbolic functions. Vector addition, Multiplication and 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.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included a fascinating look into the concept of linear algebra, trigonometry, and vector analysis. The *paper-and-pencil* exercises included classwork and homework assignments.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3	√		√	√
CLO4		√	√	√
CLO5		√	√	√
CLO6		√	√	√

Reference Book:

1. H. S. Hall and S. R. Knight : Higher Algebra.
2. B. C. Das and B. N. Mukherjee : Higher Trigonometry
3. M. R. Spiezel : Vector Analysis
4. Barnside and Panton : Theory of Equations
5. Barnside and Child : Higher Algebra
6. M. A. Sattar : Higher Trigonometry
7. M. A. Sattar : Vector Analysis

CHEM1111: Physical and Inorganic Chemistry
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	None	
Course Objectives	**:**	This course intends to give basic idea about various aspects of physical and inorganic chemistry.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Develop an understanding of the breadth and concepts of physical chemistry.	**PLO-2**
		CLO-2: Practice in some scientific methods employed in basic and applied physical chemistry.	**PLO-4**
		CLO-3: Demonstrate simple chemical kinetics including zero, first, and second order rate laws.	**PLO-2**
		CLO-4: Relate the atomic structures of elements with their physical and chemical properties.	**PLO-2**
		CLO-5: Describe Valence Bond Theory and Molecular Orbital Theory to explain the physical and chemical properties of molecules.	**PLO-4**

Course Contents

Section – A

Electrochemistry: Conductors, Electrolytes and electrolysis; Faradays laws of electrolysis and their significance. Ohm's law and electrolytic conductances; Theories for electrolytic conductance (Arrhenius & Debye-Hükel). Ionic mobility, Kohlrausch's law, Transference number and its determination; 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. Determination 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. Fruendlich, 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.

Section – B

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, electronigativety, 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 orbital's 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.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included a fascinating look into the concept of electrochemistry, chemical equilibrium and kinetics, surface chemistry and colloids, atomic structure and periodic table, electronic theory of valency and chemical bonding, and chemistry of transition elements, lanthanides and actinides. The *paper-and-pencil* exercises included classwork and homework assignments.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3	√		√	√
CLO4		√	√	√
CLO5		√	√	√

Reference Book:

1. R. D. Madan : Modern Inorganic Chemistry
2. M. M. Haque and M. A. Nawab : Principles of Physical Chemistry
3. E. S Gilreath : Fundamental Concepts in Inorganic Chemistry
4. G. M. Barrow : Physical Chemistry
5. W. J. Moore : Physical Chemistry
6. K. J. Laidler and J.H. Meiser : Physical Chemistry
7. S. R. Palit : Elementary Physical Chemistry
8. S. Z. Haider : Modern Inorganic Chemistry

9. Companion : Chemical Bonding
10. Cotton, Wilkinson & Jones : Basic Inorganic Chemistry
11. D. K. Sebera : Electronic Structure and Chemical Bonding

ENG1111: Technical and Communicative English
50 Marks, 2 Credits, 2 Hours/week, Lectures: 26, Exam time: 2 hours

Prerequisite Courses	**:**	None	
Course Objectives	**:**	This course aims to teach students the tools for writing technical error free English. It intends to grow effective and fast reading skill among the students. Students will also be taught to speak English with correct pronunciation and phonetics.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Write report, technical articles and journals.	**PLO-10**
		CLO-2: Speak in English with the correct accent.	**PLO-10**
		CLO-3: Read newspaper, technical papers, text books etc. and interpret correctly and swiftly.	**PLO-2**
		CLO-4: Practice English conversation.	**PLO-10**

Course Contents

Section – A

Grammar: Grammatical principles, Modals, Phrases & idioms, Prefixes & suffixes, Sentence structures, Why & yes/ no questions, Conditional sentences.

Vocabulary: Technical & scientific vocabulary, Defining terms.

Spoken English: Introduction to phonetic symbols, Dialogue, Responding to particular situations, Extempore speech.

Section - B

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.

Teaching-Learning Strategies:
Teaching-Learning strategies for this course consist of *lectures* and *interactive classroom discussions* well as *paper-and-pencil* exercises. The lecture materials cover the writing of

reports, technical articles and journals, the speaking in English with correct accent, the reading and interpreting of newspapers, technical papers, textbooks etc. correctly and swiftly, and the practice of English conversation. The *paper-and-pencil* exercises include classworks and homework assignments for *problem-based learning*.

Assessment and Evaluation Strategy:
Students will be assessed on basis of their overall performance in the final examination, class tests/assignments, and class attendance/participation. Final grade will be evaluated based on:

- **Four class tests/assignments** due in different times of the semester **(20%)**
- **Class attendance/participation (10%)**
- **A final examination (70%)**

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test/Assignment 1 & 2	**Class Test/Assignment 3 & 4**	**Class Participation/Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3		√	√	√
CLO4		√	√	√

Reference Book:

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

Part-I (Even Semester)

ICE1211: Electronics-II
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	PHY1121	
Course Objectives	**:**	The objective of the course is to introduce the concepts of Junction Field Effect Transistor (JFET), Metal Oxide Semiconductor Field Effect Transistor (MOSFET), low frequency response of an amplifier, two-terminal devices, power amplifier, four terminals network, and filters used in communication system.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Interpret the operation of Junction Field Effect of transistors.	**PLO-2**
		CLO-2: Apply the concept of JFET biasing and amplifier.	**PLO-5**
		CLO-3: Illustrate different types of MOSFET.	**PLO-4, PLO-5**
		CLO-4: Analyze the low frequency response of amplifier.	**PLO-4**
		CLO-5: Theory of the special types of diode and their applications.	**PLO-2**
		CLO-6 Identify and importance of power amplifier**:**	**PLO-5**
		CLO-7: Analyze the four terminals network.	**PLO-4**
		CLO-8: Design simple filter circuits.	**PLO-5**

Course Contents

Section – A

JFET: Types of FET, Construction, Characteristics curve, Principle of operation, Channel conductivity, Channel Ohmic and pinch-off region, Characteristics parameter of the FET, Effect of temperature on FET.

FET Biasing and Amplifier: Different types of biasing configuration, FET small signal model, FET AC equivalent circuit, Common source amplifier, Common drain amplifier, Common gate amplifier.

MOSFET: Depletion type and enhancement type MOSFET, Circuit operation of D-MOSFET, D-MOSFET of transfer characteristic, Trans-conductance and input impedance of D-MOSFET, D-MOSFET biasing, Common source D-MOSFET amplifier, E-MOSFET, E-MOSFET biasing circuits, Comparisons between D-MOSFETs and E-MOSFETs.

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.

Section – B

Two-Terminal Devices: Schottky diode, Varactor diode, Tunnel diode, Photodiode, Photoconductive cells, IR emitters, LED and their applications.

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.

Four Terminals Network: Introduction, Image parameters, Image transfer constant, Iterative impedance, Impedance matching, Insertion loss.

Filter Circuits: Introduction, Elementary Filter theory, Characteristics impedance, Propagation constant, Different types of filters, Design conditions, constant-K type filter.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included Junction Field Effect Transistor (JFET), Metal Oxide Semiconductor Field Effect Transistor (MOSFET), low frequency response of an amplifier, two-terminal devices, power amplifier, four terminals network, and filters used in communication system. The *paper-and-pencil* exercises included classwork and homework assignments in using various algorithms to solve simple and complex problems.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3	√		√	√
CLO4	√		√	√
CLO5		√	√	√
CLO6		√	√	√
CLO7		√	√	√
CLO8		√	√	√

Text Books:

1. R L Boylestad : Electronic Devices and Circuits Theory
2. Gupta & Kumar : Handbook of Electronics

3. V.K. Mehta & Rohit : Principle of Electronics

Reference Books:

4. Allen Mottershead : Electronic Devices and Circuits
5. Millman and Halkias : Electronic Devices and Circuits
6. A. P. Malvino : Principle of Electronics

ICE1212: Electronics-II Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Lab Objectives: The objectives of this lab are to design different electronic circuits and observe their characteristics such as high-pass and low-pass filter, FET characteristics, CE transistor characteristics etc.

CSE1291: Programming with C
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	ICE1111	
Course Objectives	**:**	The overall objective of the course is to develop programming skills using the concept of C language and to gain experience about structured programming. The course presents basics of C programming knowledge including: basics of C environment, data representation, control structures, functions, arrays, pointers, strings, user defined data types, and file I/O.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Design, develop and test programs in C programming language to solve problems related to collecting, processing and storing data.	**PLO-3, PLO-5**
		CLO-2: Solve problems systematically using a structured logic approach.	**PLO-2**
		CLO-3: Identify and explain the use and workings of programming tools (such as compilers, linkers and debuggers), standard libraries and operating system functions to support program execution.	**PLO-2, PLO-5**
		CLO-4: Demonstrate the understanding and the ability to follow professional programming practices to align with industry expectations.	**PLO-7**
		CLO-5: Communicate effectively and collaborate as a team member to solve complex problems using C programming language	**PLO-10**

Course Contents

Section – A

C Programming Fundamentals: History of C, Importance of C, Programming structure of C, Constants, Variables, Keywords and identifiers, Data types, Operators, Type conversion in expression, Reading a character, Writing a character.

Decision Making and Looping: If statements, if-else statements, Nesting of if…else statements, else if ladder, switch statements, ? : Operator, goto statement, break and continue statements, while statement, do statement, for statement.

Arrays: Introduction, One dimensional array, Declaration of one dimensional arrays, Initialization of one dimensional arrays, Two dimensional arrays, Initialization of two dimensional arrays.

Character Arrays and String: Introduction, Declaring and Initializing string variables, Reading string from terminal, Writing string to screen, Comparison of two strings, String-handling functions, Table of strings.

Section – B

Pointers: Introduction, Accessing the address of a variable, Declaring pointer variable, Accessing a variable through its pointer, Pointers and arrays, Pointers and character string, Array of pointers, Pointers as function arguments, Pointers to function, Pointers to structure.

User-defined Function: Definition of functions, Function declaration, Function Arguments: Call-by-value and Call-by-reference; Returning from a Function: Returning value, Returning Pointers; Recursion, Passing arrays to functions, Passing string to function.

Structures and Union: Defining a structure, Declaring structure variables, Arrays within structure, Structure within structure, Structures and functions, Union, Sizes of structure, Accessing structure members, Structure initialization, Arrays of structures.

File Management in C: Introduction, Streams and Files, Defining and opening a file, Closing a file, Input/output operations on files.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included a fascinating look into the fundamentals of programming, different tools of programming, simple and advanced forms of data structure used in programming, and file management technique. The *paper-and-pencil* exercises included classwork and homework assignments in using various algorithms to solve simple and complex problems.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class Test 1 & 2 /Quizzes	Class Test 3 & 4 /Quizzes	Class Attendance	Final Exam
CLO1	√		√	√
CLO2	√	√	√	√
CLO3	√	√	√	√
CLO4		√	√	√
CLO5			√	√

Text Books:

1. E. Balagurushamy : Programming in ANSI C
2. Herbert Schieldt : The Complete Reference

Reference Books:

3. Kernighan and Ritche : The C Programming Language
4. Herbert Schieldt : Turbo C/C++: The Complete Reference
5. Byron S. Gotfried : Programming with C

CSE1292: Programming with C Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Lab Objectives: The objective of this laboratory is to introduce to students to the field of programming using C language. The students will be able to enhance their analyzing and problem solving skills and use the same for writing programs in C.

MATH1211: Differential and Integral Calculus
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	:	None	
Course Objectives	:	This course is designed to provide necessary background of differential and integral calculus. Different mathematical problems in this course will help building a comprehensive skill for analyzing and solving real life engineering problems.	
Course Learning Outcomes (CLOs)	:	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Solve limiting value problems.	**PLO-3**
		CLO-2: Use different method of solving ordinary and partial differentiation.	**PLO-3**
		CLO-3: Evaluate the integral of definite and indefinite forms.	**PLO-3**
		CLO-4: Use integral and differential approaches to find useful information to solve practical problems.	**PLO-1**

Course Contents

Section – A

Functions: Domain, Range, Inverse function and graphs of functions, Limits, Continuity, Indeterminate 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, Maximum and minimum of functions of one variable.

Partial Differentiation: Euler's theorem, Tangents and normal, Application of derivatives.

Section – B

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

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

Multiple Integrals: Determination of lengths, Areas and volumes.

Teaching-Learning Strategies:
Teaching-Learning strategies for this course consist of *lectures* and *interactive classroom discussions* well as *paper-and-pencil* exercises. The lecture materials cover the solving of limiting value problems, the use of various methods in solving ordinary and partial differentiation, the evaluations of integrals of definite and indefinite forms, and the use of integral and differential approaches to find useful information to solve practical problems. The *paper-and-pencil* exercises include classworks for *problem-based learning* and homework assignments for *open-ended problem solving.*

Assessment and Evaluation Strategy:
Students will be assessed on basis of their overall performance in the final examination, class tests/assignments, and class attendance/participation. Final grade will be evaluated based on:

- **Four class tests/assignments** due in different times of the semester **(20%)**
- **Class attendance/participation (10%)**
- **A final examination (70%)**

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test/Assignment 1 & 2	**Class Test/Assignment 3 & 4**	**Class Participation/Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√

CLO3		√	√	√
CLO4		√	√	√

Reference Books:

1. B. C. Das and B.N. Mukherjee : Differential Calculus.
2. B. C. Das and B.N. Mukherjee : Integral Calculus.
3. F. Ayres : Calculus.
4. Edwards : Differential Calculus.
5. Williamson : Integral Calculus.
6. Muhammad and Bhattacherjee : Differential Calculus.
7. Muhammad and Bhattacherjee : Integral Calculus

STAT1211: Statistics for Engineers
50 Marks, 2 Credits, 2 Hours/week, Lectures: 26, Exam time: 2 hours

Prerequisite Courses	**:**	None	
Course Objectives	**:**	The purpose of this course is to provide students about concepts of basic statistics, statistical distributions and probability and their extensive use in real life situations, in particular, in the area of science and engineering. The goal is to familiarize students with powerful analytical and numerical tools in the areas of probability and statistics that can be used to solve real life problems.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Plan and implement a statistical study.	**PLO-2, PLO-3**
		CLO-2: Summarize the results of a study using graphs and numerical measures.	**PLO-2**
		CLO-3: Interpret and apply the results of statistical works.	**PLO-1, PLO-2**
		CLO-4: Choose the appropriate probability models to describe real world situations.	**PLO-4**
		CLO-5: Identify the appropriate statistical procedure to analyze the data.	**PLO-4**
		CLO-6: Report statistical results in a clear and coherent form.	**PLO-10**

Course Contents

Section – A

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.

Section – B

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.

Test of Significance: Basic ideas of Null hypothesis, Alternative hypothesis, Type-I error Type-II error level of significance degree of freedom, Rejection region and acceptance region. Test of single mean, Single variance, Two sample means and variances. Test for 2×2 contingency tables, Independence test and practical examples.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included a fascinating look into the fundamentals of basic statistics, statistical distributions and probability and their extensive use in real life situations, in particular, in the area of science and engineering. The *paper-and-pencil* exercises included classwork and homework assignments in using various algorithms to solve simple and complex problems.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3	√	√	√	√
CLO4		√	√	√
CLO5		√	√	√
CLO6			√	√

Reference Books:

1. P.G.Hoel : Introductory Statistics
2. S.G. Gupta : Fundamentals of Statistics
3. A.J.B.Anderson : Interpreting Data.
4. H. Cramer : The Elements of Probability Theory.
5. D.V.Lindley : Introduction to Probability and Statistics
6. S.Lipschutz : Probability
7. Mosteller, Rourke & Thomas : Probability with Statistical Applications
8. F.L.Wolf : Elements of Probability and Statistics
9. T.H. Wonnacot & R.J.Wonnacot : Introductory Statistics
10. Yule & M.G.Kendall : An Introduction to the Theory of Statistics

PHY1221: Applied Electricity and Magnetism
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	None	
Course Objectives	**:**	This course carries the basic concept of applied electricity and magnetism for students majoring in engineering. It is intended for students processing to advanced studies in the physical science. Some basic topics are included such as: Dipole, Gauss's law, Capacitors, Dielectric, Electric current, Insulators, Semiconductors, Faraday's law, Inductance, Thermoelectric power and DC and AC circuits.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Describe the behavior of electric dipole and the role of Gauss's law with its applications.	**PLO-1, PLO-2, PLO-3**
		CLO-2: Explain the characteristic of dielectric and the nature of Capacitor's.	**PLO-1, PLO-2**
		CLO-3: Demonstrate the understanding of different materials and the electric current mechanism within these materials.	**PLO-3, PLO-4**
		CLO-4: Apply Faraday's and Ampere's law to solve a variety of electromagnetic problems.	**PLO-2 PLO-4**
		CLO-5: Define thermoelectricity and its law to solve the problem.	**PLO-2, PLO-4**
		CLO-6: Design and apply the DC/AC circuits to solve physical problems.	**PLO-2, PLO-3**

Course Contents

Section – A

Electrostatics: Electric dipole; Electric field due to a dipole; Dipole on external electric field; Gauss's law and its applications.

Capacitors: Parallel plate capacitors with dielectric; Dielectrics and Gauss's Law; Susceptibility, Permeability, and dielectric constant; Energy stored in an electric field.

Electric Current: Electron theory of conductivity; Conductor, Semiconductors and insulators; Superconductors, Current and current density; Kirchhoffs law and its applications.

Section – B

Electromagnetic Induction: Faraday's experiment; Faraday's law; Ampere's law, Motional e.m.f.; Self and mutual inductance galvanometers-moving coil, Ballistic and deadbeat types.

Thermoelectricity: Thermal e.m.f., Seebeck, Peltier and Thomson Effects; Laws of addition of thermal e.m.f., Thermoelectric power.

DC and AC Circuits: D.C. circuits with LR, RC, and LCR in series; A.C. circuits with LR, RC, LC, and LCR in series, Power calculation, Power factor improvement.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included a fascinating look into the fundamentals of applied electricity and magnetism and some basic topics are included in the materials such as Dipole, Gauss's law, Capacitors, Dielectric, Electric current, Insulators, Semiconductors, Faraday's law, Inductance, Thermoelectric power and DC and AC circuits. The *paper-and-pencil* exercises included classwork and homework assignments in using various algorithms to solve simple and complex problems.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3	√	√	√	√
CLO4		√	√	√
CLO5		√	√	√
CLO6			√	√

Reference Books:

1. Acharyya : Electricity and Magnetism
2. Admas & Page : Principles of Electricity

3. Emran et al : Text Book of Magnetism and Electricity
4. Halliday & Resnick : Physics (Part-I & II)
5. Kip : Fundamentals of Electricity and Magnetism
6. Huq et al : Concept of Electricity and Magnetis

ECON1211: Economics
50 Marks, 2 Credits, 2 Hours/week, Lectures: 26, Exam time: 2 hours

Prerequisite Courses	**:**	None	
Course Objectives	**:**	The objective of the course is to build awareness about how the world works, including industries, businesses and governments. This course will teach about the balance of scarcity of resource to produce the desired goods and services and how to distribute them efficiently among the people.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Identify and recognize economic problems of a country	**PLO-2, PLO-11**
		CLO-2: Classify and describe different theory regarding demand and production of goods	**PLO-2, PLO-11**
		CLO-3: Analyze different economic theory	**PLO-2**
		CLO-4: Describe the need for economic planning from the perspective of Bangladesh.	**PLO-11**

Course Contents

Section – A

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.

Theory of the Firm: Perfect competition and monopoly; Total, Average and marginal revenue of a firm; Average and marginal revenue under perfect competition and monopoly; Firm's equilibrium; Equilibrium of firm under perfect competition and monopoly.

Section – B

The Input-Output Analysis: Meaning of input-output analysis; Input-output analysis model; Balance equation; Coefficient matrix; Determination of final demand vector.

Basic Concepts of Macroeconomics: Growth; Unemployment; Inflation; Philips curve, Business cycle; Circular flow of economics; Two, Three and four sector economics.

National Income Accounting and Determination: Concepts of GNP, GDP and national income; Methods of national income accounting; Problems of national income accounting; Keynesian model of national income determination; The multiplier; Effect of fiscal policy in the Keynesian model.

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

Development Planning in Bangladesh: Need for planning in Bangladesh; Various five year plans in Bangladesh; Development strategies in the five year plans of Bangladesh.

Teaching-Learning Strategies:
The strategy of teaching in this course is basically classroom lectures, and homework assignments. The course materials offer basic and advance concept of economics for helping student to understand the contents and solving the problems.

Assessment and Evaluation Strategy:
The assessment strategy for a student will be overall performance in all the final exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3		√	√	√
CLO4		√	√	√

Reference Books:

1. Semuelson and Nordhous : Economics.
2. Byrons and Stone : Economics
3. Dewett, K. K. : Modern Economic Theory
4. Ahuja, H. L. : Advanced Economic Theory
5. Government of Bangladesh : Various Five Year Plans

Part-II (Odd Semester)

EEE2181: Electronic Circuits and Semiconductor Devices
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	**APEE1121, PHY1221, ICE1211**	
Course Objectives	**:**	This course is designed to make the students understand the concepts of high-frequency response of common-emitter amplifier as well as the techniques of amplifier coupling for multistage amplifiers. They will understand the feedback principle of amplifiers and the operation of oscillators. They will as well be able to understand the concept of operational amplifiers and their applications such as active filters, to know the construction and working principle of optoelectronic devices and to gain knowledge of semiconductor device fabrication processes.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Analyze high frequency response of common-emitter amplifiers	**PLO-1, PLO-3**
		CLO-2: Design multistage amplifiers using different coupling methods	**PLO-2, PLO-3**
		CLO-3: Explain the concept of feedback amplifiers and Construct different types of oscillators.	**PLO-2, PLO-3, PLO-5**
		CLO-4: Describe the concept of operational amplifiers with their applications and Design different types of active filters using operational amplifiers.	**PLO-3, PLO-4**
		CLO-5: Explain the construction and working principle of various optoelectronic devices	**PLO-4, PLO-5**
		CLO-6: Describe the fabrication processes of semiconductor devices	**PLO-3,PLO-4, PLO-5**

Course Contents

Section – A

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.

Multistage Amplifier: Amplifier coupling, RC coupled two-stage amplifier, Impedance coupled two-stage amplifier, Transformer coupled two-stage, Direct coupled two-stage amplifier, Darlington pair, Multistage frequency effect.

Feedback: Concept of feedback, Negative feedback, Positive feedback, Voltage feedback, Current feedback, Effect of feedback on Impedance, Gain, Bandwidth, Distortion and Stabilization.

Oscillators: Positive feedback, Condition of oscillation and stabilization, Hartley oscillator, Colpitt's oscillator, RC phase shift oscillator, Wein bridge oscillator, Resonant circuit oscillators.

Section – B

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

Active Filter: Types of filters, Low-pass filter: First and second order Butter worth filter, High-pass filter: First and second order Butter worth filter, Higher order filters, Band-pass filters, Band-stop filters, All-pass filters.

Optoelectronic Devices: 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.

Teaching-Learning Strategies:
Teaching-Learning strategies for this course consist of *lectures* and *interactive classroom discussions* well as *paper-and-pencil* exercises. The lecture materials cover the analysis of high frequency response of common-emitter amplifiers, design of multistage amplifiers, concept of feedback amplifiers, construction of oscillators, theory and applications of operational amplifiers, design of active filters, working principle and construction of optoelectronic devices, and fabrication of semiconductor devices with the aid of multimedia presentations and online resources. The *paper-and-pencil* exercises include classworks for *problem-based learning* and homework assignments for *open-ended problem solving.*

Assessment and Evaluation Strategy:
Students will be assessed on basis of their overall performance in the final examination, class tests/assignments, and class attendance/participation. Final grade will be evaluated based on:

- **Four class tests/assignments** due in different times of the semester **(20%)**
- **Class attendance/participation (10%)**
- **A final examination (70%)**

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test/Assignment 1 & 2	**Class Test/Assignment 3 & 4**	**Class Participation/Attendance**	**Final Exam**
CLO1	√		√	√

CLO2	√		√	√
CLO3	√		√	√
CLO4		√	√	√
CLO5		√	√	√
CLO6		√	√	√

Text Books:

1. Gupta and Kumar : Handbook of Electronics
2. Robert F. Coughlin and Frederick F. Driscoll : Operational Amplifiers and Linear Integrated Circuits
3. Ramakant A. Gayakwad : Op-Amps and Linear Integrated Circuits
4. Allen Mottershead : Electronic Devices and Circuits
5. Jacob Millman and Arvin Grabel : An Introduction Microelectronics

Reference Books:

6. Millman and Halkias : Electronic Devices and Circuits
7. Malvino : Electronic Principles
8. B. L. Theraja and A. K. Theraja : A Textbook of Electrical Technology, Vol. 4

EEE2182: Electronic Circuits and Semiconductor Devices Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Lab Objectives: The objective of this lab course is to make the students understand the concepts of electronic circuits and semiconductor devices based on ICE 2111: Electronic Circuits and Semiconductor Devices through a set of practical experiments including the characteristics of emitter follower, construction of oscillators, characteristics of operational amplifiers and their applications.

ICE 2121: Analog Communication and Radio-TV Engineering
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	None	
Course Objectives	**:**	The objective of this course is to introduce the concepts of analog communication systems, and to equip students with various issues related to analog communication such as radio wave propagation, modulation, demodulation, broadcasting transmitters & receivers, basic concept of TV, TV Transmitter and Receiver.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Identify the different type of radio wave propagation and apply its real applications	**PLO-3, PLO-5, PLO-8**
		CLO-2: Explain the working principle of different types of modulation and apply its different techniques	**PLO-3, PLO-5, PLO-8**
		CLO-3: Explain the working principle of different types	**PLO-3, PLO-5,**

		of modulation and apply its different techniques	**PLO-8**
		CLO-4: Identify the different types of radio transmission, its techniques and applications	**PLO-3, PLO-5, PLO-8**
		CLO-5: Explain the working principle of different types of radio receivers and apply its different techniques	**PLO-3, PLO-5, PLO-8**
		CLO-6: Identify the different element of TV systems and apply its different techniques	**PLO-3, PLO-5, PLO-8**
		CLO-7: Explain the working principle of TV transmitter & receiver and apply its real applications	**PLO-3, PLO-5, PLO-8**
		CLO-8: Identify the different types of TV systems, its techniques and applications	**PLO-5**

Course Contents

Section – A

Radio Wave Propagation: Ground wave propagation, Sky wave propagation, Skip distance and Maximum usable frequency, Chapman theory of layer formation, Ionospheric storm.

Modulation: Amplitude modulation, Frequency modulation and Phase modulation, Linear modulation methods, Square law modulation methods.

Demodulation: Amplitude demodulation, Frequency demodulation and Phase demodulation, Classification of detection methods of amplitude demodulation, Square law diode detector, Linear diode detector, Choice of time constant RC in linear diode detector.

Radio Transmitter: Classification of radio transmitters, Constituent stages of amplitude modulation radio transmitter, Carrier frequency requirements of radio transmitter, Master oscillator, Harmonic generation, Single sideband transmission, Frequency shift keying transmitter, Pre and de-emphasis, Armstrong frequency modulation transmitter.

Section – B

Radio Receiver: Receiver Classification, Elements of Receiver, AM and FM Receivers, SSB Receiver, Noise in Receiver, AGC Circuits, AFC Circuits, Noise Limiters.

Fundamental of TV: Element of TV System, TV Signal, Analysis & Synthesis of TV Pictures, Composite Video Signal, Color Signal Generation, Vestigial Sideband Transmission,

TV Transmitter and Receiver: TV Transmitter, Television Transmitting and Receiving Antenna, TV Receiver: Types of TV receiver, Diagram of TV Receiver, Picture Tube, Television Camera Tube, Color Television Display Tube.

Types of TV: Color TV: Compatibility, three colors theory, Grassman's Law, Luminance, Hue and Saturation; Cable TV, Satellite TV, Digital TV, Closed Circuit TV (CCTV).

Teaching-Learning Strategies:

Teaching-Learning strategies for this course consist of *lectures* and *interactive classroom discussions* as well as *paper-and-pencil* exercises. The lecture materials cover the fundamental idea about the wave propagation and also the concepts of Radio and TV techniques. The *paper-and-pencil* exercises include class works for *problem-based learning* and homework assignments for *open-ended problem solving.*

Assessment and Evaluation Strategy:
Students will be assessed on basis of their overall performance in the final examination, class tests/assignments, and class attendance/participation. Final grade will be evaluated based on:

- **Four class tests/assignments** due in different times of the semester **(20%)**
- **Class attendance/participation(10%)**
- **A final examination(70%)**

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test/Assignment 1 & 2	**Class Test/Assignment 3 & 4**	**Class Participation/Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3	√		√	√
CLO4	√		√	√
CLO5	√		√	√
CLO6		√	√	√
CLO7		√	√	√
CLO8		√	√	√

Text Books:

1. G. K. Mathur **:** Radio Engineering
2. Gulati **:** Monochrome and Color TV

Reference Books:

3. B. Grob **:** Basic TV
4. S.L. Gupta and Kumar **:** Electronics

ICE2122: Analog Communication and Radio-TV Engineering Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Lab Objectives: The objective of this lab course is to train the students to analyze the modulation and demodulation techniques such as amplitude modulation, frequency modulation and also understand their performance using both trainer kit and circuit implementation.

PHY2191: Electromagnetic Fields and Waves
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	MATH1111	
Course Objectives	**:**	To introduce the basic concept of electromagnetic fields and waves by exploring the Maxwell's equations. To understand the fundamental theorems and properties of the electromagnetic wave propagation, reflection and refraction in different medium, as required by engineers in Wireless Communication and other technologies. To understand the electromagnetic wave propagation through transmission lines and waveguides, and use of Smith charts to solve transmission line problems.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Define and derive expressions of Maxwell's equations and interpret the terms in the theorem physically.	**PLO-1**
		CLO-2: Explain the existence of electromagnetic waves and their properties.	**PLO-2**
		CLO-3: Analyze the propagation of electromagnetic waves in different medium and how to change their properties.	**PLO-2, PLO-5**
		CLO-4: Illustrate the electromagnetic wave propagation through the transmission line and waveguide, analyze the different wave properties.	**PLO-3, PLO-6**

Course Contents

Section – A

Field Equations: Field equations based on laws of Coulomb, Ampere and Faraday, Displacement current; Maxwell′s equation, physical interpretation of Maxwell's equations, Units and dimensions of field vectors, Scalar potential, Vector potentials and Retarded potentials.

Electromagnetic Waves in Dielectric Medium: Wave equations, simple medium, Plane wave and uniform plane wave concept, transverse nature of uniform plane wave, Plane electromagnetic waves in perfect dielectric and lossy-dielectric medium, intrinsic impedance, propagation constant of dielectric medium.

Electromagnetic Waves in Conducting Medium: Wave equations for conducting medium and good conductor, intrinsic impedance and propagation constant of conducting medium, depth of penetration, Poynting vector in conducting medium, compare conducting and dielectric medium, Electromagnetic wave polarization.

Reflection and Refraction of Electromagnetic Waves: Boundary conditions; The laws of reflection and Snell′s law of refraction; Reflection from dielectrics and conductors; Fresnel′s equations; The Brewster angle; Total reflection; Skin effect; Phase and group velocities, Reflection and refraction in the ionosphere.

Section – B

Transmission Lines: Concept and definition, Different kinds of transmission lines, Applications, Primary constants, Secondary constants, General transmission line equations, Line termination, Reflection of transmission line, Standing wave ratio.

Impedance Matching in High Frequency Lines: Concept and definition, various techniques of impedance matching, Smith chart and its applications.

Fundamentals of Waveguide: Introduction, Types, Waveguide transmission, Different modes of a waveguide, Phase velocity and Group velocity, Waveguide equation, Waveguide attenuation, Applications.

Rectangular and Circular Waveguides: Definitions, Boundary conditions, Transverse Electric (TE) and Transverse Magnetic(TM) mode analysis, Sketches of TE and TM mode fields, Power transmission and Power loss expressions.

Teaching-Learning Strategies:

Teaching strategies for this course consisted of *lectures* as well as *hands-on method*. The Lecture materials are presenting and understanding the mathematical constructs of electromagnetic fields, waves and propagation as a major task for most engineering students. The hands-on exercises included classwork and homework assignments to solve realistic problems numerically.

Assessment and Evaluation Strategy:

Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3	√		√	√
CLO4		√	√	√

Text Books:

1. Gupta Kumar Sing : Electrodynamics
2. K.D. Prasad : Antenna and Wave Propagation
3. F.R. Connor : Wave Transmission

Reference Books:

4. Corson and Lorain : Introduction to Electromagnetic Field and Wave

5. A.V.Bakshi : Transmission Lines and Waveguide
6. J.D. Ryder : Networks, Lines and Fields
7. Sanjeeva Gupta : Microwave Engineering

MATH2111: Matrices and Differential Equations
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	MATH1111, MATH1211	
Course Objectives	**:**	The objective of this course is to present basic concepts of matrices and matrix algebra to solve complex engineering problems. The purpose of this course also is to provide students with the skills, knowledge and attitudes required to solve differential equations at a level that would allow articulation to higher year engineering courses.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: identify special properties of a matrix and use this information to facilitate the calculation of matrix characteristics;	**PLO-2**
		CLO-2: determine the rank, determinant, eigenvalues and eigenvectors, diagonalization, and different factorizations of a matrix;	**PLO-1**
		CLO-3: write down the matrix representing a linear transformation under a given basis, and determine how the matrix changes if the basis is changed;	**PLO-2**
		CLO-4: evaluate first order and higher order differential equations.	**PLO-2**
		CLO-5: recognize various types of differential equations.	**PLO-2**
		CLO-6: apply appropriate differential equation technique to solve engineering problem.	**PLO-3**

Course Contents

Section – A

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 nonhomogeneous systems by matrix method, and reduction to equivalent system.

Characteristic Equation: Eigenvalues, Eigenvectors and Caley-Hamilton theorem, Similar matrices and diagonalization.

Section – B

Solutions: 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.

Teaching-Learning Strategies:
The strategy of teaching in this course is basically classroom lectures, and problem based homework assignments. The course materials offer basic and advance concept of mathematics for helping student to understand the contents and solving the problems.

Assessment and Evaluation Strategy:
The assessment strategy for a student will be overall performance in all the final exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class Test 1 & 2 /Quizzes	Class Test 3 & 4 /Quizzes	Class Attendance	Final Exam
CLO1	√		√	√
CLO2	√		√	√
CLO3	√		√	√
CLO4		√	√	√
CLO5		√	√	√
CLO6		√	√	√

Reference Books:

1. M. L. Khanna : Matrices
2. S. L. Ross : Introduction of Ordinary Differential Equations
3. F. Ayres : Theory and problems of Matrices
4. Moduffe : Theory of Matrices
5. F. Ayres : Differential Equations
6. B. D. Sharma : Differential Equations
7. L. Pipes : Applied Mathematics for Engineers and Physicist
8. I. S. Sokolnikoff & R. M. Redheffer : Mathematics for Physics and Modern Physics

STAT2111: Basic Theory of Statistics
50 Marks, 2 Credits, 2 Hours/week, Lectures: 26, Exam time: 2 hours

Prerequisite Courses	**:**	STAT 1211	
Course Objectives	**:**	The objective of the course is to provide students with the basic concepts of data analysis and statistical computing. Topics covered include basic descriptive measures, measures of association, probability theory, confidence intervals, and hypothesis testing. The main objective is to provide students with pragmatic tools for assessing statistical claims and conducting their own statistical analyses.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: collect, manage and store statistical data ready for analysis;	**PLO-2**
		CLO-2: apply fundamental statistical methods to explore, analyze and visualize data and test statistical hypotheses;	**PLO-1, PLO-2**
		CLO-3: construct appropriate graphical displays of data and explain the role of such displays in data analysis;	**PLO-4**
		CLO-4: assess the nature of random variables and probability distributions through direct calculation;	**PLO-4**
		CLO-5: perform basic statistical inference tasks;	**PLO-4**
		CLO-6: demonstrate their knowledge of the basics of inferential statistics by making valid generalizations from sample data;	**PLO-1**
		CLO-7: interpret statistical analysis and draw conclusions in context and in the presence of uncertainty.	**PLO-2**

Course Contents

Section – A

Parent and Sampling Distributing: Different parent distribution, Fisher's Lemma. Study of χ^2 distribution, T-distribution and F-distribution, Properties, uses and applications. Distribution of sample correlation coefficient in the null case. Sampling distribution of the medians and range.

Elements of Point Estimations: Basics concepts, Consistent estimates, Unbiased estimates, Mean and variance of estimates, Ideas of efficiency, Principle of maximum likelihood, Illustration from binomial, Poisson and normal distributions.

Section – B

Decision Rules: Statistical decision; Critical region, Best critical region; Two types of errors, Procedure of test of hypothesis; Most powerful test; Standard errors.

Test of Significance: Test of single mean and single variance, Comparison of two sample means, Proportions and variances, Bartlett's tests for homogeneity of variances, Test for correlation and regression coefficients. Exact test for 2*2 tables, Test for **r*c**tables, Three-way contingency tables. Large ample test of significance, Non parametric test, One sample and two sample sign test, Run test and rank sum test.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included a fascinating look into the concept of parent and sampling distributing, elements of point estimations, decision rules, and test of significance. The *paper-and-pencil* exercises included classwork and homework assignments.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3	√		√	√
CLO4	√		√	√
CLO5		√	√	√
CLO6		√	√	√
CLO7		√	√	√

Reference Books:

1. Albarto Leon-Garcia : Probability and Random Processes for Electrical Engineering
2. R. L. Anderson, T. A. Bancroft : Statistical Theory in Research, McGraw-Hill N. Y. Banctoft, T.
3. G. Beaumont : Intermediate Mathematical Statistics,
4. Gutman, Wilks and Hunter : Introductory Engineering Statistics, Fourth Ed. John Wiley and Sons
5. P. G. Hoel : Introduction to Mathematical Statistics, Fifth Ed. John Wiley and Sons, N. Y.
6. R. V. Hogg. and A. T. Graig : Introduction to Mathematical Statistics, Fourth Ed. Collier Macmilan, N. LY.
7. M. G. Kendall and A. Stuart A : The Advanced Theory of Statistics, Vol. 1, Fourth Ed. Charles Griffin and Co. London
8. B. W. Lindgren : Statistical Theory, Third ed. Collier-Macmillan Co; N. Y.

9. Mood, Graybill and Boes : Introduction to the Theory of Statistics, Third ed. McGraw-Hill, N. Y.

ACCO2111: Industrial Management and Accountancy
50 Marks, 2 Credits, 2 Hours/week, Lectures: 26, Exam time: 2 hours

Prerequisite Courses	**:**	None	
Course Objectives	**:**	The main objective of the course is to provide an opportunity for students to understand how managers in industrial management accounting decision-making use finance theory and applications. Additionally, key finance methods used by management accountants for a variety of planning, strategic and risk management decisions are presented and explored in this course in detail for the students.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Identify the organizational and industry environment in which a company operates along with key the value-chain participants and associated activities in which finance concepts apply	**PLO-8** **PLO-9**
		CLO-2: Describe how theories of finance apply to management accounting practice	**PLO-11**
		CLO-3: Apply the concept of finance in management accounting and control using case studies	**PLO-6**
		CLO-4: Identify, compile and analyze financial accounting data for the management team to make decisions	**PLO-4**
		CLO-5: Explain the financial management accounting skills in different organizational contexts	**PLO-8**
		CLO-6: Identify and appraise business risks faced by organizations and propose ways to manage these risks	**PLO-2**
		CLO-7: Construct capital budgets and financial performance measurement systems using spreadsheets and associated formulas;	**PLO-4**
		CLO-8: Discuss with other organizational experts to express group ideas and collective decisions related to budgets and financial performance measurement systems.	**PLO-9**

Course Contents

Section – A

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 Organizational Behavior: Concept of management, Management principles and functions: Planning and decision making, Organizing, Leading, and controlling, Levels of management, Manager and roles of management, Scientific management and core management skills, Corporate social responsibility, Organizational structure of industrial organization, Importance and scope of organizational behavior in a global context, Motivation, Values, Attributes, Job satisfaction, Morale, Counseling, Stress, Frustration.

Strategy Policy and Project Management: Concept of strategy, Strategy formulation factors, SWOT analysis, Business strategy and goal evaluation, Strategy formulation in IT industry, Strategy vs policy, Concept of project and project management, Project life cycle, Preparation of project proposal, Scheduling, budgeting, Procurement, Project monitoring and evaluation.

Section-B

Accountings: History, Scope and nature of accounting, Purpose of accounting, Accounting equation, Meaning and classification of account, Double entry system, Rules for determining debit and credit, Accounting cycle journal, Ledger and trial balance, Worksheet, Income Statement, Balance sheet.

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.

Materials Control: Material in industry, Inventory control model, ABC analysis, Safety stock, Reorder, Level, Economic ordering quantity, Stores equipment, Stores records, Purchasing procedures, Purchase records, Bin card, Material handling, Manual lifting.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included a fascinating look into the basic concept of business and industry, management and organizational behavior, strategy policy and project management, concept of accountings, cost concepts and cost-volume-profit relationship, and materials control in industry. The *paper-and-pencil* exercises included classwork and homework assignments.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2	**Class Test 3 & 4**	**Class Attendance**	**Final Exam**

	/Quizzes	/Quizzes		
CLO1	√		√	√
CLO2	√		√	√
CLO3	√		√	√
CLO4	√		√	√
CLO5		√	√	√
CLO6		√	√	√
CLO7		√	√	√
CLO8		√	√	√

Reference Books:

1. VK Sharma OP Harkut : Industrial Management
2. M. C. Shukla : Business Organization and Management
3. Samuel C. Certo : Modern Management
4. Krajewski and Ritzman : Operation Management
5. David A. Decenzo and Stephen P. Robbins : Human Resource Management
6. Hermanson Etar : Accounting Principles
7. Ray H. Garrison : Managerial Accounting
8. Sharma BR : Environmental and Pollution Awareness

Part-II (Even Semester)

ICE2211: Cellular and Mobile Communication
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	STAT 1211	
Course Objectives	**:**	To make the student familiar with cellular and mobile communication system and limitations of 2G, 3G and beyond. To identify the basic requirements of cellular concept, frequency reuse, hand-off strategies, channel assignment strategies, interference and system capacity. To analyze and understand the fading channel and their models. To understand the mobile data networks and different types of cellular communication standards.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Explain the basic principles of mobile communication system.	**PLO-1**
		CLO-2: Illustrate the frequency reuse and handoff strategies.	**PLO-3**
		CLO-3: Examine the effect of interference (CCI & ACI) and corresponding system capacity.	**PLO-4**
		CLO-4: Analyze the channel planning of a cellular network.	**PLO-7**
		CLO-5: Classify the small-scale and large-scale fading and effects.	**PLO-1**
		CLO-6: Determine the type of appropriate model for wireless fading channel.	**PLO-2**
		CLO-7: Explain mobile data network and their protocol.	**PLO-5**
		CLO-8: Compare various generations of mobile communication standards.	**PLO-8**

Course Contents

Section – A

Introduction: Introduction to Cellular Mobile Radio Systems: Limitations of conventional mobile telephone systems, a basic cellular system, performance criteria, operation of cellular systems, planning a cellular system, overview of generation of the cellular system.

Cellular Engineering Fundamentals: Introduction, frequency reuse, channel assignment strategies, handoff strategies: prioritizing handoffs, Practical handoff considerations.

Interference and System Capacity: Co-channel interference, adjacent channel interference, channel planning, power control for reducing interference, Trunking and GoS, improving coverage and capacity in cellular system: cell splitting, sectoring, microcell zone concept.

Intelligent Cell Concept and Applications: Intelligent Cell, the philosophy of implementing power-delivery intelligent cells: delivering power intelligent, radio capacity, power-delivery intelligent cells: zone-divided cells, intelligent microcell, applications of intelligent Microcell Systems, in-building communication.

Section – B

Mobile Radio Propagation (Large-Scale) Model: Free space propagation model, Basic propagation mechanisms, Ground reflection (Two-Ray) model, Fresnel zone geometry, Knife-edge diffraction model, Practical Ling Budged Design: Log-distance path loss model, Log-normal shadowing, Outdoor and Indoor propagation models.

Mobile Radio Propagation (Small-Scale) Model: Small-Scale multipath propagation, Factors influencing small-scale fading, Doppler shift, Impulse Response Model of a Multipath Channel, Small-Scale Multipath Measurements, Parameters of mobile multipath channels, Types of small-scale fading, Fading effects due to multipath time delay spread and Doppler spread.

Mobile Data Networks: Introduction, Data-Oriented CDPD Network: CDPD, Architecture in CDPD, Mobility Support in CDPD, Protocol layer in CDPD, GPRS and Higher Data Rates: GPRS, Architecture in GPRS, Mobility Support in GPRS, Protocol layers in GPRS, Mobile Application Protocols.

Wireless Systems and Standards: AMPS and ETACS: System overview, Call handling and air interface, United States Digital Cellular (IS-54 and IS-136), GSM: Services and features, System architecture, Radio subsystem, GSM channel types, Frame structure, Signal processing in GSM, IS-95: Frequency and channel specifications, Forward and reverse CDMA channels.

Teaching-Learning Strategies:

Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included a cellular mobile concept, frequency reuse, handoff strategies, channel assignment strategies, mobile radio propagation models, different mobile networks and wireless standards. The *paper-and-pencil* exercises included classwork and homework assignments in using various algorithms to solve simple and complex problems.

Assessment and Evaluation Strategy:

Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√			√

CLO2	√			√
CLO3	√	√		√
CLO4	√	√		√
CLO5		√		√
CLO6		√		√
CLO7				√
CLO8				√

Text Books:

1. T S Rappaport : Principles of Wireless Communication
2. Y. Lee : Mobile Cellular Communication
3. Pahlavan and Krishnamurty : Principles of Wireless Network

Reference Books:

4. VK Garg and J E Wilkis : Principles and Application of GSM
5. VK Garg : IS 95 CDMA and CDMA2000

ICE2221: Signals and Systems
75 Marks, 3 credits, 3 Hours/week, Lectures: 39, Exam. Time: 3 hours

Prerequisite Courses	**:**	None	
Course Objectives	**:**	The focus of this course is to introduce the fundamental concepts and techniques used in both analog and digital signal processing relating to electronic, communication and/or computer engineering. This course is about how to use linear systems tools, especially transform analysis and convolution, to analyze and predict the behavior of linear systems. Analysis and characterization of the LTI systems through Laplace transform and Fourier transform and Z transform and DTFT are also included in the course.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Define different terminologies of signals and systems.	**PLO-1**
		CLO-2: Describe different representations of linear time invariant systems.	**PLO-1.**
		CLO-3: Convert the signals from one form to another	**PLO-2.**
		CLO-4: Use the method to represent signals and practice the conversion.	**PLO-2**

Course Contents

Section - A

Introduction: Definition of signals and 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 Periodic Signals: Introduction**,** Fourier representation of four classes of signals, Discrete-time Fourier series, Fourier series.

Fourier Representation of Nonperiodic Signals: Discrete-time Fourier transformation, Fourier transformation, Properties of Fourier representations.

Section - B

Applications of Fourier Representations: 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,

Fourier Method of Signal Processing: DT processing of CT signals, FS representations for finite duration non periodic signal, DTFS approximation to the Fourier transform, DTFS evaluation algorithm.

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.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included a fascinating look into the fundamentals of analog and digital signal processing techniques relating to electronic, communication and/or computer engineering, different linear systems tools, analysis and characterization of the LTI systems through Laplace, Fourier and Z transform. The *paper-and-pencil* exercises included class work and homework assignments in using various algorithms to solve simple and complex problems.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class Test 1 & 2 /Quizzes	Class Test 3 & 4 /Quizzes	Class Attendance	Final Exam
CLO1	√		√	√
CLO2	√	√	√	√
CLO3	√	√	√	√
CLO4		√	√	√

Text Books:

1. Simon Haykin & Barry Van Veen **:** Signals and Systems

Reference Books:

2. Alan V. Oppenheim, Alan S. Willsky& S. Hamid **:** Signals and Systems
3. A Nagoor Kani, Nagoor **:** Signals and Systems

ICE 2222: Signals and Systems Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Lab Objectives: The objectives of this laboratory experiment are to describe and analyze various examples of signals and systems using tools of MATLAB. Be able to visualize the relationship among Fourier analysis methods.

ICE2231: Data Structures and Algorithms
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	CSE1291	
Course Objectives	**:**	The main objective of the course is to understand basic data structures and algorithms. The student able to assess how the choice of data structures and algorithm design methods impacts the performance of programs. The course aim to describe the systematic way of solving problems, and various methods of organizing large amounts of data. The objective of the course also focuses to solve problems using data structures such as linear lists, stacks, queues, hash tables, binary trees, heaps, binary search trees, and graphs and writing programs for these solutions.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Define basic static and dynamic data structures and relevant standard algorithms for them.	**PLO-2**
		CLO-2: Describe different types of data structures and know how to apply them effectively in problem solving.	**PLO-2, PLO-3, PLO-5**
		CLO-3: Analyze and select the most suitable and effective algorithm for solving certain problem.	**PLO-2, PLO-5**
		CLO-4: Demonstrate advantages and disadvantages	**PLO-2**

		of specific algorithms and data structures.	
		CLO-5: Select basic data structures and algorithms for autonomous realization of simple programs or program parts.	**PLO-1**
		CLO-6: Determine and demonstrate bugs in program, recognize needed basic operations with data structures.	**PLO-2**
		CLO-7: Formulate new solutions for programming problems or improve existing code using learned algorithms and data structures.	**PLO-2, PLO-5**
		CLO-8: Evaluate algorithms and data structures in terms of time and memory complexity of basic operations.	**PLO-4**

Course Contents

Section - A

Introduction: Data types and data structures, Data structure operations, Introduction to algorithms, Performance analysis.

Arrays, Records, Pointer and Linked List: Linear arrays, Relationships of arrays, Operation on arrays, Multidimensional arrays, Pointer arrays, Record structures, Representation of records, Sparse matrices, Linked lists, Representation of linked list, Traversing and searching a linked list.

Stacks, Queues and Recursion: Fundamentals, Different types of stacks and queues: Circular, Dequeues, etc., Evaluation of expressions, Recursion, Direct and indirect recursion, Depth of recursion, Implementation of recursive procedures by stacks.

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

Section – B

Hash Tables: Direct-address tables, Hash tables, Hash functions, Open addressing, Perfect hashing.

Sorting and Searching Algorithms: Sorting, Insertion sort, Shell sort, Heap sort, Radix sort, general method of divide and conquer method, Merge sort, Quick sort, Selection sort, Binary search.

Greedy Method: Elements of greedy strategy, Knapsack problem, Job sequencing, minimum cost spanning trees, Huffman codes, Theoretical foundations for greedy methods.

Dynamic Programming: Elements of dynamic programming, multistage graphs, All pairs shortest paths, Single source shortest paths problems, Matrix-chain multiplication.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. Additionally, some innovative teaching techniques will be used to explain the concepts like different data structures- stack and queue, searching and sorting algorithms. Many of the concepts will be explained with the help of innovative teaching methods like analogy, activity, role-play and brainstorming. While using analogy, the relevant matching scenarios in real life will be predicted to explain the concept. In role-play activity, students perform different roles and demonstrate the concepts. Often, multimedia will be used to explain different concepts. The *paper-and-pencil* exercises included classwork and homework assignments in using various algorithms to solve simple and complex problems.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, assigned topics based presentations, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3	√		√	√
CLO4	√	√	√	√
CLO5	√	√	√	√
CLO6		√	√	√
CLO7		√	√	√
CLO8		√	√	√

Text Books:

1. S Lipschutz : Theory and Problems of Data Structures

Reference Books:

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

ICE2232: Data Structures and Algorithms Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Lab Objectives: The objective of this laboratory is to develop skills to design and implement linear and non linear data structures. After completion of this laboratory the student will able to gain knowledge in practical applications of data structures.

MATH2221: Discrete Mathematics and Numerical Methods
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	MATH1211, MATH2111	
Course Objectives	**:**	This course is designed to provide the mathematical foundations for information and communication engineering. Students should learn the essentials of discrete mathematical structures and numerical method. To accomplish these objectives, the course emphasizes mathematical reasoning and problem solving techniques, and to provide the student with numerical methods of solving the linear or non-linear equations, interpolation, differentiation, and integration. After successful completion of the course students should be able to communicate ideas mathematically and solve problems using the mathematical tools.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Express a logic sentence in terms of predicates, quantifiers, and logical connectives.	**PLO-2**
		CLO-2: Apply the rules of inference and methods of proof, including direct and indirect proof, proof by contradiction, and mathematical induction, to solve mathematical problem.	**PLO-1**
		CLO-3: Use tree and graph algorithms to solve problems.	**PLO-1**
		CLO-4: Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra.	**PLO-2**
		CLO-5: Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions.	**PLO-1, PLO-2**
		CLO-6: Apply numerical methods to obtain approximate solutions to mathematical problems	**PLO-1**
		CLO-7: Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.	**PLO-3**
		CLO-8: Analyze and evaluate the accuracy of common numerical methods.	**PLO-2, PLO-3**

Course Contents

Section – A

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 terminology, Representing graph and graph isomorphism, Paths, Reachability, connectivity, Euler and Hamilton path, Shortest path problems, Graph coloring, Matrix representation of graph.

Trees: Introduction of trees, Application of trees, Tree traversal, Labeling trees, Trees and sorting, Spanning trees, Minimal spanning tree, Undirected trees.

Languages and Grammars: Definition of a formal language, Phrase-structure Grammer-types of Grammers, Derivation tree, Backus-Naur form.

Section – B

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.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included a fascinating look into the concept of mathematical logic, sets, relation and ordering, functions, graphs, trees, languages and grammars, approximations of errors, roots of equations, interpolations and curve fittings, numerical differentiation and integration, and numerical solutions of ordinary differential equations. The *paper-and-pencil* exercises included classwork and homework assignments.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class Test 1 & 2 /Quizzes	Class Test 3 & 4 /Quizzes	Class Attendance	Final Exam
CLO1	√		√	√
CLO2	√		√	√
CLO3	√		√	√
CLO4	√		√	√
CLO5		√	√	√
CLO6		√	√	√
CLO7		√	√	√
CLO8		√	√	√

Reference Books:

1. Lipshutz : Theory and Problems of Discrete Mathematics, Schaum's outline series
2. C.L. Liu : Elements of Discrete Mathematics, 2nd Ed, McGraw-Hill, 1985
3. Sharon Ross : Discrete Mathematical Structure
4. S.S. Sastry : Introductory Methods of Numerical Analysis

LAW2211: Cyber and Intellectual Property Law
50 Marks, 2 Credits, 2 Hours/week, Lectures: 26, Exam time: 2 hours

Prerequisite Courses	**:**	ICE1111	
Course Objectives	**:**	Develop the knowledge about the cybercrime and related laws. Understand the ICT policy of Bangladesh. Make understanding about the intellectual property and their right and related laws. Make the students aware of their rights for the protection of their invention done in their project work.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Identify the cybercrime, cyber security and related laws.	**PLO-2**
		CLO-2: Describe about the intellectual property and their right, patent, and copyright.	**PLO-2**
		CLO-3: Identify, apply and assess principles of law relating to intellectual property right, patent, and copyright.	**PLO-2, PLO-6, PLO-8**

		CLO-4: Explain the ICT policy and understand the ICT Law of Bangladesh.	**PLO-2, PLO-7**
		CLO-5: Demonstrate a capacity to identify, apply and assess ownership rights and marketing protection under intellectual property law, copyright and patent as applicable to information, ideas, new products and product marketing.	**PLO-2, PLO-6, PLO-11**

Course Contents

Section – A

Cyber Law: Definition Nature, Nature, Scope, Utility of Cyber Law, origin and Development of Cyber Law and Internet.

ICT Policy in Bangladesh: Internet Service Providers (ISP)- Domain Name, Present Legal Basis of (ISP)- Domain Name, Present Legal Basis of ISP in Bangladesh; e-Readiness in Bangladesh-e-Commerce in Bangladesh, e-Governance in Bangladesh, e-Learning/Education in Bangladesh, e-Journal in Bangladesh, e-Voting in Bangladesh; Electronic Evidence-Digital signature, The Evidence Act of 1872 Vs. ICT act-2006, Electronic Evidence in Bangladesh, Legal Effects of electronic evidence, UNCITRAL Model Law on Electronic Evidence;

Cyber crime: Jurisdiction and Cyber crime, Criminal Justice in Bangladesh and Implications on Cyber Crime; cyber vandalism, Hacking, Malicious spreading in Viruses, Password fraud, cheating, Cyber Pornography, Child Pornography, Protection of Copyrights and Intellectual Property right. Invasion of Privacy, Constitutional basis of Privacy, Unsolicited e-mail, Defamation, Harassment and e-Mail Abuse, Present Legal Protection:
Human Rights violation and Internet; the Information and Communication Technology Act, 2006- Objectives, Strengths & weaknesses of the ICT Law, Regulation of Cryptography;

International Cyber Law: India, Sri Lanka, Japan Malaysia, Australia and the USA, International Conventions on Cyber Law & Crime.

Electronic Commerce: Electronic Money, Online credit crd Payments and Electronic bills of Lading, UNCITRAL Model Law on Electronic Commerce.

Section – B

Intellectual Property Law: Basic Concepts of IP Law, Nature of IPR, Computer-related Intellectual property rights: Copyright- Original and development of Copyright Law, subject matte4r of copyright protection, Rights protected by copyright, Neighboring rights, Limitations of Copyright Protecting, Piracy and infringement, Remedies Computer Program, New technology and copyright, Software Patents Vs. Copyright, International Convention copy right.

Patent: Patents and technological development, Requirements for patentability and ownership of patents, Scope of exclusive rights and duration of protection, patents infringement, defenses and remedies, Legal arrangement for the transfer of technology. Types of intellectual property licenses

Trademarks: Reasons for the protection of trademarks, Acquisition of trademark right, Registration procedure, Duration of protection and renewal, termination. Trademarks in Cyberspace, Domain name and Meta-tag Controversies.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material includes various aspects of cyber law, cyber crime and ICT policies of Bangladesh. It also focuses on Intellectual Property rights, Patent and Trademarks. The *paper-and-pencil* exercises includes classwork and homework assignments on contemporary issues about cyber law and cyber crime.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Three class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√
CLO2		√	√	√
CLO3		√	√	√
CLO4	√		√	√
CLO5	√	√	√	√

Text Books:

6. Vivck Sood : Cyber Law Simplified, Tata McGraw Hill Publications
7. V. D. Dudej : Information Technology & Cyber Laws, Commonwealth Publishers

Reference Books:

8. Arpad Bogsch : Universal Copyright Convention: An Analysis and Commentary, Bowker
9. Alan Daubeny Russell Clarke : Copyright in Industrial Designs, Sweet and M.

Part-III (Odd Semester)

ICE3111: Microwave Communication and Radar
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	PHY2191, ICE2211	
Course Objectives	**:**	This course introduces students to the basic concepts and applications of microwave systems, microwave components and devices. It explains how to measure different components related to microwave measurement and antenna system. It also provides fundamental concept of Radar, its classification as well as target tracking system.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: State the basic concept of microwaves, microwave measurements, Microwave link, Microwave antenna, Radar.	**PLO-2**
		CLO-2: Describe the construction, working principle, applications of basic microwave components and devices, and Time Domain Reflectrometry (TDR) Systems.	**PLO-2, PLO-3**
		CLO-3: Explain the working principle and applications of microwave tubes amplifier and oscillators.	**PLO-2, PLO-5**
		CLO-4: Analyze and deign basic microwave amplifiers, RF filters, RF oscillator, and mixer models.	**PLO-2, PLO-3**
		CLO-5: Demonstrate an understanding of the factors affecting the radar performance using Radar Range Equation. Also, Recognize the different types of Radar and their application in real-time scenario.	**PLO-1, PLO-11, PLO-12**

Course Contents

Section – A

Introduction: Definition of Microwaves, Microwave Frequency Bands, Characteristics of microwave, Advantages and Disadvantages of Microwaves, General Applications of Microwaves.

Microwave Components and Devices: Introduction, Waveguide Tees, Magic Tee, Isolating Device, Hybrid ring (Rat-Race Circuit), Coupling Probes, Coupling Loops, Wavemeter, Directional coupler, Isolator, Circulator, Cavity resonators, Maser, Parametric amplifiers.

Microwave Tubes: Introduction, Classifications of Microwave Tubes, Microwave tubes amplifiers: Klystron - Two cavities Klystron, Travelling wave tube (TWT), Microwave tubes oscillators: Reflex klystron, Magnetron.

Microwave Measurements: Introduction, Microwave Power Measurements, Frequency Measurement, Impedance Measurement, Attenuation Measurement, Noise Measurement, SWR Measurement, Time-Domain Reflectrometry (TDR) System.

Section – B

Microwave Link: Microwave link and its advantage, Basic microwave communication link, Types of communication link, transmitting and receiving equipment, Base band repeater, IF repeaters.

Microwave Antenna: Introduction, Characteristics of microwave antennas, Horn antennas, Antennas with parabolic reflectors, Feed antennas, Dielectric antennas, Lens antennas, MIMO antenna, and Plasma antenna.

Basic Concept of Radar Introduction, Basic principle, Applications of radar, Radar equation and range, Factor influencing maximum range, Effect of noise, Power and frequency used in radar.

Radar Systems: Types of radar; Continuous Wave (CW) radar, Modulated and un-modulated CW radar, Pulse radar, Pulse Doppler and Moving Target Indicator (MTI) radar, Duplexer and radar receiver, Tracking radar systems Indicators, Altimeter and IFR equipment.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included a fascinating look into the basic concept of microwaves, microwave measurements, microwave link, microwave antenna and Radar systems, construction, working principle, applications of microwave components and devices, microwave tubes and Time Domain Reflectrometry (TDR) Systems. The *paper-and-pencil* exercises included class-work and homework assignments in using microwaves, microwave measurements, microwave link, microwave antenna and Radar systems, microwave components and devices, microwave tubes and Time Domain Reflectrometry (TDR) Systems to solve simple and complex problems.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√	√	√	√
CLO3	√	√	√	√
CLO4		√	√	√
CLO5			√	√

Text Books:

1. Sanjeeva Gupta : Microwave Engineering
2. M. I. Skolnik : Introduction to Radar System

3. N. Biswas : Principle of Carriers Communication

Reference Books:

4. Sanjeeva Gupta : Electronic Communications Systems
5. A.K. Chhabra : Principles of Communication Engineering
6. V.K. Mourya : Microwave communication system

ICE 3121: Digital Signal Processing
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	ICE2221	
Course Objectives	**:**	The objective of this course is to provide a basic introduction to the theory of digital signal processing (DSP) and demonstrates some interesting and useful practical applications with Fourier and Laplace transformation. Major parts of the course will concentrate on signal analysis using Fourier transforms, linear system analysis, digital filter design, multi-rate signal processing, signal modeling and adaptive filtering. It also provides practical experience in using MATLAB in analysis and design of DSP systems and algorithms.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Explain the outline of the discrete Fourier transform, its properties and demonstrate computation of the DFT.	**PLO-2, PLO-4**
		CLO-2: Explain and design FIR & IIR filter and apply its real field application	**PLO-2**
		CLO-3: Identify the characteristics of real speech signal and its real field application by using Matlab program.	**PLO-5, PLO-10**
		CLO-4: Explain various methods for sampling-rate conversion and design the Wiener and Kalman filter.	**PLO-1, PLO-2, PLO-3**
		CLO-5: Name and explain different techniques (nonparametric or parametric methods) of power spectrum estimation.	**PLO-1, PLO-2**
		CLO-6: Design and develop the FIR adaptive filter, LMS adaptive recursive filter, and RLS algorithm.	**PLO-1, PLO-3, PLO-4**

Course Contents

Section – A

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

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

Digital Filter: Causality, Symmetric and antisymmetric Finite Impulse Response (FIR) filters, Design of linear phase FIR filters using windows, FIR differentiator, Hilbert transformer, Design of Infinite Impulse Response (IIR) by impulse invariance.

Applications: Multirate Signal Processing, Speech Processing, Adoptive Filter, Musical Sound Processing, Image Enhancement.

Section – B

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, Polyphase FIR Structure, Multistage Implementation of SRC, 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.

Signal Modeling: Modeling of a Simple Signal, Method of Signal Modeling: Direct method, Pade's Approximation, Prony's Method, Shank's Method; Stochastic Models.

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

Teaching-Learning Strategies:
The teaching-learning strategy of this course will organize with lectures, demonstration, student participation in classroom and homework assignments. For effective learning, teacher-student interaction will be allowed in the classroom. The course materials offer basic and advance concept of digital signal processing for helping student to understand the contents and solving the problems.

Assessment and Evaluation Strategy:
The assessment strategy for a student will be overall performance in all the final exams, class tests, assignments, and class participation. Written examination covering both on the theory and the exercises. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3	√	√	√	√
CLO4		√	√	√
CLO5		√	√	√

CLO6		√	√	√

Text Books:

1. J G Proakis & D G Manolakis : Digital Signal Processing- Principles and Application
2. M H Hayes : Statistical Digital Signal Processing

Reference Books:

3. R Rabiner and R W Schafer : Theory and Application of Digital Speech Processing

ICE3122: Digital Signal Processing Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Lab Objectives: The objective of this laboratory should be able to solve different easy problems with their analysis using pen and paper and then doing code computers works based on the theory classes.

ICE3131: JAVA and Network Programming
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	CSE1291, ICE2231	
Course Objectives	**:**	The course is design to extend student knowledge in object oriented programming such as class, object, method and constructor. This course also focuses on graphical user interface (GUI), multithreading, networking and database manipulation. At the end of this course, student should have sufficient knowledge in java and network programming.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Describe the basic knowledge of Object Oriented Programming.	**PLO-1, PLO-2**
		CLO-2: Relate class, object, method and their relationship in a program.	**PLO-2**
		CLO-3: Solve error in a program and also how can handle different types of event.	**PLO-2, PLO-7**
		CLO-4: Discuss the use of client/server architecture and the basic concepts relating to TCP and UDP based sockets in Java Socket API.	**PLO-1, PLO-2**
		CLO-5: Create database and retrieve the data from the databases using Java database connectivity (JDBC).	**PLO-5**
		CLO-6: Develop distributed applications using RMI and component-based Java software using JavaBeans.	**PLO-2, PLO-5**
		CLO-7: Design server side programs in the form of Servlets.	**PLO-3**

Course Contents

Section – A

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

Methods: Using methods, declaring a class method, Implementation of inheritance, calling a class method, Passing parameters, Variables, Local variables and variable scope.

Using Standard Java Packages: Creating graphical user interfaces with AWT, Managing graphics objects with GUI layout managers, Event handling of various components.

Exception Handling: Overview of exception handling, the basic model, Hierarchy of event classes, Throw clause, throws statement, try-catch block.

Section – B

Managing Input/Output Files in Java: Introduction, Concept of streams, Stream classes; Byte stream class, Character stream class, Other useful I/O classes, Using the file class.

Thread: Introduction, Multithread, Synchronization, Deadlock.

Socket Programming: Socket basics, Socket-based network concepts, Client server basics, Socket for client, Socket for server.

Java Database Connectivity: JDBC, JDBC drivers, the JAVA.sql packages, SQL, JDBC connection and executing SQL.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included a fascinating look into the concept of object oriented programming, different tools of programming, simple and advanced forms of graphical user interface (GUI) and network programming, and Java database connectivity technique (JDBC). The *paper-and-pencil* exercises included classwork and homework assignments in using various algorithms to solve simple and complex problems.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class Test 1 & 2 /Quizzes	Class Test 3 & 4 /Quizzes	Class Attendance	Final Exam
CLO1	√		√	√
CLO2	√		√	√
CLO3	√		√	√
CLO4		√	√	√
CLO5		√	√	√
CLO6		√	√	√
CLO7			√	√

Text Books:

1. John Murkowski : Mastering Java 2
2. Herbert Schildt : The Complete Reference of Java 2
3. E. Balagurusamy : Programming with Java

Reference Books:

4. H.M. Deitel and P.J. Deitle **:** Java: How to Program
5. H. Schildt, McGraw-Hill **:** Teach Yourself Java
6. Patrick Niemeyer, Jonathan Knudsen : Learning Java
7. Ken Arnold, James Gosling, David Holmes : Java Programming Language

ICE3132: JAVA and Network Programming Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Lab Objectives: The objective of this lab course is to make the students understand the fundamentals of object oriented programming in java based on ICE3211: JAVA and Network Programming including defining class, invoking method, using class libraries, designing graphical user interface, handling events and exception, managing stream-based I/O, creating multi-threaded program, network programming with socket, and creating DBMS applications using JDBC API.

ICE3141: Antenna Engineering
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	PHY2191
Course Objectives	**:**	The objective of this course is to introduce the fundamental principles of antenna theory and to apply them to the analysis, design, and measurement of antenna systems. Students will learn how to characterize antennas and how to use antennas in wireless communication systems. A comprehensive theory of different types of antennas and its radiation characteristics, antenna arrays and experimentally measurement techniques to validate the theoretical data will also be discussed in detail.

Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Define antenna, and explain the different types of antennas and the radiation mechanism.	**PLO-1, PLO-4**
		CLO-2: Name the fundamental parameters of antenna and compute the basic antenna parameters using standard formulas.	**PLO-2, PLO-5,**
		CLO-3: State and explain Duality theorem, Reciprocity, Reaction theorems, the concept of Microstrip and Smart Antennas, and their applications.	**PLO-1, PLO-4**
		CLO-4: Recognize antennas and antenna arrays as per their operating frequency ranges and radiation pattern for the specific applications.	**PLO-12**
		CLO-5: Design and analyze for the following types of antennas: Linear Wire Antennas, Loop Antennas, Antenna Arrays, Microstrip and Smart Antennas. In addition, evaluate various antenna measurements techniques to assess antenna's performance.	**PLO-3, PLO-4 PLO-6**

Course Contents

Section – A

Antennas: Introduction, Types of Antennas, Radiation mechanism: Single Wire, Two-Wires and Dipole Antennas, Current distribution on a thin wire antenna, Historical Advancement.

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

Radiation Integrals and Auxiliary Potential Functions: The Vector Potential A for an Electric Current Source J, the Vector Potential F for a Magnetic Current Source M, Electric and Magnetic Fields for Electric (J) and Magnetic (M), Current Sources, Solution of the Inhomogeneous Vector Potential Wave Equation, Far-Field Radiation, Duality Theorem, Reciprocity and Reaction Theorems.

Linear Wire Antennas: Introduction, Infinitesimal dipole, Small dipole, Region separation: Far-field and near-field, Finite length dipole, Half wavelength dipole, Linear elements near infinite perfect conductor, Ground effects.

Section – B

Loop Antennas: Introduction, Small circular loop, Circular loop of constant current, Circular loop with nonuniform current, Ground and earth curvature effect for Circular Loops, Ferrite loop, Mobile communication system applications.

Antenna Arrays: Two element array, N-element linear array: Uniform amplitude and spacing, Directivity, three-dimensional Characteristics, Uniform spacing and nonuniform amplitude, Superconductivity, Planar array.

Microstrip and Smart Antennas: Rectangular and Circular Patch, Quality Factor, Bandwidth and Efficiency, Input Impedance, Circular Polarization, Arrays and Feed Networks; Smart Antenna Analogy, Benefits and Drawbacks, Smart-Antenna Systems, Antenna Beamforming, Smart-Antenna System Design, Simulation and Results.
Antenna Manufacturing and Measurements: Antenna manufacturing concept: Conducting materials, Dielectric materials, New materials for Antennas; Antenna Measurement Basics: Antenna ranges, Radiation patterns, Gain and Directivity measurements, Radiation efficiency, Impedance, Current and Polarization measurements, Scale Model Measurements.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included a fascinating look into the basic concept of different types of an antenna and their radiation mechanism, fundamental parameters of an antenna and various antenna measurements techniques to assess antenna's performance. The *paper-and-pencil* exercises included class-work and homework assignments to calculate the basic antenna parameters using standard formulas.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√	√	√	√
CLO3	√	√	√	√
CLO4		√	√	√
CLO5			√	√

Text Books:

1. C. A. Balanis : Antenna Theory – Analysis and Design, 2nd Edition
2. Yi Huang and Kevin Boyle : Antennas: from Theory to Practice, 1st Edition

Reference Books:

3. J. D. Kraus, R. J. Marhefka, and A. S. Khan : Antennas for All Applications, 3rd Edition
4. K. D. Prasad : Antenna and Wave Propagation, 3rd Edition

ICE3142: Antenna Engineering LAB
37.5 Marks, 1.5 Credits, 3 Hours/week

Lab Objectives: The main stream of this Laboratory is to make well-known students with the computer simulation and/or programming tools such as MATLAB, HFSS, CST, ADS and different antenna hardware systems. With the help of Antenna Trainer Kits, students can set up a complete transmitting-receiving communication system and hence, can measure the radiated field and draw the radiation pattern practically. Further, computer simulation exercises are intended to help the student in familiarize and mastering the subject matter with implementation aspects and the application of theoretical knowledge to practical problems.

ICE 3151: Satellite Communication
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	ICE 2121	
Course Objectives	**:**	Satellite systems have had a profound effect on worldwide information dissemination. This course introduces the students to the basic concepts in the field of satellite communication such as how to place a satellite in an orbit, different types of satellite and its applications.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Explain the idea regarding available satellite orbits, power supply system, attitude control, station keeping.	**PLO-1, PLO-2, PLO-3**
		CLO-2: Describe satellite coverage area and satellite life time.	**PLO-7**
		CLO-3: Explain the modulation formats and multiple access techniques used in satellite communications.	**PLO-8**
		CLO-4: Demonstrate tradeoffs that must be made in selecting a frequency band and link power budget calculation.	**PLO-11**
		CLO-5: Identify and solve the issues such as transponder complexity and antenna subsystems.	**PLO-12**

Course Contents

Section – A

Introduction to Satellite Communication: Basic concepts of Satellite Communications, Kepler's First Law, Kepler's Second Law, Kepler's Third Law, Definitions of Terms for Earth-Orbiting Satellites, Orbital Elements, Apogee and Perigee Heights, Orbit Perturbations, inclined orbits.

The Geostationary Orbit: Introduction, Antenna Look Angles, the Polar Mount Antenna, Limits of Visibility, Near Geostationary Orbits, Earth Eclipse of Satellite, Launching Orbits.

Polarization: Introduction, Antenna Polarization, Polarization of Satellite Signals, Cross Polarization, Discrimination, Ionospheric Depolarization, Rain Depolarization, Ice Depolarization.

The Space Link: Introduction, Equivalent Isotropic Radiated Power, Transmission Losses, The Link-Power Budget Equation, System Noise, Carrier-to-Noise Ratio, The Uplink, Downlink, Combined Uplink and Downlink C/N Ratio, Inter-Satellite links.

Section – B

The Space Segment: Introduction, the Power Supply, Attitude Control, Station Keeping, Thermal Control, Transponders, the Antenna Subsystem

The Earth Segment: Introduction, Receive-Only Home TV Systems, Master Antenna TV System, Community Antenna TV System, Transmit-Receive Earth Stations.

Satellite Access: Introduction, Single Access, Preassigned FDMA, Demand Assigned FDMA, Spade System, TDMA, Preassigned TDMA, Demand-assigned TDMA, Satellite-Switched TDMA, Code Division Multiple Access.

Satellite Mobile and Specialized Services: Introduction, Satellite Mobile Services, VSATs, Radarsat, Global Positioning Satellite System (GPS), Orbcomm, Iridium.

Teaching-Learning Strategies:
Teaching-Learning strategies for this course consist of *lectures* and *interactive classroom discussions* well as *paper-and-pencil* exercises. The lecture materials cover the concepts of satellite orbits, power supply system, attitude control, station keeping, satellite coverage area and lifetime, modulation formats and multiple access techniques used in satellite communication, frequency band selection, link power budget calculation, transponder complexity and antenna subsystem of a satellite communication system with the aid of multimedia presentations and online resources. The *paper-and-pencil* exercises include classworks for *problem-based learning* and homework assignments for *open-ended problem solving.*

Assessment and Evaluation Strategy:
Students will be assessed on basis of their overall performance in the final examination, class tests/assignments, and class attendance/participation. Final grade will be evaluated based on:

- **Four class tests/assignments** due in different times of the semester **(20%)**
- **Class attendance/participation (10%)**
- **A final examination (70%)**

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test/Assignment 1 & 2	**Class Test/Assignment 3 & 4**	**Class Participation/Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√

CLO3	√		√	√
CLO4		√	√	√
CLO5		√	√	√

Text Books:

1. Dennis Roddy **:** Satellite Communications

Reference Books:

2. Tri T. Ha **:** Digital Satellite Communication
3. Sudhir K Pand **:** Handbook of Satellite Communication
4. Robert A. Nelson **:** Satellite Communication System Engineering

Part-III (Even Semester)

ICE3211: Digital Image processing
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	ICE2221, ICE3121	
Course Objectives	**:**	This topic describes various procedures of image enhancement, image segmentation and image compression. This depicts removal of noise using a variety of filtering techniques in both the spatial and frequency domain. This also demonstrates an understanding of spatial resampling, linear spatial transforms, and image analysis techniques to imagery in order to detect structures such as edges. Morphological filtering techniques to clean up and cluster such regions for further analysis presented in the course.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-LPO Mapping**
		CLO-1: Define digital image space and frequency domain	**PLO-1**
		CLO-2: Apply different types of filters on digital image to enhance the quality of an image	**PLO-2, PLO-5**
		CLO-3: Analyze images morphologically and compare different compression techniques	**PLO-4**
		CLO-4: Detect the edges of an image required for feature extraction	**PLO-5**

Course Contents

Section – A

Introduction to Digital Image Processing: Digital image processing, The Origins of Digital Image Processing, Examples of Fields that Use Digital Image Processing, Fundamental Steps of Digital Image Processing. Components of Image Processing System

Digital Image Fundamentals: Elements of visual Perception, Image representation and modeling, Image sampling and quantization, Basic Relationships between Pixels, Linear and Nonlinear operators.

Image Enhancement in the Spatial Domain & Frequency domain: Background, Basic gray level transformation, Histogram processing, Basics of spatial filtering, Smoothing and Sharpening Spatial filters, Smoothing and Sharpening Frequency-Domain filters.

Color Models: Properties of light, Intuitive color concepts, RGB color model, YIQ color model, CMY color model, HSV color model, Conversion between HSV and RGB models, Color selection and application.

Section – B

Introduction to Image Transform: Basic properties of frequency domain and Fourier transform, Basic concepts of filtering in the frequency domain, Correspondence between filtering in the spatial and frequency domain, Walsh-Hadamard transform and other image transforms.

Image Restoration: Image observation models, noise models, Estimation of noise parameters, Restoration in the presence of noise, Periodic noise reduction by frequency domain filtering, Inverse and Wiener filtering.

Image Segmentation: Spatial feature extraction, Thresholding, Image segmentation, Edge detection, Boundary extraction and Region representation.

Image Compression: Data redundancy and compression ratio, Fidelity criteria, General model of Image compression, Huffman coding, Run-length coding, Basic principle of predictive technique, Feedback versus feed forward prediction, Transform coding.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included various procedures of image enhancement, image segmentation, image compression, different types of filters that apply on digital image to enhance the quality in both the spatial and frequency domain of an image and edges detection of an image required for feature extraction. The *paper-and-pencil* exercises included classwork and homework assignments in using various algorithms to solve simple and complex problems.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3		√	√	√
CLO4		√	√	√

Text Books:

1. Anil K. Jain : Fundamentals of Digital Image Processing
2. Rafael C. Gonzalez : Digital Image Processing

Reference Books:

3. Michael E. Mortson : Mathematics for Computer Graphics Application

ICE3212: Digital Image Processing Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Lab Objectives: The objective of the lab is to provide the student with an understanding of the formation of an Image, to know the properties of different types of image. Additionally, to understand different types of transformation of images and learn and analyze their effects. Additional objective of course is to analyze the effects of different noises on images and perform different types of noise elimination technique. Finally, student will learn on filtering effect on degraded images.

ICE3221: Digital Communication
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	**ICE2121**	
Course Objectives	**:**	The objective of this course is to provide the fundamental knowledge about the building blocks of digital communication system. The student will learn to identify the functions of different components of a digital communication system. The understanding and analyzing the signal flow in a digital communication system will be discussed in broader sense. Additionally, the analyze of error performance of a digital communication system over various modulation techniques and waveform coding techniques in presence of noise and other interferences will also be covered to good extend.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Identify the fundamental limitations in data rate and transmission quality in different communication systems.	**PLO-2.**
		CLO-2: Define some digital modulation techniques and utilize the concepts for communication.	**PLO-1.**
		CLO-3: Formulate the power spectra, bandwidth efficiency, spread spectrum modulation.	**PLO-2.**
		CLO-4: Describe and analyze the sampling theorem, reconstruction, signal distortion, SNR, quantization etc.	**PLO-2, PLO-4.**
		CLO-5: Express and apply the power spectra analysis of discrete signal for data transmission.	**PLO-5.**
		CLO-6: Analyze error control coding to achieve error detection and correction in digital transmission systems.	**PLO-2, PLO-4.**
		CLO-7: Design and develop digital communication system through simulation by incorporating digital modulation schemes and error detection and correction schemes.	**PLO-3, PLO-4, PLO-8.**
		CLO-8: Examine the impact and the performance of different digital communication schemes through simulation works in laboratory.	**PLO-7.**

Course Contents

Section – A

Introduction: Sources and signals, Basic signal processing operation in digital communication, Channels for digital communication.

Limits on Performance: Uncertainty, Information, and Entropy, Source Coding Theorem, Discrete Memoryless Channels, Mutual Information, Channel Capacity, Channel Coding Theorem, Channel Capacity Theorem.

Detection and Estimation: Model of digital communication system, Gram-Schmidt orthogonalization procedure, Geometric interpretation of signal, Detection of signals in noise, Probability of error, Correlation receiver, Matched filter receiver, Estimation: Concept and criteria, Maximum Likelihood Estimation, Weiner filters, Adaptive filters, Linear prediction.

Error Control Coding: Rationale for coding and types of codes, Discrete memory-less channels, Linear block codes, Cyclic codes, Maximum likelihood decoding of convolution codes, Distance properties of convolution codes, Trellis codes.

Section – B

Digital Modulation Techniques: Digital modulation, Factors that influence the choice of digital modulation, Phase modulation, Pulse modulation: Types, PWM, PPM, Linear modulation: BPSK, DPSK, QPSK, $\pi/4$ QPSK, Offset QPSK, QAM; M-ary modulation techniques, Power spectrum, Bandwidth efficiency.

Spread-Spectrum Modulation: Psedonoise Sequence, a notion of Spread spectrum, Direct-Sequence Spread Coherent Binary Phase Shift Keying, Signal-Space Dimensionality and Processing Gain, Frequency-Hop Spread Spectrum.

Waveform Coding Techniques: Sampling theorem, Reconstruction of a message process from its samples, Signal distortion in sampling, PAM, PCM, Channel noise, Quantization noise, SNR, Robust quantization.

Baseband Shaping for Data Transmission: Power spectra of discrete PAM signals, Inter-symbol interference, Nyquist criterion, Correlation coding, Eye pattern, Baseband M-ary PAM systems, Adaptive equalization for data transmission.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included a fascinating look into the fundamentals of digital communication system, different components of a digital communication system, analysis of the signal flow to observe the error performance of a digital communication system over various modulation and waveform coding techniques in presence of noise and interferences. The *paper-and-pencil* exercises included class work and homework assignments in using various algorithms to solve simple and complex problems.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class Test 1 & 2 /Quizzes	Class Test 3 & 4 /Quizzes	Class Attendance	Final Exam
CLO1	√	√	√	√
CLO2	√	√	√	√
CLO3	√	√	√	√
CLO4	√		√	√
CLO5	√		√	√
CLO6		√	√	√
CLO7		√	√	√

Text Books:

1. S Haykin : Digital Communication Systems

Reference Books:

2. Kennedy-Davice : Electronic Communication Syatems
3. Theodore S. Rappaport : Wireless Communications: Principles & Practice

ICE3222: Digital Communication Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Lab Objectives: The objective of this laboratory should be able to implements different types of digital communication technique with their different types of communication kits. This implementation works based on the theory classes.

ICE3231: Telecommunication Engineering
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	None
Course Objectives	**:**	This course is designed to make the students understand the fundamentals of switching and networking principles used in telecommunication systems. They will understand the working principle and design of early automatic switching systems such as Strowger and crossbar switching as well as the concepts of telephone networks. They will also be able to learn the basic operations of electronic switching systems and resource sharing by multiplexing, to understand the computer controlled switching

		systems and to know the concepts of traffic engineering such as GoS, QoS and performance analysis based on queuing theory.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Identify the fundamentals of switching and networking principles used in telecommunication systems.	**PLO-1**
		CLO-2: Explain the working principle of automatic switching systems such as Strowger and crossbar switching.	**PLO-1**
		CLO-3: Analyze the traffic requirements and design the switching system accordingly.	**PLO-2, PLO-3**
		CLO-4: Develop concepts of various aspects of telephone networks such as switching hierarchy & routing, transmission, numbering & charging plans and signaling techniques.	**PLO-1**
		CLO-5: Identify the basic principles of the modern electronic switching system.	**PLO-1**
		CLO-6: Explain and design multistage networks.	**PLO-1, PLO-2**
		CLO-7: Analyze and evaluate fundamental telecommunication traffic models.	**PLO-2, PLO-3, PLO-4**
		CLO-8: Apply the principles of queuing theory in evaluating the performance of telecommunication networks.	**PLO-4, PLO-5**

Course Contents

Section – A

Introduction: Simple telephone communication, Basic switching system, Transmission bridge, Subscriber line circuit, CB cord circuit, Junction working.

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 terminology, Crossbar exchange organization.

Telephone Networks: Subscriber loop systems, Switching hierarchy and routing, Transmission plan, Transmission systems, Numbering plan, Charging plan, Signaling techniques, In-channel signaling, Common channel signaling.

Section – B

Electronic Space Division Switching: Stored program control, Centralized SPC, Distributed SPC, Software architecture, Application software, Two-stage network, Three-stage network.

Electronic Time Division Switching: Concept of TDM, Basic time division space switching, Basic time division time switching, Time multiplexed space switching.

Computer Controlled Switching System: Introduction, Call processing, Basic steps to process a call, State transition diagram, Switching system organization, Popular digital switching systems.

Traffic Engineering: Network traffic load and parameters, Grade of services and blocking probability, Modeling switching systems, Incoming traffic and service time characterization, Blocking models and loss estimates.

Teaching-Learning Strategies:
Teaching-Learning strategies for this course consist of *lectures* and *interactive classroom discussions* well as *paper-and-pencil* exercises. The lecture materials cover the fundamentals of switching and networking principles used in telecommunication systems, working principle and design of automatic switching systems (i.e., Strowger and Crossbar), various aspects of telephone networks including switching hierarchy & routing, transmission, numbering & charging plans, and signaling techniques, principles of modern electronic switching systems, design of multistage switching, analysis of telecommunication traffic models, and application of queuing theory to evaluate the performance of telecommunication neworks with the aid of multimedia presentations and online resources. The *paper-and-pencil* exercises include classworks for *problem-based learning* and homework assignments for *open-ended problem solving.*

Assessment and Evaluation Strategy:
Students will be assessed on basis of their overall performance in the final examination, class tests/assignments, and class attendance/participation. Final grade will be evaluated based on:

- **Four class tests/assignments** due in different times of the semester **(20%)**
- **Class attendance/participation (10%)**
- **A final examination (70%)**

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test/Assignment 1 & 2	**Class Test/Assignment 3 & 4**	**Class Participation/Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3	√		√	√
CLO4	√		√	√
CLO5		√	√	√
CLO6		√	√	√
CLO7		√	√	√
CLO8		√	√	√

Text Books:

1. ThiagrajanViswanathan : Telecommunication Switching Systems and Networks.
2. P. Gnanasivam : Telecommunication Switching and Networks.

Reference Books:

3. M. T. Hills : Telecommunication Switching Principle.
4. J.C. Bellamy : Digital Telephony.

ICE3241: Optical Fiber Communication
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hour

Prerequisite Courses	**:**	ICE 2121	
Course Objectives	**:**	The main objective of the course is to understand the basic light propagation principle in optical fiber and learn about different types of fibers as well as different propagating modes in fiber. The objective of the course also focuses on different kinds of optical losses, dispersions, sources and detectors. Optical network and characteristic will also be added here.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Define the concept of optical fiber communication and the basic principle of light propagation in optical fiber.	**PLO-1**
		CLO-2: Explain different types of optical fiber and modes. Characterized and solve the problem to justify the characteristics.	**PLO-2, PLO-3,PLO-4**
		CLO-3: Demonstrate the understanding of transmission characteristics such as attenuation, dispersion, different losses etc. to realize the propagation.	**PLO-2 PLO-4**
		CLO-4: Compare the characteristics of different optical sources and detectors to determine the appropriate tools for communication.	**PLO-5**
		CLO-5: Demonstrate the applications of an optical fiber as an amplifier, sensor and network device.	**PLO-2, PLO-4**

Course Contents

Section – A

Concept of Optical Fiber Communication: Introduction, why OFC is required, Advantages, Disadvantages of OFC, General system, Types of Optical fiber, Light propagation principle in optical fiber, Optical fiber cables, Optical windows, Applications of Optical Fiber Communication.

Optical Fiber Waveguides: Introduction, Ray theory transmission, Electromagnetic mode theory for optical propagation, Cylindrical fiber: Step index fibers, Graded index fibers; Single mode fibers, Multimode fibers.

Transmission Characteristics of Optical Fibers: Introduction, Attenuation, Absorption, Scattering loses, Bending loss, Dispersion: Intra model dispersion, Inter model dispersion, Polarization.

Optical Sources and Detectors: Introduction, LEDs, LASER Diodes, Photo detectors, Photodiodes: Avalanche photodiodes and p–i–n photodiode, Response Time, Heterojunctions, Comparison of Photo Detectors.

Section – B

Optical fiber connection: Introduction, Fiber alignment and joint loss, Multimode fiber joints, Single mode fiber joints, Fiber splices, Fiber connectors and couplers.

Optical amplifier: Introduction, Optical amplifiers, Basic applications and types, Semiconductor optical amplifiers, Erbium doped fiber amplifiers (EDFA).

Optical Sensor: Introduction, Types and operation, Sensors using single mode fiber, Fiber optic gyroscopes, Chemical sensors, applications.

Optical Networks: Introduction, key network elements, Types, Synchronous optical network (SONET), WDM network, Wavelength routed networks, Optical CDMA.

Teaching-Learning Strategies:
This course will deliver with lectures, demonstration, paper-and-pencil exercise in classroom and homework assignments. For effective learning, teacher-student interaction will be allowed in the classroom. The course materials offer basic and advance concept of optical fiber communication for helping student to understand the contents and solving the problems.

Assessment and Evaluation Strategy:
The assessment strategy for a student will be overall performance in all the final exams, class tests, assignments, and class participation. Written examination will cover both on the theory and the exercises. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class Test 1 & 2 /Quizzes	Class Test 3 & 4 /Quizzes	Class Attendance	Final Exam
CLO1	√		√	√
CLO2	√		√	√
CLO3	√	√	√	√
CLO4		√	√	√
CLO5		√	√	√

Text Books:

1. J. M. Senior : Optical Fiber Communications, Pearson Education. 3rd Impression, 2007
2. Palaise : Fiber Optic Communication, 4th edition
3. Gerd Keiser : Optical Fiber Communication, 4th Ed., MGH, 2008

Reference Books:

4. Arthur N. Chester, S. Martellucci, A.M. Verga Scheggi : Optical Fiber Sensors
5. V.S. Bagad. : Optical fiber communication
6. Govind P. Agrawal : Fiber-Optic Communication Systems
7. D. Roddy and Coolen : Electronic Communications

ICE3242: Optical Fiber Communication Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Lab Objectives: Students will do optical fiber communication based experiments by hand with kit. There are some experiments will also do by simulation. By doing this course, students will be able to gather practical knowledge about optical fiber communication.

CSE3291: Software Engineering
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	CSE1291, ICE2231	
Course Objectives	**:**	Basic concept of software engineering will be delivered to the students so that they can understand the characteristics, different components and phases of life cycle of the software engineering. Students will be able to know the different process modes and the analysis techniques for software development. The design concept of software based on analysis will also be gathered from this course.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Explain the key principles of software engineering.	**PLO-2**
		CLO-2: Explain and compare the pros and cons of major software development processes.	**PLO-2, PLO-3**
		CLO-3: Elicit and gather requirements to write up a requirement document.	**PLO-4**
		CLO-4: Describe software design architectures and apply appropriate software designs approach to a project.	**PLO-2**
		CLO-5: Asses software quality and reliability according to software quality standard.	**PLO-5**
		CLO-6: Compare and contrast different testing methods, including black box and white box approaches.	**PLO-4**

		CLO-7: Discuss the different aspects of project management and work in a team-based project for software development.	**PLO-9, PLO-10, PLO-12**
		CLO-8: Analyze and create a plan for software risk management.	**PLO-2, PLO-11**

Course Contents

Section A

Software Concept, Software Development Life Cycle: Role of Software, Software Characteristics, Software Components, Generic View of Software Engineering, Components of the Development Frame Work, Phases of SDLC,

Process Models: Software Process, Software Process Models, Linear Sequential Model, Prototyping Models, The Waterfall Model, RAD, Incremental Model, Spiral Model, Agility and Agile Process Model.

Software Requirement Understanding and Analysis: Requirement Engineering, Eliciting Requirement, Building the Requirement Model, Requirement Analysis, Scenario-Based Modeling, UML models, Data Modeling, Class-Based Modeling, Requirement Modeling for WebApps.

Software Design: Software Design Concept, The Design Model, Concept of Architectural Design, Component Level Designing: An Object-Oriented View, Designing Class-Based Component, Component-Level Design for WebApps, Designing Traditional Components, Component-Based Development, Concept of User Interface Design, Concept of WebApps Design.

Section B

Software Quality Management: Concept of Quality, Quality Factors, Achieving Software Quality, Elements of Software Quality Assurance, SQA Tasks, Goals, and Metrics, Formal Approaches to SQA. Statistical Software Quality Assurance, Software Reliability, The ISO 9000 Quality Standards, The SQA Plan.

Software Testing and Maintenance: Different Testing Philosophy and Methods, Software Testing Fundamentals, Internal and External Views of Testing, White-Box Testing, Black-Box Testing, Model-Based Testing, Patterns for Software Testing, Testing Object-Oriented Applications, Testing Web Applications

Software Projects Management: Project Management Concepts: People, Product and Process. Product Metrics, Process and Project Metrics, Estimation for Software Project.

Analysis Principle and Risk Management: Analysis Principle: Information domain, Modeling, Partitioning; Risk Management: Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation, Monitoring, and Management, The RMMM Plan.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included a fascinating look into the basic concept of software engineering, different process modes and the analysis techniques for software development, design concept of software, software quality management, project management, and testing and maintenance process. The *paper-and-pencil* exercises included classwork and homework assignments in using various case studies.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3	√		√	√
CLO4	√		√	√
CLO5		√	√	√
CLO6		√	√	√
CLO7		√	√	√
CLO8		√	√	√

Text Books:

1. R. S. Pressman : Software Engineering-A Practitioner's Approach

Reference Books:

2. K. K. Aggarwal & Yogesh Singh : Software Engineering
3. Rod Stephens : Beginning Software Engineering

Part-IV (Odd Semester)

ICE4111: Artificial Intelligence and Neural Computing
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	MATH2221, STAT 2111	
Course Objectives	**:**	This course provides an introduction to the fundamentals of artificial intelligence and neural networks, fuzzy logic fundamentals, program related algorithms. It contains a theory component about the concepts and principles that underlie modern AI algorithms, and a practice component to relate theoretical principles with practical implementation. The objective of the course also focuses on Game playing, Natural language processing, Expert system, Genetic algorithm and Robotics.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Discuss the core concepts and algorithms of advanced AI, including informed searching,, logic, uncertain knowledge and reasoning, dynamic Bayesian networks, graphical models, decision making, statistical learning, reinforcement learning, deep learning, natural language processing, robotics, and so on.	**PLO-1, PLO-2**
		CLO-2: Apply the basic principles, models and algorithms of AI to recognize, model, and solve problems in the analysis and design of information systems.	**PLO-1, PLO-5**
		CLO-3: Compare AI with human intelligence and traditional information processing, and discuss its strengths and limitations and its application to complex and human-centered problems.	**PLO-4, PLO-6, PLO-8**
		CLO-4: Select Artificial Intelligence techniques for problem solving.	**PLO-1, PLO-5**
		CLO-5: Recognize the biological and mathematical foundations of neural network models.	**PLO-2**
		CLO-6: Explain the different types of neural networks and different types of learning models.	**PLO-2**
		CLO-7: Apply back propagation for multilayer neural nets.	**PLO-1**

Course Contents

Section-A

Introduction: Nature and goals of AI, Background of AI, Comparison of conventional and neural computation, AI and related fields.

Knowledge Acquisition and Representation: Definition and Importance of Knowledge, Knowledge based systems, Representation of knowledge, Knowledge acquisition, Associative Networks, Conceptual graph, Frame Structures.

Overview of AI Programming Language: Importance of prolog, Basic elements of prolog, Relationship of clauses, predicates, relations and objects, Turbo Prolog Data Types, Bound and free variable, Backtracking, Rules of prolog, Input and Output Predicates.

Reasoning and Problem Solving: Reasoning with uncertainty, Probabilistic reasoning, searching of state space, Breadth first, Depth-first and related types of search, Brief revision of propositional and predicate calculus, Well-formed formula (Wff), Inference rules, Resolution.

Section-B

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, Generalization, Cross-validation, Network pruning technique.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included all the basic and advanced theory about AI and Neural Network, several learning algorithms of machine perception and heuristic knowledge, different types of knowledge base system used in AI such as Robotics, Expert system and Fuzzy logic. The *paper-and-pencil* exercises included classwork and homework assignments in using various algorithms and mathematics to solve simple and complex problems of Neural System.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class Test 1 & 2 /Quizzes	Class Test 3 & 4 /Quizzes	Class Attendance	Final Exam
CLO1	√		√	√
CLO2	√		√	√
CLO3	√		√	√
CLO4	√		√	√
CLO5		√	√	√
CLO6		√	√	√
CLO7		√	√	√

Text Books:

1. Simon Haykin : Neural Networks A Comprehensive Foundation
2. Dan W. Patterson : Introduction to Artificial Intelligence and Expert System
3. S. Russel and P. Norving : Artificial Intelligence A Modern Approach
4. Carl Townsend : Introduction to Turbo Prolog

Reference Books:

5. Generserth, Michael R, and Nilsson Nills : Logical Fundamentals of AI.
6. Ivan Bratko : Prolog Programming for AI.

ICE4121: Computer Architecture and Microprocessor
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	EEE2191, ICE2211	
Course Objectives	**:**	This course is designed to gain the fundamental concepts of underlying modern computer organization and architecture. The student will familiarize about hardware design including logic design, basic structure and behavior of the various functional modules of the computer and how they interact to provide the processing needs of the user. It will cover ALU structure and functions, Control Unit design, memory system organization and architecture, Processor basic and system organization, and Parallel Processing. It will also cover Microprocessor which is includes its Evolution, Organization and Application.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Describe the basic design of computer logic, through simple combinational and sequential logic circuits.	**PLO-2**
		CLO-2: Discuss computer arithmetic and logical operation systems.	**PLO-1, PLO-2**
		CLO-3: Demonstrate the design of control unit based on hardware and micro programmed control.	**PLO-1, PLO-11**
		CLO-4: State different types of memory, memory hierarchy and its impact on computer cost/performance.	**PLO-2**

		CLO-5: Analyze the architectural design and programming of the 8086 microprocessor.	**PLO-2**
		CLO-6: Assemble a simple computer with hardware design including instruction format, instruction set, addressing modes, bus structure, memory, Arithmetic/Logic unit.	**PLO-3, PLO-4**
		CLO-7: Define the principle of pipelining, the interdependencies between pipelines, and the different types of pipeline hazards.	**PLO-3, PLO-4**
		CLO-8: Compute the operation of the arithmetic unit including the algorithms & implementation of fixed-point and floating-point addition, subtraction, multiplication & division.	**PLO-2**

Course Contents

Section – A

Design Methodology: Introduction, Combinational circuits, Sequential circuits, the register level, Register-level components, Design method, the processor-level, Processor-level components, Design techniques.

Arithmetic Logic Unit: Fixed-point arithmetic, Addition, Subtraction, Multiplication and division, Processor Organization, Arithmetic Logic Unit, Design of Arithmetic Circuit, Design of Logic Circuit, Design of Arithmetic Logic Unit.

Control Design: Basic concepts of control unit, Hardwired control, GCD processor control unit, Multiplier control unit, CPU control unit, Micro-programmed control; Microinstruction.

Memory Organization: Memory devices and characteristics, RAM organization, Serial access memory; Virtual memory, Main-memory allocation, Segments and pages, High speed memories, Cache memory.

Section – B

Microprocessors: Evolution of microprocessors, Microprocessor organization, microprocessor applications, 8086 microprocessors, 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.

Teaching-Learning Strategies:

Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included a fascinating look into the architecture and organization of computer, different types of instruction set and addressing modes, and the architecture, generation and application of microprocessor. The *paper-and-pencil* exercises included classwork and homework assignments in using various algorithms to solve simple and complex problems.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3	√		√	√
CLO4	√		√	√
CLO5		√	√	√
CLO6		√	√	√
CLO7		√	√	√
CLO8			√	√

Text Books:

1. John P. Hayes **:** Computer Architecture and Organization
2. Morris Manno **:** Digital Logic and Computer Design

Reference Books:

3. Barry B. Brey **:** Microprocessor Hardware Interfacing and Application
4. P. Pal Choudhury **:** Computer Organization and Design.
5. M. Morris Manno **:** Computer System and Architecture

ICE4122: Computer Architecture and Microprocessor Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Lab Objectives: This course introduces the assembly language programming of 8086 microprocessors. It gives a practical training of interfacing the peripheral devices with the 8086 microprocessor. The main objective of this lab course is to introduce the basic concepts of 8086 microprocessor and to develop in students the assembly language programming skills. It is also gain knowledge on interfacing of different peripherals to microprocessor.

ICE 4131: Wireless Communication
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	ICE 2211, ICE 3141	
Course Objectives	**:**	Wireless Personal Communications, one of the fastest growing fields in the world. Technical concepts which are at the core of design, implementation, research and invention of wireless communication systems are presented in this course.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Analyze the radio channel characteristics.	**PLO-2**
		CLO-1: Explain the different techniques of multiuser system and channel capacity.	**PLO-5, PLO-5**
		CLO-1: Describe the operational principle of multicarrier modulation.	**PLO-5**
		CLO-4: Describe the performance of the most common digital modulation techniques used in wireless communications.	**PLO-1, PLO-2, PLO-3**
		CLO-5: Analyze bit error rate for fading channel and spectral occupancy in wireless communications.	**PLO-10**
		CLO-6: Identify and solve the issues such as transmitter and receiver complexity as well as modulation demodulation implementation.	**PLO-7**
		CLO-7: Explain Equalization and Diversity techniques which are commonly used in wireless communications for performance improvement.	**PLO-8**
		CLO-8: Describe Spread Spectrum modulation, RAKE receiver and multi-user detection etc. are typically used in wireless communications for performance improvement.	**PLO-11, PLO-12**

Course Contents

Section - A

Introduction: History, Wireless vision, Technical issues, Current wireless systems, Wireless spectrum, Standards.

Statistical Multipath Channel: Transmit and receive signal models, Time varying channel impulse response, Narrow band fading model, Wideband fading models, Discrete time model. Space-time channel model.

Multiuser Systems: Multiuser channels: The uplink and downlink, Multiple access: Frequency-Division Multiple Access (FDMA), Time-Division Multiple Access (TDMA), Code-Division Multiple Access (CDMA), Space-division, Hybrid techniques, Random access: Pure ALOHA, Slotted ALOHA, Carrier sense multiple access, Downlink (broadcast)

channel capacity: Channel model, Capacity in AWGN, Uplink (multiple access) channel capacity: Capacity in AWGN.

Multi Carrier Modulation: Data transmission using multi carrier, MCM with overlapping sub channel, Sub carrier fading mitigation, cyclic prefix, OFDM, Matrix reorientation of OFDM, Challenges in MCM.

Section – B

Digital Modulation Performance: SNR and bit/symbol energy, Error probability in AWGN channel for BPSK, QPSK, MPSK, MQAM, FSK, CPFSK and differential modulation; Alternate Q-function; Performance in fading channel, Outage probability, Average probability of error, Combined outage and average error probability, Doppler spread, ISI.

Diversity: Receiver diversity system model, Selection combining, Threshold combining, MRC, EGC, Transmit diversity, Alamouti scheme. Diversity analysis.

Equalization: Equalizer noise enhancement; Equalizer types; ISI free transmission; ZF and MMSE equalizer; MLSE, Decision feedback equalizer; Training and tracking for adaptive equalization.

Spread Spectrum: SS principle, DSSS system model, Spreading codes, System model, Spreading codes, Synchronization, RAKE receiver, FHSS, Spreading code for Multi-user DSSS, DL & UL channel, Multi-user detection, MC-CDMA, Multiuse FHSS.

Teaching-Learning Strategies:
Teaching-Learning strategies for this course consist of *lectures* and *interactive classroom discussions* well as *paper-and-pencil* exercises. The lecture materials cover the analysis of radio channel characteristics, different techniques of multiuser system, channel capacity, operational principle of multicarrier communication, common digital modulation techniques used in wireless communication, analysis of bit error rate for fading channels, spectral occupancy, transmitter and receiver complexity, equalization and diversity techniques, spread spectrum modulation, RAKE receiver, and multi-user detection techniques with the aid of multimedia presentations and online resources. The *paper-and-pencil* exercises include classworks for *problem-based learning* and homework assignments for *open-ended problem solving.*

Assessment and Evaluation Strategy:
Students will be assessed on basis of their overall performance in the final examination, class tests/assignments, and class attendance/participation. Final grade will be evaluated based on:

- **Four class tests/assignments** due in different times of the semester **(20%)**
- **Class attendance/participation (10%)**
- **A final examination (70%)**

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test/Assignment 1 & 2	**Class Test/Assignment 3 & 4**	**Class Participation/Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3	√		√	√

CLO4	√		√	√
CLO5		√	√	√
CLO6		√	√	√
CLO7		√	√	√
CLO8		√	√	√

Text Books:

1. AJ Goldsmith : Wireless Communication
2. T.S Rappaport : Wireless Communication: Principles and Practices

Reference Books:

3. A Molisch : Wireless Communication
4. Pahlavan and Krishnamurty : Principles of Wireless Network

ICE4132: Wireless Communication Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Lab Objectives: The objectives of this lab are to design a wireless communication system and to see the effect of different modulation techniques. Students will also get the idea about various communication channels, different coding and decoding techniques as well as system performance.

ICE4141: Database Management Systems
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	CSE 1291	
Course Objectives	**:**	After successfully completing this course, students will be able to design and implement database management applications, organize different types of data in database, basic architecture of database diagrams and relationship model. They will as well be able to implement database management systems using Structured Query Language (SQL), handle transactions, maintain concurrency control, ensure recovery of data, and finally to use real life practical database management applications.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Design and implement database management system applications.	**PLO-1, PLO-2, PLO-3**
		CLO-2: Identify different types of data in a database.	**PLO-1**
		CLO-3: Explain basic architecture of database diagrams and relationship models.	**PLO-1, PLO-2**
		CLO-4: Describe integrity and security issues of database management systems.	**PLO-1, PLO-2**
		CLO-5: Explain the basics of Structured Query Language (SQL) for handling databases.	**PLO-1, PLO-2**

		CLO-6: Illustrate the concepts of transaction management, concurrency control and recovery systems for managing real life practical database applications.	**PLO-4, PLO-5, PLO-6**

Course Contents

Section – A

Introduction: Overview, File systems versus database systems, View of data, Data models, Database users and administrators, Transaction management, Database system structure, Applications.

The Entity-Relationship Model: Basic concept, Design issue, Mapping constraints, Keys, E-R diagram, Weakentity sets, Extended E-R features, Design of an E-R database schema, Reduction of an E-R schema to table.

Relational Database System: Structure of relational databases, Relational algebra, Extended relational-algebra operations, Modification of the database, Views, Normalization.

Integrity and Security: Domain constraints, Referential integrity, Assertions, Triggers, Security and authorization, Authorization in SQL, Encryption and authentication.

Section – B

Structured Query Language: Data definition, Basic structure of SQL query, Set operation, Nested queries, Aggregate operations, Null values, Complex queries, Embedded SQL, Cursors, Dynamic SQL, ODBC and JDBC, Active database.

Transaction: ACID properties, Transaction state diagram, Implementation of atomicity and durability, Concurrent executions, Serializability, Recoverability, Implementation in isolation, Transaction definition in SQL, Testing for serializability.

Concurrency Control: Lock-based protocols, Timestamp-based protocols, Multiplegranularity, Deadlock handling, Insert and delete operations.

Recovery System: Failure classification, Storage structure, Recovery and atomicity, Recovery with concurrent transactions.

Teaching-Learning Strategies:
Teaching-Learning strategies for this course consist of *lectures* and *interactive classroom discussions* well as *paper-and-pencil* exercises. The lecture materials cover the design and implementation of database management system applications, various types of data, basic architecture of database diagrams and relationship models, integrity and security issues of database management systems, basics of Structured Query Language (SQL) for handling databases, and the concepts of transaction management, concurrency control and recovery systems for managing real-life practical database applications with the aid of multimedia presentations and online resources. The *paper-and-pencil* exercises include classworks for *problem-based learning* and homework assignments for *open-ended problem solving.*

Assessment and Evaluation Strategy:
Students will be assessed on basis of their overall performance in the final examination, class tests/assignments, and class attendance/participation. Final grade will be evaluated based on:

- **Four class tests/assignments** due in different times of the semester **(20%)**
- **Class attendance/participation (10%)**
- **A final examination (70%)**

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test/Assignment 1 & 2	**Class Test/Assignment 3 & 4**	**Class Participation/Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3	√		√	√
CLO4		√	√	√
CLO5		√	√	√
CLO6		√	√	√

Text Books:

1. A. Silberschatz, H. F. Korth and S.Sudarshan : Database Systems Concept, Fifth Edition.

Reference Books:

2. Joseph A. Vasta : Understanding Database Management Systems.
3. James Martin : Principles of Database Management.
4. Jeffrey D. Ullman : Principles of Database Systems.

ICE4142: Database Management Systems Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Lab Objectives: The objective of this lab is to provide the students with the practical experiences on the concepts of Database Management Systems based on ICE4141: Database Management System. They will be able to design relational databases and implement them using Structured Query Language (SQL), to perform queries to retrieve data, to manipulate data, to enforce data-integrity constraints, to create and execute stored procedure and to create triggers.

ICE4151: Information System Analysis and Design
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	None
Course Objectives	**:**	The main objective of this course is to provide students with a broad perspective on system analysis and design. It provides an overview of principles, methods and techniques of system development life

		cycle (SDLC). Introduce the student in detail to each phase of the SDLC. The course also deals with the concepts, skills, methodologies, techniques, tools, and perspectives essential for systems analysts.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Compare and evaluate alternative methodologies used in developing information systems.	**PLO-2, PLO-4**
		CLO-2: Identify and describe key aspects of the systems development process, from initial investigation through analysis and design to implementation and maintenance.	**PLO-2, PLO-3**
		CLO-3: Recognize and employ interpersonal and technical skills of the systems analyst with respect to different phases of a system development life cycle.	**PLO-9, PLO-10**
		CLO-4: Recognize and apply various strategies, tools and modelling techniques related to different approaches to systems development to the analysis and design of a business information system.	**PLO-2, PLO-5**
		CLO-5: Analyze the feasibility of an information system.	**PLO-11**
		CLO-6: Analyze the cost/benefit of an information system.	**PLO-11**

Course Contents

Section - A

Introduction: Definition of systems concept; Characteristics of a system: Organization, Interaction, Interdependence, Integration, Central objective; Elements of a system: Outputs and inputs, Processor (s), Control, Feedback, Environment, Boundaries and interface; Types of systems: Physical or abstract systems, Open or closed systems, Man-made information systems; The major information systems.

The System Development Life Cycle: The system development life cycle; Feasibility study; Analysis; Design; Implementation; Post-implementation and maintenance; Prototyping.

The Role of the Systems Analyst: Analyst and User, Academic and personal qualifications; The analyst /user interface: Behavioral issues, Conflict resolution; The MIS organization.

Systems Analysis: Bases for planning in systems analysis: Dimension of planning; Initial investigation: Needs identification, determining the user' information requirements; Fact-finding.

Section – B

Information Gathering: Categories of Information; Information gathering tools: Review of literature, Procedures and forms, On-site observation, Interviews and questionnaires; Types of interviews and questionnaires.

The Tools of Structured Analysis: Structured analysis techniques; The tools of structured analysis: The Date Flow Diagram (DFD), Data dictionary, Decision tree, Structured English, Decision tables; Pros and cons of each tool.

Feasibility Study: System performance definition; Feasibility Study: Feasibility Considerations, Steps in feasibility analysis, Feasibility report, Oral presentation.

Cost/Benefit Analysis: Data analysis; Cost/benefit analysis: Cost and benefit categories, Procedure for cost/benefit determination, Classification of costs and benefits, Cost/Benefit Evaluation Methods.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included a fascinating look into the fundamentals of information system analysis and design specifying in detail what a system should do and how the components of the system should be implemented and work together. The lecture materials also incorporate the theoretical concepts, skills, methodologies, techniques, tools, and perspectives essential for systems analysts. The paper-and-pencil exercises included classwork and homework assignments in using various algorithms to solve simple and complex problems.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√	√	√	√
CLO3	√	√	√	√
CLO4	√		√	√
CLO5	√	√	√	√
CLO6		√	√	√

Text Books:
1. E. M. Award : System Analysis and design

Reference Books:
2. P. Edward : System Analysis and design

3. J. G-Burch Jr. F.R. : Information System
4. G. Scott : Principle of Management Information System
5. A. Daniels and J Yeates : Basic System Analysis

Part-IV (Even Semester)

ICE 4211: Computer Networks
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	ICE1121, ICE 2221, ICE 3121	
Course Objectives	**:**	This course attempts to provide a unified overview of data and computer communications. It emphasizes the basic principles and topics of fundamental importance concerning the technology and architecture of this field.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Explain three general areas: data communications, networking and protocols.	**PLO-1, PLO-2, PLO-3**
		CLO-2: Analyze the transmission of signals in a reliable and efficient manner.	**PLO-7**
		CLO-3: Define the transmission media, signal encoding, switching, interfacing, data link control and multiplexing for a data communication model.	**PLO-8, PLO-9, PLO-10**
		CLO-4: Demonstrate both the architectural principles and the mechanisms required for the exchange of data among computers, workstations, servers and other data processing devices.	**PLO-10, PLO-11**
		CLO-5: Summarize the ideas about network reference models such as TCP/IP and OSI.	**PLO-1, PLO-2**
		CLO-6: Illustrate the concepts of physical layer, data link layer, medium access layer etc. to establish LANs and WANs etc.	**PLO-12**
		CLO-7: Design and implement network layer protocols within a simulated networking environment.	**PLO-3**
		CLO-8: Analyses and compare a number of network, transport, and application layer protocols.	**PLO-2**

Course Contents

Section – A

Introduction: Introduction to Computer Networks, Network Architecture, Application of Computer Network, Protocols, Circuit Switching and Packet Switching Technique, Network Reference Model: Layer Task, the OSI Model, Layer in the OSI Model, TCP/IP Protocol.

Physical Layer: The Theoretical Basis for Data Communication, Guided Transmission Media and Unguided Transmission Media, Narrowband ISDN: Basic Concept, ISDN Standard, ISDN channel & Protocol Architecture and Broadband ISDN, ATM and Frame Relay.

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 Sublayer: Channel allocation problem, multiple access protocols, IEEE standards for LANs and MANs, Bridges, and High Speed LANs.

Section – B

Network Layer Design: Network layer design issues, Routing algorithms, Congestion control algorithms, IP, IP addresses.

Network Layer and Routing Protocols: Network layer protocols; ARP, IPv4, ICMP, IPv6, Routing protocols; OSPF and BGP.

Transport Layer: Process-to-process delivery, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Congestion control.

Application Layer: Client-Server Model, Domain Name System (DNS), Electronic mail (SMTP) and File Transfer (FTP), HTTP and WWW.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included a fascinating look into the fundamental of different type's wire and wireless networks, established of computer networks using static and dynamic IP address, and discuss of different layer in open system interconnection (OSI) model. The *paper-and-pencil* exercises included classwork and homework assignments in using various algorithms to solve simple and complex problems.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3	√		√	√
CLO4	√		√	√
CLO5		√	√	√
CLO6		√	√	√
CLO7		√	√	√
CLO8			√	√

Text Books:

1. B. Forouzan : Data Communication Networking
2. A. S. Tanenbaum : Computer Networks

Reference Books:

3. W. Stallings : Data and Computer Communications

ICE4212: Computer Networks Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Lab Objectives: The objective of this lab is to extend student knowledge in computer networking, concept of IP address and subnet, configure network using different routing protocol, and allow the student to gain expertise in designing of computer network.

ICE4221: Fundamentals of Cryptography
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	None	
Course Objectives	**:**	This course is design to provide a fundamental concept of cryptographic techniques. Introduce the basic algorithms for symmetric and asymmetric cryptography and their mathematical principles. This course will also address the confidentiality, key management, Digital signature and authentication as well as their applications.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Describe the fundamental concepts of computer security, Services and Mechanism.	**PLO-1, PLO-5, PLO-7, PLO-11**
		CLO-2: Analyze the popular secret key and public key cryptosystems algorithm.	**PLO-2, PLO-3**
		CLO-3: Describe the idea behind the finite fields and number theory in prospect of cryptography.	**PLO-4**
		CLO-4: Apply the public-key cryptosystem for encryption/decryption, digital signature and key exchange.	**PLO-5, PLO-10**

Course Contents

Section – A

Introduction of Classical Encryption Techniques: Computer Security concepts, The OSI security architecture, A model for network security, Symmetric cipher model, Substitution cipher and Transposition cipher.

DES & Number Theory: Block cipher principles, The Data Encryption Standard, The strength of DES, Differential and linear cryptanalysis, Modular arithmetic, Euclid's algorithm, Finite fields, Polynomial arithmetic.
AES & Block Cipher Operation: The Origins of AES, AES structure, AES Round function, AES key expansion, AES cipher, Avalanche Effect, multiple encryption and triple DES, Block cipher modes of operation, Stream ciphers and RC4.

Key Management and Distribution: Symmetric key distribution using symmetric encryption and asymmetric encryption, Distribution of public key, public key infrastructure.

Section – B

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, Elgamal cryptographic system, 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: Authentication protocols, Secure hash algorithm, HMAC, HMAC design objectives, Digital signature, Elgamal digital signature scheme, Schnorr digital signature scheme, Digital signature standard, Mutual authentication, One-way authentication, Digital signature standard.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *hands-on method*. These lecture will approach to achieve this as it engages students in real-world settings, which will inspire creativity of students and train them to adapt cryptographic solutions to emerging areas. The hands-on exercises tied with each cryptography topic to teach students both cryptographic algorithm and vulnerabilities.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√

CLO2	√	√	√	√
CLO3	√	√	√	√
CLO4		√	√	√

Text Books

1. William Stallings : Cryptography and Network Security

Reference Books

2. Bruce Schneier : Applied Cryptography
   : Security in Computing
3. Charles P. Pfleeger

ICE4222: Fundamentals of Cryptography Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Lab Objectives: The learning objective of this cryptography lab is to get familiar with the concepts of symmetric and asymmetric encryption and decryption algorithm implementation. After finishing the lab, students should be able to gain an experience on encryption algorithms, encryption modes and padding.

ICE4231: Information Theory and Coding
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	STAT1211, ICE3221	
Course Objectives	**:**	The objective of this course is to introduce the basic concept of information theory and coding for communication engineering. The course is designed with the entropy of random variables and the inequalities. The fundamental principles of source coding and data compression theorems are included. The student will gather knowledge about various coding schemes to solve the problems.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Describe the concept of information and the entropy of random variables.	**PLO-1, PLO-2**
		CLO-2: Define several inequalities of random variables to explain and estimate the entropy.	**PLO-2, PLO-4**
		CLO-3: Summarized different coding schemes.	**PLO-5**
		CLO-4: Choose the most suitable model for solving certain problem.	**PLO-2, PLO-5**
		CLO-5: Analyzed the channel to estimate the capacity.	**PLO-4**
		CLO-6: Demonstrate channel coding theorem to predict error in the communication system.	**PLO-2, PLO-4**

Course Contents

Section – A

Entropy, Relative Entropy: Entropy; Joint entropy and conditional entropy; Relative entropy and mutual information; Relationship between entropy and mutual information; Chain rules for entropy; Relative entropy

Mutual Information, Inequality: 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.

Section – B

Source Coding: Source code, nonsingular code, uniquely decodable code, prefix code, Kraft Inequality theorem, Extended Kraft Inequality theorem, Kraft inequality for uniquely decodable codes; Optimal codes; Bounds on the optimal code length.

Data Compression: McMillan's theorem; 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.

Teaching-Learning Strategies:
The teaching-learning strategy of this course will organize with lectures, demonstration, student participation in classroom and homework assignments. For effective learning, teacher-student interaction will be allowed in the classroom. The course materials offer basic and advance concept of information theory and coding for helping student to understand the contents and solving the problems.

Assessment and Evaluation Strategy:
The assessment strategy for a student will be overall performance in all the final exams, class tests, assignments, and class participation. Written examination covering both on the theory and the exercises. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class Test 1 & 2 /Quizzes	Class Test 3 & 4 /Quizzes	Class Attendance	Final Exam
CLO1	√		√	√
CLO2	√		√	√
CLO3	√	√	√	√
CLO4		√	√	√
CLO5		√	√	√
CLO6		√	√	√

Text Books:

1. TM Gover, JM Thomos : Elements of Information Theory

Reference Books:

2. Roberto Togneri and Christopher J.S. deSilva : Fundamentals of Information Theory and Coding Design

ICE4241: Web Engineering
75 Marks, 3 Credits, 3 Hours/week, Lectures: 39, Exam time: 3 hours

Prerequisite Courses	**:**	CSE1291, ICE2231	
Course Objectives	**:**	To understand the concepts, principles, strategies, and methodologies of web applications and development. To familiarize with Web technologies and Web business models. After completion of the course, you are also able to understand and apply Web development processes.	
Course Learning Outcomes (CLOs)	**:**	**Students who successfully complete the course will be able to:**	**CLO-PLO Mapping**
		CLO-1: Identify the wider engineering issues that form the background to developing complex and evolving web application systems.	**PLO-2**
		CLO-2: Identify, document and analyze requirements for web application.	**PLO-2, PLO-10**
		CLO-3: Develop a web application using server side programming languages and components.	**PLO-3, PLO-5**
		CLO-4: Apply the web engineering methodologies for web application development.	**PLO-5**
		CLO-5: Develop a component based web solution.	**PLO-3**
		CLO-6: Formulate a testing strategy for a web application.	**PLO-4**

Course Contents

Section – A

Introduction to Web Engineering: Web Applications, Characteristics of Web Applications, Product-related Characteristics, Usage related Characteristics, Development-related Characteristic, Web Engineering Concepts, Evolution of web engineering.

Requirements Engineering for Web Applications: Requirements Engineering (RE) Activities, RE Specification in Web Engineering, Principles for RE of Web Applications, Adapting RE Methods to Web Application Development, Requirement Types, Notations, Tools.

Technologies for Web Applications: Client-side Technologies, ActiveX Controls, Document-specific Technologies, Hypertext Markup Language (HTML), DHTML, Synchronized Multimedia Integration Language (SMIL), eXtensible Markup Language (XML), XML Stylesheet Language, Java Script, Server-side Technologies, Servelet, URI Handlers, Web Service, Middleware Technologies.

Web Application Architectures: Components of a Generic Web Application Architecture, Layered Architectures, 2-Layer Architectures, N- Layer Architectures Data-aspect Architectures, Database-centric Architectures, Architectures for Web Document Management, Architectures for Multimedia Data

Section – B

Modeling Web Applications: Modeling Requirements, Hypertext Modeling, Hypertext Structure Modeling Concepts, Access Modeling Concepts, Relation to Content Modeling, Presentation Modeling, Relation to Hypertext Modeling, Customization Modeling.

Web Application Design: Information Design, Software Design, Merging Information Design and Software Design, Problems and Restrictions in Integrated Web Design, Presentation Design, Interaction Design, Navigation Design, Designing a Link Representation, Designing Link Internals, Navigation and Orientation, Structured Dialog for Complex Activities, Interplay with Technology and Architecture, Functional Design.

Testing Web Applications: Testing terminology, Quality Characteristics, Test Objectives, Test Levels, Role of the Tester, Test Approaches: Conventional Approaches, Agile Approaches, Test Scheme, Test Dimensions, Applying the Scheme to Web Applications, Test Methods and Techniques, Link Testing, Browser Testing, Usability Testing, Load, Stress, and Continuous Testing, Testing Security, Test-driven Development, Test Automation, Benefits and Drawbacks of Automated Test, Test Tools.

Web Project Management: Understanding Scope, Refining Framework Activities, Building a Web E-Team, Managing Risk, Developing a Schedule, Managing Quality, Managing Change, Tracking the Project.

Teaching-Learning Strategies:
Teaching strategies for this course consisted of *lectures* as well as *paper-and-pencil* exercises. The lecture material included a fascinating look into the basic concept of Web

engineering, requirement analysis for web application, technologies and architecture of web application, modeling, design and testing of web application, and web project management. The *paper-and-pencil* exercises included classwork and homework assignments in using various case studies related to web application.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Quizzes** due in different times of the semester (20%)
- **Class attendance** (10%)
- **A final exam** (70%)

CLOs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class Test 1 & 2 /Quizzes	**Class Test 3 & 4 /Quizzes**	**Class Attendance**	**Final Exam**
CLO1	√		√	√
CLO2	√		√	√
CLO3	√	√	√	√
CLO4		√	√	√
CLO5		√	√	√
CLO6		√	√	√

Text Books:

1. Gerti Kappel, and Birgit Proll :Web Engineering", John Wiley and Sons Ltd, 2006
2. Roger S.Pressman, and David Lowe : Web Engineering: A Practitioner's Approach", Tata McGraw Hill Publication, 2008

Reference Books:

3. Moller : An Introduction to XML and Web Technologies", Pearson Education New Delhi, 2009
4. Chris Bates : Web Programming: Building Internet Applications", Third Edition, Wiley India Edition, 2007
5. John Paul Mueller : Web Development with Microsoft Visual Studio 2005", Wiley Dreamtech, 2006

ICE4242: Web Engineering Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Lab Objectives: The objective of the web engineering laboratory is to apply the concepts, principles, and methods of Web engineering to Web applications development.

ICE4252: Research Project
50 Marks, 2 Credits

Course Objectives: In the fourth year even semester, student has to do a project based research. Project should be a new finding which reflects the student own idea. This project is a kind of hand on training. A close interaction will be established between student and supervisor. Student will be able to know the way of doing research and research writing. They will gather basic knowledge about citation and plagiarism.