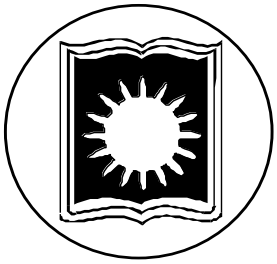
University of Rajshahi

Department of Information and Communication Engineering

Faculty of Engineering



Curriculum for B. Sc. in Information and Communication Engineering

Session: 2023-2024

Examination

1st Year – 2024

2nd Year – 2025

3rd Year – 2026

4th Year – 2027

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University of Rajshahi

Vision

To pursue enlightenment and creativity for producing world-class human resources to cater for the needs of changing time.

Mission

M1-RU: To ensure a world-class curriculum with talented academicians and conductive academic and research environment for generation and dissemination of knowledge

M2-RU: To maintain international standards in education with focus on both knowledge and skills, and humanitarian and ethical values to meet the needs of the society and state.

M3-RU: To develop strategic partnerships with leading national and international universities, and organizations for academic as well as research collaborations

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

M1-ICE: Establish a unique learning environment to enable the students to face the challenges in the field of Information and Communication Engineering.

M2-ICE: Promote the establishment of center of excellence in appropriate technological areas to enhance the spirit of innovation and creativity among faculty members and students.

M3-ICE: Provide ethical and value-based education by promoting activities addressing the socio-economic needs.

M4-ICE: Enable students to develop skills to solve complex technological problems and provide a framework for promoting collaborative and multidisciplinary activities.

Objectives of the Program Offering Entity:

1. Produce professional Information and Communication engineers.
2. Establish a center of excellence in research and innovation.
3. Contribute the community for achieving sustainable development goals (SDGs) of Bangladesh through research and innovation.
4. Facilitate industrial collaboration to contribute in industrial revolution (IR).

Name of the Degree: Bachelor of Science in Information and Communication Engineering abbreviated as B. Sc. Engg. (ICE)

Description of the Program:

The B. Sc. in Information and Communication Engineering program is designed to equip students with a comprehensive understanding of the theories, principles, and practical applications in the dynamic field of information and communication technologies. This program integrates a broad range of subjects, encompassing both theoretical knowledge and hands-on skills, to prepare students for a successful career in the rapidly evolving world of technology.

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.

Mapping between Mission of the University of Rajshahi (RU) and Program Educational Objectives (B.Sc. in Information and Communication Engineering)

Mission of RU	Program Educational Objectives			
	PEO-1	PEO-2	PEO-3	PEO-4
M1-RU	√	√		√
M2-RU		√	√	
M3-RU		√	√	

Program Learning Outcomes (PO):

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

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

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

PO-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.

PO-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.

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

PO-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.

PO-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.

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

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

PO-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.

PO-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.

PO-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 Attributes:

By the time of graduation, the students should have achieved the graduate attributes (also known as **Program Learning Outcomes, PO**), 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 PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	√	√		√								
PEO2			√		√	√						
PEO3							√	√	√	√	√	
PEO4												√

CO-PO-K Mapping of Courses

All Courses: Course ID, Course Title & Credit hours			Program Outcomes (POs)												Knowledge Profile (K)							
															PO1-PO2				PO3	PO5	PO6-PO8	PO4
			Engineering Knowledge	Problem Analysis	Design of Solutions	Investigation	Modern Tools Usage	Engineer & Society	Environment & Sustainability	Ethics	Individual Work/Team Work	Communication	Project Management & Finance	Life Long Learning	Natural Sciences	Mathematics	Engineering Fundamentals	Special Knowledge	Engineering Design	Engineering Practice	Comprehension	Research Literature
Course ID	Course Title	Cr.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	K1	K2	K3	K4	K5	K6	K7	K8
ICE1111	Introduction to Information and Communication Engineering	3	√														√					
ICE1121	Digital Electronics	3	√	√	√										√	√	√		√	√		
ICE1122	Digital Electronics Lab	1.5				√	√								√	√	√		√	√		
PHY1191	Electronics-I	3	√	√											√	√	√					
PHY1192	Electronics-I Lab	1.5				√	√								√	√	√		√	√		
MATH1111	Algebra, Trigonometry and Vector Analysis	3	√	√												√						
CHEM1111	Physical and Inorganic Chemistry	3	√												√	√						
ENG1111	Technical and Communicative English	2										√										√
ICE1211	Electronics-II	3	√	√											√	√	√	√				
ICE1212	Electronics-II Lab	1.5				√	√				√				√	√	√	√	√	√		
CSE1291	Programming with C	3	√	√	√										√	√	√					
CSE1292	Programming with C Lab	1.5					√				√				√	√	√		√	√		
MATH1211	Differential and Integral Calculus	3	√	√											√	√						
STAT1211	Statistics for Engineers	2	√												√	√						
PHY1221	Electricity and Magnetism	3	√	√											√	√	√					
ECON1211	Economics	2	√	√												√					√	
ICE1210	Viva-Voce											√										
ICE2111	Electronics-III	3	√	√	√										√	√	√	√				
ICE2112	Electronics-III Lab	1.5				√	√				√							√	√	√		
ICE2121	Data Structures and Algorithms	3	√	√	√												√	√				
ICE2122	Data Structures and Algorithms Lab	1.5					√				√						√	√	√	√		
EEE2191	Electromagnetic Fields and Waves	3	√	√											√	√	√	√				

MATH2111	Matrices and Differential Equations	3	√	√										√	√						
STAT2111	Basic Theory of Statistics	2	√	√										√	√						
ACCO2111	Industrial Management and Accountancy	2											√			√					√	
ICE2211	Cellular and Mobile Communication	3	√	√	√											√	√	√				
ICE2221	Signals and Systems	3	√	√												√	√	√				
ICE2222	Signals and Systems Lab	1.5	√	√		√	√										√	√	√	√		
ICE2231	Analog Communication and Radio-TV Engineering	3	√	√													√	√				
ICE2232	Analog Communication and Radio-TV Engineering Lab	1.5			√	√	√				√						√	√	√	√		
MATH2221	Discrete Mathematics and Numerical Methods	3	√	√										√	√	√						
LAW2211	Cyber Law and Engineering Ethics	2	√	√				√		√											√	
ICE2210	Viva-Voce	2										√										
ICE3111	Microwave Communication and Radar	3	√	√												√	√	√				
ICE3121	Digital Signal Processing	3	√	√	√											√	√	√				√
ICE3122	Digital Signal Processing Lab	1.5	√	√		√	√									√	√	√	√	√		√
ICE3131	Object-Oriented Programming with Java	3	√		√												√	√				
ICE3132	Object-Oriented Programming with Java Lab	1.5					√				√						√	√	√	√		
ICE3141	Antenna Engineering	3	√	√	√												√	√				√
ICE3142	Antenna Engineering Lab	1.5				√	√				√						√	√	√	√		√
ICE3151	Software Engineering	3	√	√	√	√											√	√				
ICE3152	Software Engineering Lab	1.5				√	√				√						√	√	√	√		
ICE3211	Database Management Systems	3	√		√												√	√	√			√
ICE3212	Database Management Systems Lab	1.5					√				√								√	√		√
ICE3221	Digital Communication	3	√	√												√	√	√				√
ICE3222	Digital Communication Lab	1.5		√			√				√					√	√	√	√	√		√
ICE3231	Telecommunication Engineering	3	√	√	√											√	√	√				
ICE3241	Artificial Intelligence and Neural Computing	3	√	√	√											√	√	√				√
ICE3242	Artificial Intelligence and Neural Computing Lab	1.5					√				√					√	√	√	√	√		√
ICE3251	Satellite Communication	3	√	√												√	√	√				
ICE3210	Viva-Voce	1										√										
ICE4111	Optical Fiber Communication	3	√	√												√	√	√				√
ICE4112	Optical Fiber Communication Lab	1.5				√	√									√	√	√	√	√		√
ICE4121	Machine Learning	3	√	√													√	√	√			√
ICE4122	Machine Learning Lab	1.5					√				√								√	√		√
ICE4131	Wireless Communication	3	√	√												√	√	√				√
ICE4132	Wireless Communication Lab	1.5			√	√	√									√	√	√	√	√		√
ICE4141	Digital Image Processing	3	√	√												√	√	√				√
ICE4142	Digital Image Processing Lab	1.5					√				√					√	√	√	√	√		√
ICE4154	Research Project – Phase I	1		√				√	√			√		√				√	√	√	√	√
ICE4156	Industrial Training	1						√		√	√	√	√					√	√	√	√	√
ICE4211	Computer Networks	3	√	√													√	√				√
ICE4212	Computer Networks Lab	1.5	√	√	√		√				√						√	√	√	√		√

ICE4221	Computer Architecture and Microprocessor	3	√	√												√	√	√				
ICE4222	Computer Architecture and Microprocessor Lab	1.5	√	√			√			√								√	√			
ICE4231	Information Theory and Coding	3	√	√											√	√	√					
ICE4241	Cryptography	3	√	√												√	√	√				√
ICE4242	Cryptography Lab	1.5	√	√			√											√	√			√
ICE4251	Robotics and Automation	3	√	√	√											√	√	√				√
ICE4252	Robotics and Automation Lab	1.5	√	√	√		√			√								√	√			√
ICE4261	Internet of Things	3	√		√		√									√	√	√				√
ICE4262	Internet of Things Lab	1.5					√			√								√	√			√
ICE4271	Information Security	3	√	√												√	√	√				√
ICE4272	Information Security Lab	1.5	√	√			√											√	√			√
ICE4281	Web Engineering	3	√	√								√				√	√	√				
ICE4282	Web Engineering Lab	1.5				√	√			√								√	√			
ICE4210	Viva-Voce	2									√											
ICE4254	Research Project – Phase II	3		√		√	√	√	√	√	√	√	√	√			√	√	√	√	√	√

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 First year, Second year, Third year and Fourth year in succeeding higher levels of study. The academic year will be divided into two semesters (First and Second). 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 75% 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, class participation and attendance, and research project and are of 4000 marks (160 credits). The 3 credits, 2 credits and 1 credit courses carry 75 marks, 50 and 25 marks, respectively.

Rules and Regulations for Students of the B.Sc. Engineering Program (Reference: Academic Ordinance, Faculty of Engineering, University of Rajshahi)

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

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:

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

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' 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 75% 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 75% 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 14 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 Second semester of the academic year. A student entering in an First 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 four weeks after the end of the semester final examinations.

3.4. **Minimum Passing Grade:** The minimum passing grade in each course will be D.

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

3.5.1. Year-wise minimum YGPA required:

Academic year	Minimum YGPA
First year	2.00
Second year	2.25
Third year	2.5
Fourth year	2.5

3.5.2. Credit point loss (F) in theoretical courses not more than 8.

3.6. **Course Improvement:**

3.6.1. A promoted student only be allowed to appear in the theoretical course improvement examination in the immediate next academic year for one time in order to improve a maximum of 6 credits. To clear F grade the candidate will be allowed to appear in the examination for maximum of two times in the immediate consecutive similar semesters. In such case, the student has to give his/her choice of course/courses for course improvement in writing. In the case of student's failure to improve his/her course grade at the course improvement examination, the previous grade shall remain valid. This will be applicable to third year second semester.

3.6.2. Theoretical course improvement will only be allowed if the earned letter grade is less than B- (GP < 2.75).

3.6.3. In practical courses a student will not be allowed to appear in clearing F grade or improvement examination.

3.6.4. A student will carry his/her previous marks on continuous assessment (CA).

3.6.5. In case of student's failure to improve course grade at the course improvement examination, the previous grade will remain valid.

3.7. **Merit Position:** The YGPA obtained by a student in first year, second year and third year and CGPA obtained in the fourth year will be considered for determining the **merit position for the award of scholarships, stipends etc.**

3.8. **Class Test / Class Assessment**

3.8.1. 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 course greater than 2 credits in a semester.

3.8.2. The class test/class assessment will be evaluated by the class teacher and marks with scripts will be submitted to the examination committee for preservation.

3.9. **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 obtain B.Sc. Engg. Degree a student must fulfill the following conditions:

4.1.1. Bachelor degree program must be completed within 4-6 academic years from the date of admission. A student will not be allowed to stay for more than two consecutive years in the same academic year.

4.1.2. The minimum CGPA for awarding B.Sc. Engg. Degree is 2.50 out of 4.00.

4.1.3. The total credit point required for awarding B.Sc. Engg. Degree is 160 with the exemption of maximum 8 credits. The result will be published in accordance with merit.

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

4.3. **Final Result (CGPA) Improvement:** A student obtaining B.Sc. Engg. Degree within 4 or 5 academic years will only be allowed to improve result in the immediate next regular examination. A student will only be allowed to take part in result improvement examination for a maximum of two theoretical courses (maximum of 6 credits) in fourth year if the earned letter grade is less than B (CGPA<3.0). If a candidate fails to improve CGPA with the block of new GP in total, the previous results shall remain valid.

4.4. **Readmission:** If a student fails to obtain the degree within 4 or 5 academic year, he/she will be readmitted in fourth year and will appear for the examination.

4.5. **Dean's List:** As a recognition of excellent performance, the names of students obtaining a CGPA of 3.75 or above in the final examination may be published in the Dean's List in the faculty. Students who have received an 'F' grade in any course during will not be considered for Dean's List.

4.6. **Recording of Result:** The transcripts in English will show the course designation, course title, credit, letter grade, and grade point of individual courses, YGPA of first year, second year, third year, and finally, CGPA of fourth year.

4.7. **Credit Transfer:** A student will be allowed at best one semester in his/her undergraduate program with the relevancy of course curriculum from a designated university under exchange program. Credit of a semester completed from the foreign university will be added which will not be more than the assigned credit for a semester and maximum 8 credit can be adjusted in the immediate next semester. Subject and course should be approved through the relevance committee of the faculty.

5. Distribution of Marks

Distribution of the marks as per following table

<table>
<tr><td>5.1</td><td>Theoretical Courses:
<table>
<tr><td rowspan="2">Continuous Assessment (CA)</td><td>Class Attendance/Participation</td><td>10%</td><td rowspan="2">30%</td></tr>
<tr><td>Quizzes/Class Test</td><td>20%</td></tr>
<tr><td colspan="3">Semester Final Examination</td><td>70%</td></tr>
<tr><td colspan="3">Total</td><td>100%</td></tr>
</table></td></tr>
<tr><td>5.2</td><td>Laboratory
<table>
<tr><td>Class Attendance/Participation</td><td>10%</td></tr>
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	Quizzes, Viva-Voce and Continuous Assessment	30%
	Practical Examination	60%
	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 hours/week

7. Academic Calendar

7.1. The academic year shall be divided into two semesters each having duration of **14 teaching weeks.**

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

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:

First Semester (24 weeks)	Number of weeks
Teaching	**14**
Preparatory Leave	**2**
Examination Period	**2 - 4**
Result Publication	**2 - 4**
Inter Semester Recess	**1**
Second Semester (24 weeks)	
Teaching	**14**
Preparatory Leave	**2**
Examination Period	**2 -4**
Result Publication	**2- 4**
Inter Year Recess	**1**

Summary of 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	**662.5**	**16.5625%**	**26.5**
Mathematics	300	7.5%	12
Statistics	100	2.5%	4
Physics	187.5	4.6875%	7.5
Chemistry	75	1.875%	3
Basic and Major Engineering	**3137.5**	**78.4375%**	**125.5**
(i) Basic Engineering with Lab	**(187.5)**	**(4.6875%)**	**(7.5)**
Computer Science and Engineering	112.5	2.8125%	4.5
Electrical and Electronic Engineering	75	1.875%	3
(ii) Major Engineering	**(2950)**	**(73.75%)**	**(118)**
(a) Theoretical	1950	48.75%	78
(b) Laboratory, Industrial Training and Project	875	21.875%	35
(c) Board viva-voce	125	3.125%	5
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 - First	6	17	2	3	20
1st - Second	6	16	3	4	20
2nd - First	6	16	2	3	19
2nd - Second	5	14	3	4	18
3rd - First	5	15	4	6	21
3rd - Second	5	15	4	5.5	20.5
4th - First	4	12	6	8	20
4th - Second	4	12	5	9.5	21.5
Total	**41**	**117**	**29**	**43**	**160**

Semester Wise Course Distribution

First Year, First 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
PHY1191	Electronics-I	75	3	3
PHY1192	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**

First Year, Second 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	Electricity and Magnetism	75	3	3
ECON1211	Economics	50	2	2
ICE1210	Viva-Voce	25	1	-
		500	**20**	**22**

Second Year, First Semester

Course Code	Course Titles	Marks	Credits	Contact Hours/week
ICE2111	Electronics-III	75	3	3
ICE2112	Electronics-III Lab	37.5	1.5	3
ICE2121	Data Structures and Algorithms	75	3	3
ICE2122	Data Structures and Algorithms Lab	37.5	1.5	3
EEE2191	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**

Second Year, Second 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	Analog Communication and Radio-TV Engineering	75	3	3
ICE2232	Analog Communication and Radio-TV Engineering Lab	37.5	1.5	3
MATH2221	Discrete Mathematics and Numerical Methods	75	3	3
LAW2211	Cyber Law and Engineering Ethics	50	2	2
ICE2210	Viva-Voce	25	1	-
		450	**18**	**20**

Third Year, First 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	Object-Oriented Programming with Java	75	3	3
ICE3132	Object-Oriented Programming with Java Lab	37.5	1.5	3
ICE3141	Antenna Engineering	75	3	3
ICE3142	Antenna Engineering Lab	37.5	1.5	3
ICE3151	Software Engineering	75	3	3
ICE3152	Software Engineering Lab	37.5	1.5	3
		525	**21**	**27**

Third Year, Second Semester

Course Code	Course Titles	Marks	Credits	Contact Hours/week
ICE3211	Database Management Systems	75	3	3
ICE3212	Database Management Systems 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	Artificial Intelligence and Neural Computing	75	3	3
ICE3242	Artificial Intelligence and Neural Computing Lab	37.5	1.5	3
ICE3251	Satellite Communication	75	3	3
ICE3210	Viva-Voce	25	1	-
	Study Tour			
		512.5	**20.5**	**24**

Fourth Year, First Semester

Course Code	Course Titles	Marks	Credits	Contact Hours/week
ICE4111	Optical Fiber Communication	75	3	3
ICE4112	Optical Fiber Communication Lab	37.5	1.5	3
ICE4121	Machine Learning	75	3	3
ICE4122	Machine Learning Lab	37.5	1.5	3
ICE4131	Wireless Communication	75	3	3
ICE4132	Wireless Communication Lab	37.5	1.5	3
ICE4141	Digital Image Processing	75	3	3
ICE4142	Digital Image Processing Lab	37.5	1.5	3
ICE4154	Research Project – Phase I	25	1	2
ICE4156	Industrial Training	25	1	-
		500	**20**	**26**

Fourth Year, Second 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
ICE42**	Elective-I	75	3	3
ICE42**	Elective-I Lab	37.5	1.5	3
ICE4231	Information Theory and Coding	75	3	3
ICE42**	Elective-II	75	3	3
ICE42**	Elective-II Lab	37.5	1.5	3
ICE4210	Viva-Voce	50	2	-
*ICE4254	Research Project – Phase II	75	3	6
		537.5	**21.5**	**27**

***** Research Project – Phase II is the continuation of Research Project – Phase I

List of Elective Courses (Elective-I, Elective-II, Elective-III & Elective-IV)

Course Code	Course Titles	Marks	Credits	Contact Hours/week
ICE4221	Computer Architecture and Microprocessor	75	3	3
ICE4222	Computer Architecture and Microprocessor Lab	37.5	1.5	3
ICE4241	Cryptography	75	3	3
ICE4242	Cryptography Lab	37.5	1.5	3
ICE4251	Robotics and Automation	75	3	3
ICE4252	Robotics and Automation Lab	37.5	1.5	3
ICE4261	Internet of Things	75	3	3
ICE4262	Internet of Things Lab	37.5	1.5	3
ICE4271	Information Security	75	3	3
ICE4272	Information Security Lab	37.5	1.5	3
ICE4281	Web Engineering	75	3	3
ICE4282	Web Engineering Lab	37.5	1.5	3

Course Outline

First Year, First Semester

ICE1111: Introduction to Information and Communication Engineering
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: None
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The main objective of this course is to introduce the fundamental concept of ICT, computer system, and to understand the concept of networks, internet and programming basic.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Identify the basic concepts of computer, information, software, hardware and ICT.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Describe different aspects of communication systems, networks, information system and programming concepts.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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**.**

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 Processing 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.

Text Books:

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

Reference Books:

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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√		√	√
CO2		√	√	√

ICE1121: Digital Electronics

75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: None

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective:

The objective of this course is to acquire knowledge about number systems, Boolean algebra and function minimization techniques. This course includes the understanding of digital logic gates and its application in digital electronics. The course explains analysis and design procedure of the combinational and sequential logic circuits.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Describe the principles of number systems, Boolean algebra and minimization techniques.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☒ Presentation
CO-2	Explain different logic gates and their operational principle in real applications.	**PO-1, PO-2**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Investigate the operations	**PO-1, PO-2**	Cognitive Level 2	☒Lecture notes	☒ Class test

	of combinational and sequential logic circuits.		(Understand)	☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Final exam ☐ Assignment ☐ Participation ☐ Presentation
CO-4	Analyze and design solutions of different types of combinational and sequential circuits as well as memory devices.	**PO-2, PO-3**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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

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

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

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.

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).

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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class tests /Assignments /Quizzes 1 & 2	Class tests /Assignments /Quizzes 3 & 4	Class participation	Final exam
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√
CO4		√	√	√

ICE1122: Digital Electronics Lab

37.5 Marks, 1.5 Credits, 3 Hours/week

Prerequisite: None

Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

This lab aims at practical experience with the logic gates and its applications in digital systems. Experiments of this lab include the design of simple combinational and sequential logic circuits and test/verify the functionality of the circuits using various types of digital logic ICs.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Operate various digital logic gates.	**PO-5**	Psychomotor Level 1 (Imitate)	☐Programming ☒Experiment ☐Open-ended Lab ☒Demonstration ☒Practice Lab	☒Lab Performance ☒Lab Test ☒Lab Report ☐Open-ended Lab Report ☒Lab Quiz ☒Viva
CO-2	Analyze the given problems by using various digital logic gates.	**PO-4**	Psychomotor Level 2 (Manipulate)	☐ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒Lab Performance ☒Lab Test ☒Lab Report ☐Open-ended Lab Report ☒Lab Quiz ☒Viva
CO-3	Design and implement combinational and sequential logic circuits.	**PO-4, PO-5**	Psychomotor Level 4 (Articulate)	☐Programming ☒Experiment ☐Open-ended Lab ☒Demonstration ☒Practice Lab	☒Lab Performance ☒Lab Test ☒Lab Report ☐Open-ended Lab Report ☒Lab Quiz ☒Viva

Assessment and Evaluation Strategy:

Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab test, assignments, quiz, viva-voce)** (20%)
- **Final exam** (70%)

COs	Assessment tools (Total 100%)			
	20%		10%	70%
	Lab test 1/Quiz/ Viva-voce	Lab test 2/Quiz/ Viva-voce	Class participation	Final exam
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√

PHY 1191: Electronics-I

75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: None

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The focus of this course is to introduce the basic concepts of electrical networks, mathematical methods for the analysis of linear and non-linear circuit models, electrical circuits with various network theorems and methods. This course also covers the basic idea of semiconductor diodes and transistors with their characteristics and applications.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Explain the various laws and theorems of electrical circuits to solve the circuit problems.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Describe the fundamental ideas of semiconductor diodes, transistors with their properties and applications.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Analyze various DC circuits using network theorems, and transistor amplifiers such as CE, CB, and CC using hybrid parameters.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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.

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.

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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√

PHY 1192: Electronics-I Lab

37.5 Marks, 1.5 Credits, 3 Hours/week

Prerequisite: None

Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

This lab introduces the practical knowledge of using modern tools related to electrical and electronic devices and components including multi-meter, power supply, signal generator, oscilloscope, resistor, capacitor, inductor, diode, and transistor. The main objective of this lab is to comprehend the concept of applying network theorems to practical circuit analysis and to study BJT characteristics.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Use the modern measuring	**PO-5**	Psychomotor	☐Programming	☒Lab Performance

	tools and equipment such as multi-meter, power supply, signal generator and oscilloscope.		Level 1 (Imitate)	☒Experiment ☐Open-ended Lab ☒Demonstration ☒Practice Lab	☒Lab Test ☒Lab Report ☐Open-ended Lab Report ☒Lab Quiz ☒Viva
CO-2	Construct and analyze DC circuits or networks using different network theorems.	**PO-4**	Psychomotor Level 2 (Manipulate)	☐Programming ☒Experiment ☐Open-ended Lab ☒Demonstration ☒Practice Lab	☒Lab Performance ☒Lab Test ☒Lab Report ☐Open-ended Lab Report ☒Lab Quiz ☒Viva
CO-3	Analyze the characteristics of diodes and transistors.	**PO-4**	Psychomotor Level 2 (Manipulate)	☐Programming ☒Experiment ☐Open-ended Lab ☒Demonstration ☒Practice Lab	☒Lab Performance ☒Lab Test ☒Lab Report ☐Open-ended Lab Report ☒Lab Quiz ☒Viva

Assessment and Evaluation Strategy:

Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab test, assignments, quiz, viva-voce)** (20%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab test 1/Quiz/ Viva-voce	**Lab test 2/Quiz/ Viva-voce**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√

MATH1111: Algebra, Trigonometry and Vector Analysis
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: None

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this course is to introduce the methods of linear algebra, trigonometry, and vector analysis that will facilitate the students for solving engineering problems.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Explain the concept of linear algebra, trigonometry, and vector analysis.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Describe a physical	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes	☒ Class test

	interpretation of the gradient, divergence, curl and related concepts.			☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Evaluate the trigonometric function at an angle whose measure is given in degrees and radians.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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.

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.

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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√	√	√	√
CO2		√	√	√
CO3		√	√	√
CO4	√	√	√	√

CHEM1111: Physical and Inorganic Chemistry
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: None
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this course is to provide the basic concepts of physical and inorganic chemistry.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Explain the basic concepts of physical chemistry.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Demonstrate simple chemical kinetics including zero, first, and second order rate laws.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Explain the atomic structures of elements with their physical and chemical properties.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
	Describe valence bond theory and molecular orbital theory to explain the physical and chemical properties of molecules.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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.

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.

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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√
CO4		√	√	√

ENG1111: Technical and Communicative English
50 Marks, 2 Credits, 2 Hours/week, Lectures: 28, Exam time: 2 hours

Prerequisite: None

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objectives of this course are to provide students with the tools for writing technical error free English, to develop effective and fast reading skill among the students, and to enable students to speak English with correct pronunciation and phonetics.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO	CO Statement	Corresponding	Domain/ level of	Delivery methods	Assessment tools

No.		PO	learning taxonomy	and activities	
CO-1	Write report, technical articles and journals.	**PO-10**	Affective Level 1 (Receive)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Speak in English with the correct accent.	**PO-10**	Affective Level 2 (Respond)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Read newspaper, technical papers, text books etc. and interpret correctly and swiftly.	**PO-10**	Affective Level 1 (Receive)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
	Practice English conversation.	**PO-10**	Affective Level 1 (Respond)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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.

Reading: Comprehension of technical & non-technical materials-skimming, Scanning, Inferring & responding to context.

Technical Writing: Paragraph & composition writing on scientific & other themes, Report writing, Research paper writing, Library references.

Professional Communication: Business letter, Job application, Memos, Quotations, Tender notice.

Reference Book:

1. A. 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

Assessment and Evaluation Strategy:

Students will be assessed on basis of their overall performance in the final examination, class tests/assignments/quizzes, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final examination** (70%)

COs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class tests /Assignments /Quizzes 1 & 2	Class tests /Assignments /Quizzes 3 & 4	Class participation	Final exam
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√
CO4		√	√	√

First Year, Second Semester

ICE1211: Electronics-II
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: PHY1121

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The focus of this course is to introduce the fundamental concepts of Junction Field Effect Transistor (JFET), Metal Oxide Semiconductor Field Effect Transistor (MOSFET) and low frequency response of an amplifier. This course also includes two-terminal devices, power amplifiers, four terminals networks, and filter circuits.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Explain the basic characteristics of JFET, MOSFET, special types of diodes and their applications.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Analyze low frequency response of amplifiers.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Describe the basic concepts of power amplifiers and filter circuits.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-4	Analyze the four-terminal networks.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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.

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.

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:

1. Allen Mottershead : Electronic Devices and Circuits
2. Millman and Halkias : Electronic Devices and Circuits
3. A. P. Malvino : Principle of Electronics

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√
CO4		√	√	√

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

Prerequisite: None
Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objectives of this lab are to observe the characteristics of different electronic devices such as transistor, FET and MOSFET. This lab also includes the design and analysis the characteristics of different filter circuits.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Use different equipment to investigate the characteristics of different electronic devices.	**PO-5**	Psychomotor Level 1 (Imitate)	☐ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-2	Design and implement different filter circuits.	**PO-4**	Psychomotor Level 4 (Articulate)	☐ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-3	Write individual or group report on the experiments conducted in this lab.	**PO-9**	Affective Level 4 (Organize)	☐ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab report, quiz, viva)** (20%)
- **Final exam** (70%)

COs	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab report	**Quiz/ Viva**	**Class participation**	**Final exam**
CO1	√	√	√	√
CO2	√	√	√	√
CO3	√	√	√	√

CSE1291: Programming with C
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: ICE1111
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this course is to develop programming skills using the concept of C language and to gain experience about structured programming. The course presents the concept of C programming knowledge to develop the problem solving skills using C environment, data representation, control structures, functions, arrays, pointers, strings, user defined data types, and file I/O.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Recognize the concept of C programming language.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Identify and solve problems systematically using structured programming approaches.	**PO-2, PO-3**	Cognitive Level 3 (Apply)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Apply the advanced features such as pointer, structure, and file management systems of C programming to solve problems.	**PO-3**	Cognitive Level 3 (Apply)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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, for statement, while statement, do-while 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.

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.

Text Books:

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

Reference Books:

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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√	√	√	√
CO3		√	√	√

CSE1292: Programming with C Lab

37.5 Marks, 1.5 Credits, 3 Hours/week

Prerequisite: None

Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this lab is to introduce the basic concepts of programming with C language. This lab includes control structure, array, function, pointer, structure, union and file management to develop C programs to solve various problems and thereby enhance their analyzing and problem solving skills.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Write and debug computer programs to solve practical problems with C programming language using IDE.	**PO-5**	Psychomotor Level 4 (Articulate)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report

				☒ Practice Lab	☐ Project(Presentation)
CO-2	Write individual or group report by solving open-ended problems with specific needs and requirements using C programming.	**PO-9**	Affective Level 4 (Organize)	☐ Programming ☐ Experiment ☒ Open-ended Lab ☐ Demonstration ☒ Practice Lab	☐ Lab Performance ☒ Lab Test ☐ Lab Report ☒ Open-ended Lab Report ☐ Project(Presentation)

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab test, assignments, open-ended lab report, quizzes, viva)** (20%)
- **Final exam** (70%)

COs	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab test/ Assignments/ Quizzes/ Viva	**Open-ended lab report/ Viva**	**Class performance**	**Final exam**
CO1	√		√	√
CO2		√	√	

MATH1211: Differential and Integral Calculus
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: None
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this course is to introduce the concept of differential and integral calculus. The course also provides concepts in building skill for analyzing and solving engineering problems.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Explain the basic concept of differential and integral calculus.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Solve ordinary and partial differential equations.	**PO-2**	Cognitive Level 3 (Apply)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Evaluate the integral of definite and indefinite forms.	**PO-2**	Cognitive Level 4 (Evaluate)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-4	Solve practical problems using integral and differential	**PO-2**	Cognitive Level 3 (Apply)	☒Lecture notes ☒ Text books	☒ Class test ☒ Final exam

	approaches.			☐Discussion ☐ Audio/video ☐ Web material	☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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.

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.

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

Assessment and Evaluation Strategy:

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

- **Four class tests/Assignments/Quizzes (20%)**
- **Class participation (10%)**
- **Final examination (70%)**

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√	√	√	√
CO2	√		√	√
CO3		√	√	√
CO4	√	√	√	√

STAT1211: Statistics for Engineers
50 Marks, 2 Credits, 2 Hours/week, Lectures: 28, Exam time: 2 hours

Prerequisite: None
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this course is to provide students with the basic concepts of statistics, statistical distributions, probability and their extensive use in real life situations, in particular, in the area of science and engineering. This course covers random variables, logistic regression and different kind of tests.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Explain the concept of probability and statistics.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Apply the rules and algorithm of probability to solve different problems.	**PO-1**	Cognitive Level 3 (Apply)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Explain basic ideas of linear regression and correlation.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-4	Conduct and interpret hypothesis tests.	**PO-1**	Cognitive Level 1 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

Analysis of Statistical Data: Location, Dispersion and their measures, Skewness, Kurtosis and their measures, Moment and Cumulants and practical examples.

Probability: Concept of probability, Sample space, Events union and intersection of events. Probability of events, Loss of probability, Conditional probabilities. Bose Einstein Statistics. Bay's theorem, Chebysec's Inequality and practical examples.

Random Variables and Probability Distribution: Basic concepts, Discrete and continuous random variables, Density and distributional functions, Mathematical expectation and variance, Joint marginal and conditional density functions, Conditional expectation and conditional variance. Moments and Cumulant generating functions. Characteristic function. Study of binomial, Poisson, normal and Bivariate normal distribution and practical examples.

Linear Regression: Correlation, Rank correlation. Partial and multiple correlations linear regression for two Variables, Principle of least squares method, Lines of best fit, Residual analysis and examples.

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.

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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **`Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√
CO4		√	√	√

PHY1221: Electricity and Magnetism

75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: None

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this course is to introduce the basic concepts of electricity and magnetism. This course covers dipole, Gauss's law, capacitors, dielectric, electric current, insulators, semiconductors, Faraday's law, inductance, DC and AC circuits, and thermoelectric power.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools

CO-1	Describe the behavior of electric dipole and the role of Gauss's law with its applications.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Explain the characteristic of dielectric and the nature of Capacitors.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☐ Assignment ☐ Participation ☐ Presentation
CO-3	Apply Faraday's and Ampere's law to solve a variety of electromagnetic problems.	**PO-2**	Cognitive Level 3 (Apply)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-4	Analyze the DC/AC circuits to solve physical problems.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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.

Magnetic Field and its Interaction: Magnetic induction, Magnetic force on a charge, Lorentz force, Magnetic field of a current, Torque on a current loop, The Hall effect, Biot-Savart law and its applications.

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, instrument transformer.

AC Fundamentals: Generation of Alternating voltages and currents, Simple and Complex waveform, Root-Mean-Square value, Average value, Form factor, Mathematical presentation of Complex Number.

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.

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

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 Magnetism

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/assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√
CO4		√	√	√

ECON1211: Economics
50 Marks, 2 Credits, 2 Hours/week, Lectures: 28, Exam time: 2 hours

Prerequisite: None

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of the course is to build awareness about how the world works, including industries, businesses and governments. This course also covers topics about the balance of scarcity of resource to produce the desired goods and services and how to distribute them efficiently among the people.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Identify and recognize economic problems of a country.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Classify and describe different theory regarding demand and production of goods.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Analyze different economic theories.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-4	Describe the need for economic planning from the perspective of Bangladesh.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation

				☐ Web material	☐ Presentation

Course Contents

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

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

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

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.

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.

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

Assessment and Evaluation Strategy:

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

- **Four class tests/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**		
	20%	**10%**	**70%**

	Class tests /Assignments /Quizzes 1 & 2	Class tests /Assignments /Quizzes 3 & 4	Class participation	Final exam
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√
CO4		√	√	√

ICE1210: Viva-Voce
25 Marks, 1 Credit

Prerequisite: None
Course Type: ☐ Theory ☐ Laboratory work ☐ Project work ☒ Viva Voce
Course Objective
The objective of the course is to enable students to express verbally their knowledge gained from the theory and lab courses of First Year in an effective and clear manner.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Assessment tools
CO-1	Communicate and express verbally the knowledge obtained in an effective and clear manner.	**PO-10**	Affective Level 2 (Respond)	☒ Viva Voce

Second Year, First Semester

ICE2111: Electronics-III
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: ICE1211, PHY1221
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this course is to develop the concepts of feedback, high-frequency response, multi-staging of amplifiers, and oscillators. This course also covers the basics of operational amplifiers and their application as active filters, optoelectronic devices and fabrication of microelectronic devices.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Identify the basic concept of feedback and apply it for the design of amplifier and oscillator.	**PO-1, PO-3**	Cognitive Level 3 (Apply)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Analyze high frequency response of common-emitter amplifier and design multi-stage amplifiers using different coupling methods.	**PO-2, PO-3**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Describe the concept of operational amplifiers and	**PO-2, PO-3**	Cognitive Level 4	☒Lecture notes	☒ Class test

	design different types of active filters using operational amplifiers.		(Analyze)	☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-4	Explain the construction, working principle of various optoelectronic devices and the fabrication processes of semiconductor devices.	**PO-1**	Cognitive Level 1 (Remembering)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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

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.

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

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.

Text Books:

1. Gupta and Kumar : Handbook of Electronics
2. Ramakant A. Gayakwad : Op-Amps and Linear Integrated Circuits
3. Allen Mottershead Electronic Devices and Circuits

Reference Books:

1. Millman and Halkias : Electronic Devices and Circuits
2. Malvino : Electronic Principles
3. B. L. Theraja and A. K. Theraja : A Textbook of Electrical Technology, Vol. 4
4. Robert F. Coughlin and Frederick F. Driscoll : Operational Amplifiers and Linear Integrated Circuits
5. Jacob Millman and Arvin Grabel : An Introduction to Microelectronics

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√
CO4		√	√	√

ICE2112: Electronics-III Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Prerequisite: None

Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this lab is to comprehend the practical concepts of electronic circuits and semiconductor devices such as the characteristics of emitter followers, construction of oscillators, characteristics of operational amplifiers and their applications.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Analyze the characteristics of emitter follower and operational amplifiers.	**PO-4, PO-5**	Psychomotor Level 1 (Imitate)	☐ Programming ☒ Experiment ☐Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-2	Investigate the design of oscillators and determine their frequency of oscillations.	**PO-4, PO-5**	Psychomotor Level 4 (Articulate)	☐ Programming ☒ Experiment ☐Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-3	Write individual or group report on the experiments conducted in this lab.	**PO-9**	Affective Level 4 (Organize)	☐ Programming ☒ Experiment ☐Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)

Assessment and Evaluation Strategy:

Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab report, quiz, viva)** (20%)
- **Final exam** (70%)

COs	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab report	**Quiz/ Viva**	**Class participation**	**Final exam**
CO1	√	√	√	√
CO2	√	√	√	√
CO3	√	√	√	√

ICE2121: Data Structure and Algorithm
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: CSE 1291

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objectives of this course are to provide the foundations of the practical implementation and usage of data structures and algorithms. This course ensures that the student evolves into a competent programmer capable of designing, analyzing and implementing the algorithms and data structures for different kinds of problems.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Describe different types of data structures and algorithms.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Analyze how the choice of data structures and algorithms design methods impacts the performance of programs.	**PO-2, PO-3**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☒ Presentation
CO-3	Solve complex problems using the knowledge of advanced algorithms.	**PO-3**	Cognitive Level 3 (Apply)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☒ Presentation

Course Contents

Introduction: Data types and data structures, data structure operations, performance analysis, linear arrays, relationships of arrays, operation on arrays, multidimensional arrays, pointers, record structures, representation of records, sparse matrices.

Linked List: Linked lists, Representation of linked list, Traversing and searching a linked list, Doubly linked list and dynamic storage management, Generalized list, Garbage collection and compaction.
Stacks, Queues and Recursion: Fundamentals, Different types of stacks and queues, Evaluation of expressions, Recursion, Direct and indirect recursion, Depth of recursion, Implementation of recursive procedures by stacks.
Trees and Graphs: Basic terminologies, Binary trees, Binary tree representation, Tree traversal, Extended binary tree, Huffman codes/algorithm, Graphs, Graph representation, Traversing a graph, Shortest path and transitive closure.
Sorting and Searching: Insertion sort, Heap sort, Bubble sort, Radix sort, Complexity of different types of sorting.
Divide and Conquer method: General method of divide and conquer technique, The maximum sub array problem, Merge sort, Quick sort, Selection sort, Binary search.
Greedy Methods: The general method, Knapsack algorithm, Tree vertex splitting, Job sequencing with deadline, Optimal merge patterns, Minimum cost spanning trees: Prim's algorithm, Kruskal's algorithm.
Dynamic Programming: The general method, multistage graphs, All pairs shortest paths, Single source shortest paths problems, The travelling salesman problem.

Text Books:

1. S Lipschutz : Theory and Problems of Data Structures
2. E. Horowitz and S. Sahni : Computer Algorithm

Reference Books:

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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class tests /Assignments /Quizzes 1 & 2	Class tests /Assignments /Quizzes 3 & 4	Class participation	Final exam
CO1	√		√	√
CO2	√	√	√	√
CO3		√	√	√

ICE 2122: Data Structures and Algorithms Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Prerequisite: None
Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this lab is to introduce the implementation of basic data structures with an IDE. This lab includes array, linked list, stack, queue, tree and graph data structures to write programs for solving problems with different algorithms to enhance their analyzing and problem solving skills.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO	CO Statement	Corresponding	Domain/ level of	Delivery methods	Assessment tools

No.		PO	learning taxonomy	and activities	
CO-1	Write and debug computer programs to solve problems using different data structures and algorithms with an IDE.	**PO-5**	Psychomotor Level 4 (Articulate)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☐ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☐ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-2	Write individual or group report by solving open-ended problems with specific needs and requirements using the IDE.	**PO-9**	Affective Level 4 (Organize)	☒ Programming ☒ Experiment ☒ Open-ended Lab ☐ Demonstration ☒ Practice Lab	☐ Lab Performance ☒ Lab Test ☐ Lab Report ☒ Open-ended Lab Report ☐ Project(Presentation)

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab test, assignments, open-ended lab report, quizzes, viva)** (20%)
- **Final exam** (70%)

COs	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab test/ Assignments/ Quizzes/ Viva	**Open-ended lab report/ Viva**	**Class performance**	**Final exam**
CO1	√		√	√
CO2		√	√	

EEE2191: Electromagnetic Fields and Waves
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: MATH1111
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The focus of this course is to introduce the basic concept of electromagnetic fields and waves by exploring Maxwell's equations. The course also covers wave propagation, reflection, and refraction in various media and application of Smith chart to solve transmission line problems.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Interpret the expressions of Maxwell's equations and the associated theorems.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Explain the properties of electromagnetic waves in dielectric and	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books	☒ Class test ☒ Final exam

	conducting media.			☐Discussion ☐ Audio/video ☐ Web material	☒ Assignment ☐ Participation ☐ Presentation
CO-3	Analyze the electromagnetic wave propagation across the transmission line and waveguide using Smith chart.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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.

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.

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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√

MATH2111: Matrices and Differential Equations
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: MATH1111, MATH1211

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this course is to present basic concepts of matrices and differential equations. This course covers matrix algebra and higher orders differential equation to solve engineering problems.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Identify special properties of a matrix that are used to facilitate the calculation of matrix characteristics.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Explain the rank, determinant, eigenvalues and eigenvectors, diagonalization, and different factorizations of a matrix.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Explain first order and higher order differential equations.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-4	Apply appropriate differential equation technique to solve engineering problem.	**PO-2**	Cognitive Level 3 (Apply)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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

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

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

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.

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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class tests /Assignments /Quizzes 1 & 2	Class tests /Assignments /Quizzes 3 & 4	Class participation	Final exam
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√
CO4		√	√	√

STAT2111: Basic Theory of Statistics
50 Marks, 2 Credits, 2 Hours/week, Lectures: 28, Exam time: 2 hours

Prerequisite: STAT1211

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of the course is to provide the basic concepts of data analysis and statistical computing. This course covers basic descriptive measures, measures of association, probability theory, confidence intervals, and hypothesis testing.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Demonstrate different distributions.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Analyze the nature of probability distributions through direct calculation.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Demonstrate knowledge of applicable large sample theory of estimators and tests.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-4	Apply the concepts of parametric and non-parametric tests.	**PO-1**	Cognitive Level 3 (Apply)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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.

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.

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.

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3	√	√	√	√
CO4		√	√	√

ACCO2111: Industrial Management and Accountancy
50 Marks, 2 Credits, 2 Hours/week, Lectures: 28, Exam time: 2 hours

Prerequisite: None

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The main objective of the course is to provide an opportunity for students to understand how managers in industrial management and accounting use finance theory and applications for decision making. This course also covers key finance methods used by management accountants for a variety of planning, strategic and risk management decisions.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-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.	**PO-11**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Describe how theories of finance apply to management accounting practice.	**PO-11**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation

				☐ Web material	☐ Presentation
CO-3	Apply the concept of finance in management accounting and control using case studies.	**PO-11**	Affective Level 4 (Organize)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-4	Identify, compile and analyze financial accounting data for the management team to make decisions.	**PO-11**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

Business and Industry: Basic concept of business and industry, Objectives of business, Types of business, Types of industry, Business and society, Business environment, and ethical issues of business.

Management and 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.

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.

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

Assessment and Evaluation Strategy:

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

- **Four class tests/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√
CO4		√	√	√

Second Year, Second Semester

ICE2211: Cellular and Mobile Communication
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: STAT1211

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The focus of this course is to make the students familiar with cellular and mobile communication systems including 2G, 3G and next generation systems. Along with the overview, this course provides advanced knowledge including mobile radio propagation models and different wireless standards. This course also enables the students to develop an understanding of the challenges for designing cellular mobile communication systems.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Explain the basic principles of the cellular mobile communication system.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Develop cellular mobile communication system considering the channel interferences, system capacity and intelligent cell concepts.	**PO-3**	Cognitive Level 3 (Apply)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Analyze and design mobile radio propagation models.	**PO-2, PO-3**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation

				☐ Web material	☐ Presentation
CO-4	Describe and differentiate various wireless standards.	**PO-1**	Cognitive Level 1 (Remembering)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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.

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.

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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class tests /Assignments /Quizzes 1 & 2	Class tests /Assignments /Quizzes 3 & 4	Class participation	Final exam
CO1	√		√	√
CO2		√	√	√
CO3	√	√	√	√
CO4		√	√	√

ICE2221: Signals and Systems
75 Marks, 3 credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: None

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this course is to introduce the fundamental concepts and techniques used in both analog and digital signal processing relating to electronic, computer and communication engineering. This course covers linear system techniques especially convolution and transform analysis using Fourier transform, Laplace transform and Z transform to analyze and predict the behavior of linear systems.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Explain the basic concepts of signals and systems.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Describe time- and frequency-domain representations of Linear Time Invariant (LTI) systems.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Analyze the LTI systems using Fourier, Laplace, and Z transforms.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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 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 (DTFS), Fourier Series (FS).

Fourier Representation of Non-periodic Signals: Discrete-time Fourier Transformation (DTFT), Fourier Transformation (FT), Properties of Fourier representations.

Applications of Fourier Representations: Frequency response of LTI systems, FT representation for periodic signals, Convolution and modulation with mixed signal classes, FT representation for Discrete-Time (DT) signals, Sampling, Reconstruction of continuous time signals from samples.

Fourier Method of Signal Processing: DT processing of Continuous-Time (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 Region of Convergence (RoC), Properties of z-transform, Inversion of z-transform, Transform analysis of LTI system, Computational structures for implementing DT systems, Unilateral z-transform.

Text Books:

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

Reference Books:

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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√

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

Prerequisite: None
Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this lab is to provide practical experience with the generation and processing of basic signals using MATLAB. Experiments of this lab cover fundamental concepts and basic operations on matrices, generation of various signals and sequences, operation on signals and convolution on different types of signals. Fourier, Laplace and z-transforms are also included in the experiments.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Generate different signals and sequences using MATLAB.	**PO-1, PO-5**	Psychomotor Level 2 (Manipulate)	☐ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-2	Perform different operations on matrices, signals and sequences.	**PO-4**	Psychomotor Level 2 (Manipulate)	☐ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-3	Use different methods to represent signals.	**PO-2**	Cognitive Level 3 (Apply)	☐ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-4	Analyze the signals using Fourier, Laplace and Z-transforms.	**PO-2**	Cognitive Level 4 (Analyze)	☐ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)

Assessment and Evaluation Strategy:

Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab test, assignments, quizzes, viva)** (20%)
- **Final exam** (70%)

COs	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab test 1/ Quizzes/ viva	**Lab test 2/ Quizzes/ viva**	**Class performance**	**Final exam**
CO1	√		√	√

CO2	√		√	√
CO3		√	√	√
CO4		√	√	√

ICE2231: Analog Communication and Radio-TV Engineering
75 Marks, 3 credits, 3 Hours/week, Lectures: 42, Exam. Time: 3 hours

Prerequisite: None
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective:
This course aims to introduce the concept and theory of analog communication systems including radio and TV. This course covers radio wave propagation, modulation, demodulation, transmitters and receivers.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Describe the basic concepts of wave propagation, modulation, and demodulation techniques.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☐ Assignment ☐ Participation ☐ Presentation
CO-2	Explain the working principle of different types of radio transmitters and receivers.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Identify the different elements of TV systems.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☒ Presentation
CO-4	Illustrate the working principles of TV transmitter and receiver, as well as several types of TV including Cable TV, Satellite TV, HDTV, and CCTV.	**PO-2**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☐ Assignment ☐ Participation ☒ Presentation

Course Contents

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.
Radio Receiver: Receiver Classification, Elements of Receiver, AM and FM Receivers, SSB Receiver, Noise in Receiver, AGC Circuits, AFC Circuits, Noise Limiters, Receiver sensitivity, Cross-modulation.
TV System: Element of TV System, TV Signal, Interlace Scanning, Bandwidth, Signal Generation by VSB Modulation, Composite Video Signal Analysis, Horizontal and Vertical Sync Details. Video Section, Color Signal Generation, Channel bandwidth.
Color TV: Introduction: Compatibility, three colors theory, Grassman's Law, Luminance, Hue and Saturation, Color Mixing, Color Reproduction Circuits and Color Matrix; Color TV Receiver: Diagram of TV Receiver, Picture Tube, Television Camera Tube, Color Television Display Tube. TV Transmitter, Transmitting and Receiving Antenna.
Modern TV System: HDTV: Standards and Applications, HDTV transmitter and receiver; Cable TV system, Satellite Broadcasting Home TV System, Closed Circuit TV (CCTV): types of CCTV, working principle, application.

Text Books:

4. G. K. Mathur **:** Radio Engineering
5. Gulati **:** Monochrome and Color TV

Reference Books:

6. B. Grob **:** Basic TV
7. S.L. Gupta and Kumar **:** Electronics

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class tests /Assignments /Quizzes 1 & 2	Class tests /Assignments /Quizzes 3 & 4	Class participation	Final exam
CO1	√		√	√
CO2	√	√	√	√
CO3		√	√	√
CO4		√	√	√

ICE2232: Analog Communication and Radio-TV Engineering Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Prerequisite: None
Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this lab is to train the students to analyze the modulation and demodulation techniques and understand the basic operation of radio and TV transceiver. This lab also investigates the performance of the techniques by using both the trainer kit and circuit implementation.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Design and implement different types of modulation and demodulation techniques using ICs and different electronic components.	**PO-3, PO-5**	Psychomotor Level 2 (Manipulate)	☐ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-2	Investigate the operations of radio and TV transceiver using trainer kit.	**PO-4**	Psychomotor Level 3 (Manipulate)	☐ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-3	Write individual or group report on the experiments conducted in this lab.	**PO-9**	Affective Level 4 (Organize)	☐ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab test, assignments, open-ended lab report, quizzes, viva)** (20%)
- **Final exam** (70%)

COs	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab report	**Quiz/ viva**	**Class participation**	**Final exam**
CO1	√	√	√	√
CO2	√	√	√	√
CO3	√	√	√	√

MATH2221: Discrete Mathematics and Numerical Methods
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: None
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this course is to provide students with the basic concepts of discrete mathematics and numerical methods. In particular, this course includes logic, proofs, sets, relations, functions, counting, and probability, with an emphasis on applications in information and communication engineering. This course also includes solution of a single nonlinear equation, polynomial interpolation, numerical differentiation and integration, solution of initial value and boundary value problems.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Explain the set, relation, function, tree, graph.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Analyze logical propositions via truth tables.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Apply numerical methods to obtain approximate solutions to mathematical problems.	**PO-1**	Cognitive Level 3 (Apply)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-4	Analyze the accuracy of common numerical methods.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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

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

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

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

Graph: Introduction to graph, Graph 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.

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

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

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

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

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

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

Reference 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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√
CO4		√	√	√

LAW2211: Cyber Law and Engineering Ethics
50 Marks, 2 Credits, 2 Hours/week, Lectures: 28, Exam time: 2 hours

Prerequisite: ICE1111

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this course is to provide the students with insights on cyber law, ICT policy of Bangladesh, intellectual property rights and engineering ethics.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Identify cybercrime and develop consciousness about cyber security and laws.	**PO-1, PO-6**	Affective level 3, (Value)	☒Lecture notes ☒ Text books ☒Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Explain the ICT act of Bangladesh, and intellectual property rights.	**PO-2**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion	☒ Class test ☒ Final exam ☒ Assignment

				☐ Audio/video ☐ Web material	☐ Participation ☐ Presentation
CO-3	Understand professional ethics, and responsibilities as engineer in organization.	**PO-2, PO-8**	Affective level 4, (Organize)	☒Lecture notes ☒ Text books ☒Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

Cyber Law and Cyber Crime: Definition, Scope, Utility of Cyber Law, International Cyber Law, Jurisdiction and Cyber crime, Criminal Justice in Bangladesh and Implications on Cyber Crime, Cyber vandalism, Hacking, Malicious spreading in Viruses, Password fraud, Cyber Pornography, Human Rights violation and Internet.

ICT Policy in Bangladesh: Information and Communication Technology Act, 2006, 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, Digital signature, Electronic Evidence in Bangladesh.

Intellectual Property Law, Patent and Trade Marks: Basic Concepts of IP and IPR, Computer-related Intellectual property rights, Copyright, New technology and copyright, Patents and technological development, Patentability and ownership of patents, Scope of IPR and duration of protection, Software Patents and Copyright, International Convention copy right, Protection of trademarks, Trademarks in Cyberspace.

Professional Ethics: Profession, Engineering and Professionalism, Models of Professionalism, Types of Ethics and morality, Preventive Ethics, Aspirational Ethics, Professional Character.

Responsibility in Engineering: Engineering Standards, Risk and Liability in Engineering, Design Standards, Framing the problem: Determining the Facts, Clarifying Concepts, General Principles, Respect for persons, Resolving Problems: Ethics and Design, Line Drawing, Conflicting Values, Convergence, Divergence and Creative Middle Ways.

Engineers in Organizations: Engineers and Managers, Proper Engineering and Management Decisions, Responsible Organizational Disobedience, The scope of Professional Engineering Obligations to the Environment, Ethical Resources for Solving Boundary Crossing Problems.

Text Books:

1. Vivck Sood : Cyber Law Simplified, Tata McGraw Hill Publications
2. V. D. Dudej : Information Technology & Cyber Laws, Commonwealth Publishers
3. Charles E. Harris, Michael S. Pritchard, Michael J. Rabins : Engineering Ethics Concepts and Cases

Reference Books:

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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)

- **Final exam** (70%)

COs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class tests /Assignments /Quizzes 1 & 2	Class tests /Assignments /Quizzes 3 & 4	Class participation	Final exam
CO1	√		√	√
CO2		√	√	√
CO3	√	√	√	√

ICE2210: Viva-Voce
25 Marks, 1 Credit

Prerequisite: None
Course Type: ☐ Theory ☐ Laboratory work ☐ Project work ☒ Viva Voce
Course Objective
The objective of the course is to enable students to express verbally their knowledge gained from the theory and lab courses of Second Year in an effective and clear manner.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Assessment tools
CO-1	Communicate and express verbally the knowledge obtained in an effective and clear manner.	**PO-10**	Affective Level 2 (Respond)	☒ Viva Voce

Third Year, First Semester

ICE 3111: Microwave Communication and Radar
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: EEE2191
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The focus of this course is to introduce the basic concepts of microwave systems, microwave components, and devices with applications. The course also covers microwave measurement and antenna system components, radar principles, radar types as well as target tracking systems.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Describe the basic concept of microwaves, microwave measurements, microwave links, microwave antenna, and Radar.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

CO-2	Explain the construction, operation, and applications of microwave components, devices, and tubes.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Analyze fundamental microwave amplifiers, RF filters, RF oscillators, mixer models, and describe various types of radars and their applications.	**PO-1, PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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, Hybrid ring (Rat-Race Circuit), Directional coupler, Isolator, Circulator, 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, Description of Microwave Bench, Microwave Power Measurements, Microwave Attenuation Measurement, Microwave Frequency Measurement, Microwave SWR Measurement, Impedance Measurement.

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 and MIMO antennas.

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 and Altimeter.

Text Books:

1. G. S. B. Rao : Microwave and Radar Engineering
2. M. I. Skolnik : Introduction to Radar System

Reference Books:

3. Sanjeeva Gupta : Microwave Engineering
4. N. Biswas : Principle of Carriers Communication
5. A. K. Chhabra : Principles of Communication Engineering
6. Louis E. Frenzel : Principles of Electronic Communication Systems

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class tests /Assignments /Quizzes 1 & 2	Class tests /Assignments /Quizzes 3 & 4	Class participation	Final exam
CO1	√		√	√
CO2	√	√	√	√
CO3	√	√	√	√

ICE 3121: Digital Signal Processing
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: ICE2221

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this course is to introduce the theory of digital signal processing (DSP). The course concentrates on digital signal analysis using different transformation methods and design digital filters using different techniques. This course also describes conversion, optimization and estimation of digital signals.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Describe the basic concepts of the sampling and reconstruction of signals, discrete Fourier transform (DFT) and computation of DFT.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Analysis and design of FIR, IIR filter and its application.	**PO-2, PO-3**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Explain various methods of sampling-rate conversion, power spectrum estimation and design optimum filters.	**PO-1, PO-3**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

Sampling and Reconstruction of Signals: Ideal sampling and reconstruction of continuous-time signals, Discrete-time processing of continuous-time signals, Analog-to-digital converters, Analysis of quantization errors, Digital-to-analog converters, Sampling and interpolation of discrete-time signals.

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: Fast 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.

Multirate Signal Processing: Decimation by a Factor D, Interpolation by a Factor I, Sampling Rate Conversion by a Rational Factor I/D, Direct form FIR Filter Structure, Polyphase FIR Structure, Interchange of filters, Multistage Implementation of SRC, Applications of Multirate Signal Processing.

Optimum Linear Filters: Wiener Filters for Filtering and Prediction, FIR Wiener Filter, Orthogonality Principle in Linear Mean-Square Estimation, IIR Wiener Filter, Discrete Kalman Filter.

Spectrum Estimation: Nonparametric Methods: The Periodogram Method, Bartletts Method, Welch's Method, Parametric Methods: Autoregressive Method, Moving Average Method, Autoregressive Moving Average Method.

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

TEXT BOOK:

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

REFERENCE BOOK:

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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√	√	√	√
CO3		√	√	√

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

Prerequisite: None

Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this lab is to perform different operations on digital signal including decimation and interpolation. It also covers different transformation of signals including DFT and FFT.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Correspond-ing PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Perform decimation and interpolation processes on discrete-time signals.	**PO-1, PO-5**	Psychomotor Level 2 (Manipulate)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-2	Analyze different properties of DFT using digital signals.	**PO-2**	Cognitive Level 4 (Analyze)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-3	Analyze and design different digital filters.	**PO-4**	Psychomotor Level 4 (Articulate)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-4	Apply FIR filters and FFT for signal analysis.	**PO-5**	Psychomotor Level 4 (Articulate)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab report, quiz, viva)** (20%)
- **Final exam** (70%)

COs	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab test/Quiz 1	**Lab test /Quiz 2**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√
CO4		√	√	√

ICE3131: Object-Oriented Programming with Java
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: CSE1291
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this course is to introduce the basic concepts of Object Oriented Programming (OOP) and demonstrate skills in writing programs using OOP concept, Graphical User Interface (GUI) technique, multithreading, and Java Database Connectivity (JDBC). The course also focuses on event and exception handling techniques and network programming concept using socket programming.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Describe the syntax and semantics of Java programming language and basic concepts of OOP.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Develop reusable programs using the concepts of inheritance, polymorphism, interfaces and packages.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Design event driven GUI programming, multithreading, and JDBC applications to solve the real world problems.	**PO-3**	Cognitive Level 4 (Create)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-4	Apply the concepts of socket programming to develop network program.	**PO-3**	Cognitive Level 3 (Apply)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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.

Managing Input/Output Streams 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.

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:

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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO-1	√		√	√
CO-2	√		√	√
CO-3	√	√	√	√
CO-4		√	√	√

ICE3132: Object-Oriented Programming with Java Lab

37.5 Marks, 1.5 Credits, 3 Hours/week

Prerequisite: None

Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this lab course is to introduce the basic concepts of OOP using Java. This lab includes GUI, event and exception handling, JDBC, multi-threading and network programming with sockets.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Write and debug OOP programs to solve practical problems with Java using IDE.	**PO-5**	Psychomotor Level 4 (Articulate)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-2	Write individual or group report by solving open-ended problems with specific needs and requirements using Java programming.	**PO-9**	Affective Level 4 (Organize)	☐ Programming ☐ Experiment ☒ Open-ended Lab ☐ Demonstration ☒ Practice Lab	☐ Lab Performance ☒ Lab Test ☐ Lab Report ☒ Open-ended Lab Report ☐ Project(Presentation)

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab test, assignments, open-ended lab report, quizzes, viva)** (20%)
- **Final exam** (70%)

COs	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab test/ Assignments/ Quizzes/ Viva	**Open-ended lab report/ Viva**	**Class performance**	**Final exam**
CO1	√		√	√
CO2		√	√	

ICE3141: Antenna Engineering
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: EEE2191
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this course is to introduce the fundamental principles of antenna theory and apply them to the analysis, design, and measurement of antenna systems. This course also covers a comprehensive theory of various types of antennas and their radiation characteristics, antenna arrays, and experimental measurement techniques.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Explain the fundamentals of antennas, including their types, radiating mechanisms, and parameters.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Describe the antenna theorems of duality, reciprocity, reaction, maximum power transfer, and their applications.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☐ Assignment ☐ Participation ☐ Presentation
CO-3	Design and analyze several types of antennas, including microstrip antenna, smart antenna, antenna arrays, thin linear antenna, and loop antenna, and apply various antenna measurement methods to assess the performance of the antenna.	**PO-2, PO-3**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☐ Assignment ☐ Participation ☒ Presentation

Course Contents

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, Patterns in principal planes, Main lobe and Side lobes, Radiation intensity, Radiation resistance, Input impedance, Directivity, Gain, Antenna efficiency, Beamwidths, Beam area, Beam efficiency, Bandwidth, Front to back ratio, Polarization, Antenna apertures, Effective height.

Antenna Theorems: Reciprocity theorem and its applications, Reaction theorem, Duality theorem, Maximum power transfer theorem and its importance in antenna measurements.

Electric Dipoles and Thin Linear Antennas: Short electric dipole, Field components of a short dipole, Radiation resistance of short electric dipole, Thin linear antenna, Radiated power and Radiation resistance of $\lambda/2$ antenna.

Loop Antennas: Introduction, Principle of Operation, Radiation field, Radiation pattern of loop antenna, Small circular loop, Loop antenna parameters, Maximum effective area and gain, Impedance of loop antenna, Ferrite loop, Mobile communication system applications.

Antenna Arrays: Design consideration of loop antenna, Array configuration, two element array, N-element linear array: Uniform amplitude and spacing, Directivity, 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 Beam forming, Smart-Antenna System Design, Simulation and Results.

Antenna Measurements: Measurement Basics: Reflection ranges, Free-space ranges, Elevated ranges, Anechoic Chamber, Radiation patterns measurements, Gain and Directivity measurements, Radiation efficiency measurements, Impedance, Current and Polarization measurements, Scale Model Measurements.

Text Books:

1. C. A. Balanis : Antenna Theory – Analysis and Design, 2nd Edition
2. J. D. Kraus, R. J. Marhefka, and A. S. Khan : Antennas for All Applications, 3rd Edition

Reference Books:

3. K. D. Prasad : Antenna and Wave Propagation, 3rd Edition
4. Yi Huang and Kevin Boyle : Antennas: From Theory to Practice, 1st Edition

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO – 1	√		√	√
CO – 2	√	√	√	√
CO – 3	√	√	√	√

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

Prerequisite: None
Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this lab is to introduce experimental measurement of various types of antennas using antenna trainer kit. This lab also enables the students to design antennas and analyze their performance using software tool.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Analyze the radiation characteristics of various types of antennas such as simple dipole, folded dipole, Yagi-Uda, Loop antenna, and Slot antenna using antenna trainer kit .	**PO-4, PO-5**	Psychomotor Level 4 (Articulate)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-2	Write individual or group report by designing various types of antennas and evaluating their performances using antenna kit and software tools .	**PO-9**	Affective Level 4 (Organize)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab test, assignments, open-ended lab report, quizzes, viva)** (20%)
- **Final exam** (70%)

COs	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab test/ Assignments/ Quizzes/ Viva	**Lab report**	**Class performance**	**Final exam**
CO1	√		√	√
CO2		√	√	

ICE3151: Software Engineering
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: CSE1291, ICE2121
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective:
The main objectives of this course are to provide students the basic concepts of information system analysis, design and implementation. This course also provides the details about how to use the knowledge of software engineering to develop a software project.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Identify the key aspects of the information system development and software engineering.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☐ Assignment ☐ Participation ☐ Presentation
CO-2	Analyze and design an information systems and software products.	**PO-2, PO-3**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Build solutions to real-world problem using the concept of information system and software engineering.	**PO-4**	Cognitive Level 4 (Create)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

Introduction: System Concepts, characteristics of a system, Elements of a system, Types of systems, Types of information systems, Information systems environments, System Development Life Cycle, Role of system analyst.

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.

Feasibility Study: System performance definition, Feasibility study, Feasibility Considerations, Steps in feasibility analysis, Feasibility report, Oral presentation, Data analysis, Cost/benefit analysis: Cost and benefit categories, Procedure for cost/benefit determination, Classification of costs and benefits, Cost/benefit evaluation methods.

System Design and Implementation: The process and stages of system design. Input/output and forms design, File organization and database design, System Testing and Quality Assurance, Implementation and software maintenance, Hardware/software selection, Project scheduling and Software, Security, Disaster/recovery and Ethics in System Development.

Software Process Models: Software process, Software process models, Linear sequential model, Prototyping models, Waterfall model, RAD, Incremental model, Spiral model, Agility and agile process model.

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 and Risk Management: Project management concepts: People, Product and process. Product metrics, Process and project metrics, Estimation for software project, Risk identification, Risk projection, Risk refinement, Risk mitigation, Monitoring, and management.

Text Books:

1. E. M. Award : System Analysis and design
2. R. S. Pressman : Software Engineering-A Practitioner's Approach

Reference Books:

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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class tests /Assignments /Quizzes 1 & 2	Class tests /Assignments /Quizzes 3 & 4	Class participation	Final exam
CO1	√	√	√	√
CO2	√	√	√	√
CO3	√	√	√	√

ICE3152: Software Engineering Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Prerequisite: None

Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this lab course is to develop software-based project utilizing the standard practices of information system analysis and software engineering.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Analyze and design information system and/or software based project to solve real-world problems.	**PO-4, PO-5**	Psychomotor Level 4 (Articulate)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☐ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☐ Lab Report ☒ Open-ended Lab Report ☐ Project(Presentation)
CO-2	Write individual or group report by solving open-ended software projects with specific needs and requirements.	**PO-9**	Affective Level 4 (Organize)	☒ Programming ☒ Experiment ☒ Open-ended Lab ☐ Demonstration ☒ Practice Lab	☐ Lab Performance ☐ Lab Test ☐ Lab Report ☒ Open-ended Lab Report ☐ Project(Presentation)

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab test, assignments, open-ended lab report, quizzes, viva)** (20%)
- **Final exam** (70%)

COs	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab test/ Assignments/ Quizzes/ Viva	**Open-ended lab report/ Viva**	**Class performance**	**Final exam**
CO1	√		√	√
CO2		√	√	

Third Year, Second Semester

ICE3211: Database Management Systems
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 Hours

Prerequisite: None
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this course is to present the design and development of database applications, organization of different types of data in database and basic architecture of entity-relationship (ER) diagram. This course also includes topics on database management using Structured Query Language (SQL), transaction management, concurrency control, recovery of data and development of real-life database applications.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Identify different types of data in a database and design database management system applications.	**PO-1, PO-3**	Cognitive Level 4 (Create)	☒Lecture notes ☒ Text books ☐Discussion ☒ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation
CO-2	Explain the basic architecture of entity-relationship (ER) diagram and describe integrity and security issues of database management systems.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☒ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation
CO-3	Describe the basics of Structured Query Language (SQL) for handling databases and illustrate the concepts of transaction management, concurrency control and recovery systems for managing real-life database applications.	**PO-1, PO-3**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☒ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation

Course Contents

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 Diagram: 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.

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, Multiple-granularity, Deadlock handling, Insert and delete operations.

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

Text Books:

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

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.

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√

ICE 3212: Database Management Systems Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Prerequisite: None

Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this lab is to provide the students with the practical experiences on the concepts of Database Management Systems. This lab includes the design of relational databases and their implementation using Structured Query Language (SQL), retrieval of data using queries, data manipulation, enforcing data-integrity constraints, implementation of stored procedures and triggers.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Write and debug computer programs to solve practical problems with SQL using IDE.	**PO-5**	Psychomotor Level 4 (Articulate)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-2	Write individual or group report by solving open-ended problems with specific needs and requirements using SQL.	**PO-9**	Affective Level 4 (Organize)	☐ Programming ☐ Experiment ☒ Open-ended Lab ☐Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☐ Lab Report ☒ Open-ended Lab Report ☐ Project(Presentation)

Assessment and Evaluation Strategy:

Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab test, assignments, open-ended lab report, quizzes, viva)** (20%)
- **Final exam** (70%)

COs	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab test/ Assignments/ Quizzes/ Viva	**Open-ended lab report/ Viva**	**Class performance**	**Final exam**
CO1	√		√	√
CO2	√	√	√	

ICE3221: Digital Communication
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: ICE2231

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this course is to provide fundamental knowledge about digital communication systems. This course covers signal detection, estimation, and sampling processes. This course also describes various digital modulation techniques and waveform coding techniques in the presence of noise and other interferences.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Explain the fundamental concepts of digital communication systems, signal detection and estimation, and sampling process.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Explain and analyze the impact and performance of different digital modulation techniques.	**PO-1, PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☐ Assignment ☐ Participation ☒ Presentation
CO-3	Analyze error control coding to achieve error detection and correction in digital transmission systems.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☐ Assignment ☐ Participation ☒ Presentation

Course Contents

Fundamentals of Digital Communication: Sources and signals, Basic signal processing operation in digital communication, Channels for digital communication, Uncertainty, Information, and Entropy, Source coding theorem, Discrete memoryless channels, Mutual information, Channel capacity, Channel coding theorem, Channel capacity theorem.

Signal Detection: 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.

Signal Estimation: Concept and criteria, Maximum likelihood estimation, Weiner filters for waveform estimation, Linear prediction, Linear predictive vocoders, Adaptive filters.

Sampling Process: Sampling theorem, Quadrature sampling of band-pass signals, Reconstruction of a message process from its samples, Signal distortion in sampling, Practical aspects of sampling and signal recovery, Pulse amplitude modulation.

Digital Modulation Techniques: Digital modulation, Factors that influence the choice of digital modulation, Linear modulation: BPSK, DPSK, QPSK, $\pi/4$ QPSK, Offset QPSK, QAM; M-ary modulation techniques, Spread-Spectrum Modulation: Direct Sequence Spread Spectrum, Frequency-Hop Spread Spectrum.

Baseband Pulse and Digital Signaling: Pulse Code Modulation (PCM), Quantization of Noise in PCM, Differential PCM (DPCM), Delta Modulation (DM), Adaptive Delta Modulation Pulse code modulation (ADMPCM), Channel noise, Quantization noise, SNR, Robust quantization.

Multiplexing: Time Division Multiplexing (TDM), Intersymbol interference, Correlation coding, Eye pattern, Pulse Amplitude Modulation (PAM), Power spectra of discrete PAM signals, Baseband M-ary PAM systems, Regenerative Repeater.

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.

Text Books:

1. Simon Haykin : Digital Communication Systems

Reference Books:

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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO – 1	√		√	√
CO – 2	√	√	√	√
CO – 3		√	√	√

ICE 3222: Digital Communication Lab

37.5 Marks, 1.5 Credits, 3 Hours/week

Prerequisite: None

Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective:

The objective of this lab is to achieve practical experience of different techniques of digital communication system by using digital communication kits such as ASK, FSK, and PSK, etc. This lab also covers experiments on different line coding techniques.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Conduct different experiments to understand the operations of different digital modulation techniques using digital communication kit.	**PO-2, PO-5**	Psychomotor Level 3 (Manipulate)	☒Programming ☒Experiment ☐Open-ended Lab ☒Demonstration ☒Practice Lab	☒Lab Performance ☒Lab Test ☒Lab Report ☐Open-ended Lab Report ☐Project(Presentation)
CO-2	Write individual or group report by analyzing different line	**PO-2, PO-9**	Psychomotor Level 3 (Perfect)	☒ Programming ☒ Experiment ☐Open-ended Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report

	coding techniques using digital communication kit.			☒ Demonstration ☒ Practice Lab	☐ Open-ended Lab Report ☐ Project(Presentation)

Teaching-Learning Strategies:
Teaching strategies for this course consists of Lab demonstration as well as assignments. The lecture material includes lab manual that consists of experiments and assignments on different types of digital modulation and line coding techniques.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab test, assignments, quizzes, viva)** (20%)
- **Final exam** (70%)

COs	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab test 1/ Quizzes/ Viva	**Lab test 2/ Quizzes/ Viva**	**Class performance**	**Final exam**
CO1	√		√	√
CO2		√	√	√

ICE3231: Telecommunication Engineering
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 Hours

Prerequisite: ICE2231
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this course is to deliver the fundamentals of switching and networking principles in telecommunication systems. This course includes the working principle and design of early automatic switching systems such as Strowger and crossbar switching and modern electronic switching systems, the concepts of telephone networks, traffic engineering and performance analysis of traffic based on queuing theory.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Describe the fundamentals of switching and networking principles used in telecommunication systems and explain the working principle of automatic switching systems such as Strowger and crossbar switching.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☒ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation
CO-2	Design switching systems based on traffic requirements and explain the concepts of switching hierarchy, routing, transmission, numbering,	**PO-1, PO-3**	Cognitive Level 3 (Create)	☒Lecture notes ☒ Text books ☐Discussion ☒ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation

	charging plans, and signaling techniques.				
CO-3	Identify the basic principles of the modern electronic switching systems and design multistage networks.	**PO-1, PO-3**	Cognitive Level 4 (Create)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation
CO-4	Analyze telecommunication traffic models and apply the principles of queuing theory in evaluating the performance of telecommunication networks.	**PO-2, PO-3**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation

Course Contents

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.

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.

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.

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√
CO4		√	√	√

ICE3241: Artificial Intelligence and Neural Computing
75 Marks, 3 credits, 3 Hours/week, Lectures: 42, Exam. Time: 3 hours

Prerequisite: MATH2221, STAT1211

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

This course provides artificial intelligence and neural computing concepts that can be applied in different modern technological fields. The goal is to describe the basic methods of representing knowledge in suitable forms for computer processing using logic programming languages and developing an intelligent system by automated reasoning. The course also introduces neural computing technique as an alternative knowledge processing paradigm using different machine learning algorithms.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Identify problems that can be represented and expressed in terms of logic and search problems.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Solve problems using logic programming languages and automated reasoning approach.	**PO-3**	Cognitive Level 3 (Apply)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Identify problems that can be expressed in terms of neural networks, and to select an appropriate learning methodology for the problem area.	**PO-1, PO-2**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

Introduction: Definition, goal and application of AI, Conventional and neural computation, Intelligent agent, Agent environment, Turing test, Game playing, Natural language processing, Expert system, Genetic algorithm, Robotics and Fuzzy logic.

Knowledge Acquisition and Representation: Definition and importance of knowledge, Knowledge-based agent, Representation of knowledge, Knowledge acquisition, Propositional and predicate logic, CNF, DNF, Well-formed formula (WFF), Inference rules, Resolution.

Overview of AI Programming Language: Introduction to Prolog's Domains, Predicates, Clauses, Relations and objects, Prolog data types, Bound and free variable, Backtracking, Unification rules of Prolog, Input and output predicates.

Reasoning and Problem Solving: Reasoning with uncertainty, Probabilistic reasoning, Bayes rule, Searching of state space, Breadth first, Depth-first and related types of search, Heuristic search technique, Hill climbing algorithm, Logic of non-monotonic reasoning, Inductive and deductive reasoning, Forward and backward chaining.

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.

Basic Concept of Deep Neural Network: Fundamentals of deep learning, convolutional neural network (CNN) and tensorflow, RCNN, Representation learning and generative learning, Deep learning applications for reinforcement learning and NLP.

Text Books:	
1. Simon Haykin	: Neural Networks A Comprehensive Foundation
2. Dan W. Patterson	: Introduction to Artificial Intelligence and Expert System
3. Carl Townsend	: Introduction to Turbo Prolog
4. Charu C. Aggarwal	: Neural Networks and Deep Learning: A Textbook
Reference Books:	
1. S. Russel and P. Norving	: Artificial Intelligence A Modern Approach
2. Generserth, Michael R, and Nilsson Nills	: Logical Fundamentals of AI
3. Ivan Bratko	: Prolog Programming for AI

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments	**Class tests /Assignments**	**Class participation**	**Final exam**

	/Quizzes 1 & 2	/Quizzes 3 & 4		
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√

ICE3242: Artificial Intelligence and Neural Computing Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Prerequisite: None

Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this lab course is to provide the basic concepts to solve the AI problems. The course also implements the neural computing techniques using machine-learning algorithms for solving real-world problems.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Write programs on AI and neural computing.	**PO-5**	Psychomotor Level 4 (Articulate)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-2	Write individual or group report by solving open-ended AI and neural computing problems using prolog and other programming languages	**PO-9**	Affective Level 4 (Organize)	☐ Programming ☐ Experiment ☒ Open-ended Lab ☐ Demonstration ☒ Practice Lab	☐ Lab Performance ☒ Lab Test ☐ Lab Report ☒ Open-ended Lab Report ☐ Project(Presentation)

Assessment and Evaluation Strategy:

Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab test, assignments, open-ended lab report, quizzes, viva)** (20%)
- **Final exam** (70%)

COs	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab test/ assignments/ quizzes/ viva	**Open-ended lab report/ viva**	**Class performance**	**Final exam**
CO1	√		√	√
CO2		√	√	

ICE3251: Satellite Communication
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: ICE2231
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this course is to introduce the basic concepts of satellite communication including satellite positioning in orbit, different types of satellite and their applications, modulation schemes and multiple access techniques used for satellite, antennas for satellite and link power budget calculation.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Explain the Kepler's laws, satellite orbits, launching orbits, orbital perturbations and analyze antenna look angles and limits of visibility.	**PO-1, PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Explain antenna polarization and depolarization, transmission losses and analyze the link-power budget.	**PO-1, PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Explain the attitude control, station keeping, power supply, receive-only home TV systems and transmit-receive earth stations.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-4	Describe the modulation formats, multiple access techniques, satellite mobile services and global positioning satellite system.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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.

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.

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

Assessment and Evaluation Strategy:

Students will be assessed on basis of their overall performance in the final examination, class tests/assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/assignments/quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO – 1	√		√	√
CO – 2	√		√	√
CO – 3	√	√	√	√
CO – 4		√	√	√

ICE3210: Viva-Voce
25 Marks, 1 Credit

Prerequisite:

Course Type: ☐ Theory ☐ Laboratory work ☐ Project work ☒ Viva Voce

Course Objective

The objective of the course is to enable students to express verbally their knowledge gained from the theory and lab courses of Third Year in an effective and clear manner.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Assessment tools
CO-1	Communicate and express verbally the knowledge obtained in an effective and clear manner.	**PO-10**	Affective Level 2 (Respond)	☒ Viva Voce

ICE4111: Optical Fiber Communication
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: ICE2231

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this course is to introduce the fundamental concepts of optical fiber communication systems and various optical devices. The course also emphasizes on different optical transmission characteristics as well as optical networking systems.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Explain the basic concept of optical fiber communication and propagation of light through optical fiber.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Describe different types of optical fiber, propagation modes and fiber characteristics.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Analyze the transmission characteristics to realize the optical propagation using various sources, detectors and optical network.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

Concept of Optical Fiber Communication: Introduction, 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: 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: Attenuation, Absorption, Scattering loses, Bending loss, Dispersion: Intra model dispersion, Inter model dispersion, Polarization.

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

Optical fiber connection: Introduction, Fiber alignment and joint loss, 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: Types and operation, Sensors using single mode fiber, Fiber optic gyroscopes, Chemical sensors, applications.

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

Text Books:

1. J. M. Senior : Optical Fiber Communications.

Reference Books:

2. Palaise : Fiber Optic Communication.
3. Gerd Keiser : Optical Fiber Communication.
4. P Chakrabarti : Optical Fiber Communication.

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

Cos	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class tests /Assignments /Quizzes 1 & 2	Class tests /Assignments /Quizzes 3 & 4	Class participation	Final exam
CO1	√		√	√
CO2	√		√	√
CO3	√	√	√	√

ICE4112: Optical Fiber Communication Lab

37.5 Marks, 1.5 Credits, 3 Hours/week

Prerequisite: None

Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

This lab introduces the simplex method of transmitting information from one place to another by sending pulses of light through an optical fiber. The lab covers analog and digital transceiver systems for fiber communication. It also analyze fiber optics characteristics, modulation and demodulation techniques using trainer kit.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Identify the establishment of analog-digital link, characteristics of fiber optic communication link and voice link using amplitude, frequency and PWM modulation with trainer kit.	**PO-5**	Psychomotor Level 2 (Manipulate)	☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-2	Analyze the propagation and bending losses in an optical fiber using trainer kit.	**PO-5**	Psychomotor Level 4 (Articulate)	☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report

					☐ Project(Presentation)
CO-3	Evaluate the numerical aperture, and compare different step index and graded index fiber using trainer kit.	**PO-4, PO-5**	Psychomotor Level 4 (Articulate)	☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab test, assignments, quiz, viva-voce)** (20%)
- **Final exam** (70%)

COs	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab test 1 /Quiz /Viva	**Lab test 2/Quiz/ Viva**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√

ICE4121: Machine Learning
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: ICE3241
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective:
The objective of this course is to provide students with the fundamental concepts of machine learning and its applications. This course covers both supervised and unsupervised learning techniques including Bayesian theory, dimensionality reduction, clustering, classification and decision tree.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Correspond-ing PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Explain a wide variety of learning algorithms.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Explain a how to evaluate models generated from training data.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Apply the learning algorithms to real-world problems.	**PO-2**	Cognitive Level 3 (Apply)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation

				☐ Web material	☐ Presentation
CO-4	Analyze supervised and unsupervised learning algorithms with examples.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

Introduction to Machine Learning (ML): Definition, Aspects of developing a learning system: training data, target function, target function representation and function approximation; Issues of machine learning, Applications of ML in image recognition, Speech recognition, Traffic prediction, Email spam, Online fraud, Stock market trading, Medical diagnosis and language translation.

Supervised Learning: Introduction, Learning class from examples, Vapnik-Chervonenkis dimension, probably approximately correct learning, noise, learning multiple classes, regression, model selection and generalization, dimension of a supervised learning.

Bayesian Decision Algorithm: Introduction, Classification, Losses and risks, discriminant functions, association rules, Bayesian estimation of discrete and Gaussian

Dimensionality Reduction: Subset selection, Principle component analysis, Feature embedding, Factor analysis, Singular value decomposition and matrix factorization. Multidimensional scaling, linear discriminant analysis and canonical analysis.

Clustering: Introduction, Mixture densities, k-means clustering, Expectation-maximization algorithm, Mixtures of latent variable models, Supervised learning after clustering, Spectral clustering, Hierarchical clustering.

Nonparametric Method: Introduction, Nonparametric Density Estimation, Multivariate Data, Nonparametric classification, Condensed nearest neighbor, Distance-based classification, Outlier Detection, Nonparametric regression, Choosing smoothing parameters.

Decision Trees: Introduction, Univariate trees: Classification trees, Regression trees; Pruning, Rule extraction from trees, Learning rules from data, Multivariate trees.

Linear Discrimination: Generalizing the linear model, Geometry of the linear discriminant, Pairwise separation, Parametric discrimination, Gradient descent, Logistic discrimination, Discrimination by regression, Learning to rank

Text Books:

Ethem Alpaydin : Introduction to Machine Learning

Reference Books:

Tom M. Mitchell : Machine Learning

Gopinath Rebala, Ajay Ravi and Sanjay Churiwala : An Introduction to Machine Learning

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)

- **Final exam** (70%)

COs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class tests /Assignments /Quizzes 1 & 2	Class tests /Assignments /Quizzes 3 & 4	Class participation	Final exam
CO1	√	√	√	√
CO2	√	√	√	√
CO3	√	√	√	√
CO4		√	√	√

ICE4122: Machine Learning Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Prerequisite: None

Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective:

This objective of this lab is to explore the basic programming concept and techniques of machine learning using python or suitable programming language with related libraries. This lab covers the implementation of different machine learning algorithms using different data sets to solve real-life problems.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Write and debug programs to solve different practical machine learning problems using python.	**PO-5**	Psychomotor Level 4 (Articulate)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-2	Write individual and group report by solving open-ended problems.	**PO-9**	Affective Level 3 (Organize)	☐ Programming ☐ Experiment ☒ Open-ended Lab ☐ Demonstration ☒ Practice Lab	☐ Lab Performance ☐ Lab Test ☐Lab Report ☒ Open-ended Lab Report ☒ Project(Presentation)

Assessment and Evaluation Strategy:

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

- **Continuous assessment** (lab test, assignments, open-ended lab report, quizzes, viva) (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Lab Test	Open-ended lab	Class	Final exam

	/Assignments /Quizzes	report/ Viva	participation	
CO1	√		√	√
CO2		√	√	

ICE4131: Wireless Communication
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: ICE2211, ICE3141

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this course is to introduce the basic idea of wireless communication systems. This course covers statistical analysis of radio channels, multiuser systems and their capacities, multi-carrier systems, performance analysis of digital modulation techniques, diversity and equalization strategies, and spread spectrum systems.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Analyze the radio channel characteristics, and explain the different techniques of multiuser system and channel capacity.	**PO-1, PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Explain the operational principle of multicarrier systems.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Analyze the performance of the digital modulation techniques, diversity, and equalization techniques.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-4	Describe spread spectrum technique, RAKE receiver and multi-user detection. .	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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.

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.

TEXT BOOK:

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

REFERENCE BOOK:

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

Assessment and Evaluation Strategy:

Students will be assessed on basis of their overall performance in the final examination, class tests/assignments, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO – 1	√		√	√
CO – 2	√		√	√
CO – 3		√	√	√
CO – 4		√	√	√

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

Prerequisite: None
Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The main objective of this lab is to develop a simulation environment for wireless communication using Matlab. This lab covers the evaluation of system performance under various communication channels, different coding and decoding techniques.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Design analog and digital modulation techniques for wireless communication.	**PO-5**	Psychomotor Level 4 (Articulate)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-2	Apply different coding and decoding methods and analyze the corresponding system BER performance.	**PO-4**	Psychomotor Level 2 (Manipulate)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-3	Analyze the effect of noise and different communication channels on system performance.	**PO-3**	Cognitive Level 4 (Analyze)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab test, assignments, quiz, viva-voce)** (20%)
- **Final exam** (70%)

COs	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab test 1/Quiz/ Viva	**Lab test 2/Quiz/ Viva**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√

ICE4141: Digital Image Processing
75 Marks, 3 credits, 3 Hours/week, Lectures: 42, Exam. Time: 3 hours

Prerequisite: ICE2221
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this course is to introduce the basic concepts of digital image processing including image representation, sampling and quantization, imaging geometry, image enhancement, and image transforms. The course also familiarizes students with advanced topics on image processing such as color models, degradation and restoration, filtering, segmentation and compression techniques.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Describe the fundamentals of digital image and its processing.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Analyze images in spatial and frequency domains using various transforms to enhance image quality.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Explain color models, image restoration and compression.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-4	Apply the concept of image segmentation to subdivide an image into its constituent objects or regions.	**PO-2**	Cognitive Level 3 (Apply)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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: Background, Basic gray level transformation, Histogram processing, Basics of spatial filtering, Smoothing and Sharpening Spatial 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.

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, Smoothing and Sharpening Frequency-Domain filters, 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.

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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO-1	√		√	√
CO-2	√	√	√	√
CO-3	√	√	√	√
CO-4		√	√	√

ICE4142: Digital Image Processing Lab

37.5 Marks, 1.5 Credits, 3 Hours/week

Prerequisite: None

Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of the lab is to introduce the fundamental operations of image processing. This lab also covers image enhancement in special and frequency domain.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Write and debug computer programs to perform fundamental operations of image processing using MATLAB.	**PO-5**	Psychomotor Level 4 (Articulate)	☒Programming ☒Experiment ☐Open-ended Lab ☒Demonstration ☒Practice Lab	☒Lab Performance ☒Lab Test ☒Lab Report ☐Open-ended Lab Report ☐Project(Presentation)

CO-2	Write computer programs to develop the concept of image enhancement in spatial and frequency domain.	**PO-5**	Psychomotor Level 4 (Articulate)	☒Programming ☒Experiment ☐Open-ended Lab ☒Demonstration ☒Practice Lab	☒Lab Performance ☒Lab Test ☒Lab Report ☐Open-ended Lab Report ☐Project(Presentation)
CO-3	Write individual or group report by solving open-ended problems with specific needs and requirements using MATLAB .	**PO-9**	Affective Level 4 (Organize)	☐ Programming ☐ Experiment ☒ Open-ended Lab ☐ Demonstration ☒ Practice Lab	☐ Lab Performance ☒ Lab Test ☐ Lab Report ☒ Open-ended Lab Report ☐ Project(Presentation)

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab test, assignments, open-ended lab report, quizzes, viva)** (20%)
- **Final exam** (70%)

COs	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab test/ Assignments/ Quizzes/ Viva	**Open-ended lab report/ Viva**	**Class performance**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3		√	√	

ICE 4154: Research Project – Phase I
25 Marks, 1 Credits, 2 Hours/week

Prerequisite: None
Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective
The objectives of the research project are to:

- Prepare students to systematically review the existing literatures and to find possibly real-world engineering problems,
- Provide students with opportunity to apply and integrate their previously acquired engineering knowledge to formulate and find the solution of the problems,
- Enhance students' creativity in analyzing complex and the real-world engineering problems,
- Prepare students to understand the impact of engineering solutions to the society, health, safety, reliability, legal, cultural, and social aspects,
- Prepare students to understand the sustainability and impact of engineering solution towards environment,
- Develop communication skill among students through complex activities, technical report writing, oral presentations etc.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Specify a solvable complex engineering problem preferably relevant to the	**PO-2**	Cognitive Level 4 (Create)	☐Programming ☐ Experiment	☐ Lab Performance ☐ Lab Test

	current and future industry through appropriate research methodology.			☐ Open-ended Lab ☒Demonstration ☐ Practice Lab	☐ Lab Report ☐ Open-ended Lab Report ☒ Project(Presentation)
CO-2	Conduct independent research, literature survey and learning of new technologies and concepts as appropriate to design, develop and validate the solution.	**PO-12**	Affective Level 5 (Internalize)	☐Programming ☐ Experiment ☐ Open-ended Lab ☒Demonstration ☐ Practice Lab	☐ Lab Performance ☐ Lab Test ☐ Lab Report ☐ Open-ended Lab Report ☒ Project(Presentation)
CO-3	Assess the impact of the solution of the engineering project in terms of societal, health, safety, legal and cultural context.	**PO-6**	Cognitive Level 4 (Evaluate)	☐Programming ☐ Experiment ☐ Open-ended Lab ☒Demonstration ☐ Practice Lab	☐ Lab Performance ☐ Lab Test ☐ Lab Report ☐ Open-ended Lab Report ☒ Project(Presentation)
CO-4	Analyze the sustainability and impact of solution of the proposed project in terms of environmental consideration.	**PO-7**	Affective Level 5 (Internalize)	☐Programming ☐ Experiment ☐ Open-ended Lab ☒Demonstration ☐ Practice Lab	☐ Lab Performance ☐ Lab Test ☐ Lab Report ☐ Open-ended Lab Report ☒ Project(Presentation)
CO-5	Communicate effectively through writings, technical reports, deliverables, presentations and verbal communication as appropriate at various stages of project development.	**PO-10**	Affective Level 4 (Organize)	☐Programming ☐ Experiment ☐ Open-ended Lab ☒Demonstration ☐ Practice Lab	☐ Lab Performance ☐ Lab Test ☐ Lab Report ☐ Open-ended Lab Report ☒ Project(Presentation)

Teaching-Learning Strategies:

Teaching strategies for this course consist of project meetings with students as well as hands-on guidance sessions. The teaching-learning activities of the course comprises of two parts: Instructional part and technical demonstration part.

The Instructional Part includes the following activities:

• Concept of the research project, expected outcomes, assessment policy, project checklist etc.
• Introduction to engineering design process including formulation of problem, analysis of objectives, specifications and requirements, consideration of realistic constraints, engineering standards and impact of engineering solutions, design of solution, implementation, evaluation and validation of the solution
• Preparation of project proposal, estimation, project management and scheduling etc.
• Implication of engineering ethics and professional practices.
• Safety concern in engineering design.
• Contemporary issues and life-long learning
• Overview of project proposal writing and presentation techniques
• Guidelines for teamwork building

The Technical Demonstration part focuses the following activities:
• Literature review, technical reading and research process
• Identification and formulation of research project problem
• Analysis of objectives, requirements and specifications
• Project plan, proposal and management
• Documentation, project proposal writing, oral presentation etc.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in the research project report and viva-voce. Final numeric reward will be the compilation of:

- **Research Project Proposal Report** (60%)
- **Presentation & Viva-Voce** (40%)

COs	**Assessment tools (Total 100%)**		
	30%	**30%**	**40%**
	Internal examination	**External examination**	**Presentation & Viva-Voce**
CO1	√	√	√
CO2	√	√	√
CO3	√	√	√
CO4	√	√	√
CO5	√	√	√

ICE 4156 Industrial Training
25 Marks, 1 Credit

Prerequisite: None
Course Type: ☐ Theory ☒ Field Work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this course is to provide students with practical experiences with the ICT professionals in companies or Industries.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Develop work habits and attitude required for ICT professionals.	**PO-6, PO-8**	Affective Level 2 (Respond)	☒ Field work	☒ Field work report
CO-2	Develop communication and technical report writing skills.	**PO-10**	Affective Level 3 (Value)	☒ Field work	☒ Field work report
CO-3	Develop soft skills to work independently as well as in a group in a professional environment.	**PO-9, PO-11**	Affective Level 4 (Organize)	☒ Field work	☒ Field work report
CO-4	Gain practical experiences on how ICT industries maintain environmental practices and work towards sustainable development.	**PO-7, PO-12**	Affective Level 5 (Internalized)	☒ Field work	☒ Field work report

Fourth Year, Second Semester

ICE4211: Computer Networks
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: None
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this course is to provide a unified overview of data and computer communications. This course covers the details of different layers of the reference models for computer networking and data communication.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Explain the basic concepts of data communications and computer networking.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation
CO-2	Describe the functions of different layers of Open System Interconnection (OSI) reference model.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation
CO-3	Describe the functions of different layers of TCP/IP reference model.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation
CO-4	Analyze protocols of different layers.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation

Course Contents

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.

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.

Text Books:

1. W. Stallings : Data and Computer Communications
2. A. S. Tanenbaum : Computer Networks

Reference Books:

1. B. Forouzan : Data Communication Networking

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√	√	√	√
CO2	√		√	√
CO3	√	√	√	√
CO4	√	√	√	√

ICE4212: Computer Networks Lab

37.5 Marks, 1.5 Credits, 3 Hours/week

Prerequisite: None

Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective:

The objective of this lab is to introduce the implementation of computer network using network simulator tools such as Cisco Packet Tracer. This lab includes design of different classes of computer networks, analysis of network structures with different protocols including TCP/IP and UDP.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Implement different types of computer networks using the network simulator (Cisco Packet Tracer).	**PO-1, PO-5**	Psychomotor Level 4 (Articulate)	☒Programming ☒Experiment ☐Open-ended Lab ☒Demonstration	☒Lab Performance ☒Lab Test ☒Lab Report ☐Open-ended Lab Report

				☒Practice Lab	☐Project(Presentation)
CO-2	Design different classes of computer networks.	**PO-3**	Cognitive Level 4 (Create)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-3	Analyze the performance of the networks using different protocols including TCP/IP and UDP.	**PO-2**	Cognitive Level 4 (Analyze)	☒Programming ☒Experiment ☐Open-ended Lab ☒Demonstration ☒Practice Lab	☒Lab Performance ☒Lab Test ☒Lab Report ☐Open-ended Lab Report ☐Project(Presentation)
CO-4	Write individual or group report by solving open-ended problems with specific needs and requirements.	**PO-9**	Affective Level 4 (Organize)	☒Programming ☒Experiment ☒Open-ended Lab ☒Demonstration ☒Practice Lab	☒Lab Performance ☒Lab Test ☒Lab Report ☒Open-ended Lab Report ☐Project(Presentation)

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab test, assignments, open-ended lab report, quizzes, viva)** (20%)
- **Final exam** (70%)

COs	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab test/ Assignments/ Quizzes/ Viva	**Open-ended lab report/ Viva**	**Class performance**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3	√		√	√
CO4		√	√	

ICE4221: Computer Architecture and Microprocessor
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: ICE1121
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this course is to introduce the fundamental concepts of computer architecture. This course covers the evolution, organization and applications of microprocessor.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Explain the basic design	**PO-1**	Cognitive Level 2	☒Lecture notes	☒ Class test

	concepts of computer architecture.		(Understand)	☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation
CO-2	Describe the functions of ALU, control design and memory organization.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation
CO-3	Analyze the operation of the arithmetic unit including the algorithms & implementation of fixed-point and floating-point operation.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation
CO-4	Explain the architecture and organization of 8086 microprocessor.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation

Course Contents

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.

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.

Text Books:

1. John P. Hayes **:** Computer Architecture and Organization
2. Mohamed Rafiquzzaman **:** Microprocessors: Theory and Applications

Reference Books:

1. Barry B. Brey **:** Microprocessor Hardware Interfacing and Application
2. P. Pal Choudhury **:** Computer Organization and Design

3. M. Morris Manno **:** Computer System and Architecture

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

CO No.	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√
CO4		√	√	√

ICE4222: Computer Architecture and Microprocessor Lab

37.5 Marks, 1.5 Credits, 3 Hours/week

Prerequisite: None

Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this lab course is to introduce the assembly language programming with 8086 microprocessors. This lab course provides the students with hands-on experience on interfacing of different peripherals to microprocessor.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Write assembly language programs to solve practical problems and interfacing of different peripherals using 8086 microprocessor trainer kit.	**PO-5**	Psychomotor Level 4 (Articulate)	☒Programming ☒Experiment ☐Open-ended Lab ☒Demonstration ☒Practice Lab	☒Lab Performance ☒Lab Test ☒Lab Report ☐ Open-ended Lab Report ☐Project(Presentation)
CO-2	Write individual or group report by solving open-ended problems with specific needs and requirements using assembly language. Write individual or group report by solving open-ended problems with specific needs and requirements using assembly language.	**PO-9**	Affective Level 4 (Organize)	☐ Programming ☐ Experiment ☒ Open-ended Lab ☐ Demonstration ☒ Practice Lab	☐ Lab Performance ☒ Lab Test ☐ Lab Report ☒ Open-ended Lab Report ☐ Project(Presentation)

Assessment and Evaluation Strategy:

Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab test, assignments, open-ended lab report, quizzes, viva)** (20%)
- **Final exam** (70%)

Cos	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab test/ Assignments/ Quizzes/ Viva	**Open-ended lab report/ Viva**	**Class performance**	**Final exam**
CO1	√		√	√
CO2		√	√	

ICE4231: Information Theory and Coding
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: STAT1211, ICE3221

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this course is to introduce the fundamental principles of information theory. This course covers measuring information in terms of probability and other statistical approaches and channel capacity with or without noise. It also discusses the basic concepts of source coding and data compression techniques.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Explain the fundamental concepts of information theory including probability, entropy and their inter-relationships.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Analyze and compute entropy and mutual information of channel and information sources.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Explain different source and channel coding theorems.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-4	Analyze different data compression and source coding techniques.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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 and 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.

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.

Text Books:

1. TM Cover, JA Thomas : Elements of Information Theory

Reference Books:

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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class tests /Assignments /Quizzes 1 & 2	Class tests /Assignments /Quizzes 3 & 4	Class participation	Final exam
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√
CO4		√	√	√

ICE4241 Cryptography
75 Marks, 3 credits, 3 Hours/week, Lectures: 42, Exam. Time: 3 hours

Prerequisite: None
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this course is to introduce the fundamental concepts of cryptographic techniques. This course covers the confidentiality, key management, digital signature and authentication and their applications.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Explain the fundamental concepts of computer security, services and mechanisms.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☐ Assignment ☐ Participation ☐ Presentation
CO-2	Analyze the popular secret key and public key cryptosystems to exchange message in a secure manner.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☒Discussion ☐ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☒ Presentation
CO-3	Explain the concept of different key management techniques.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☒ Presentation
CO4	Analyze message authentication algorithms using MAC and hash function.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☐ Assignment ☐ Participation ☐ Presentation

Course Contents

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.

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, Digital signature, Elgamal digital signature scheme, Schnorr digital signature scheme, Mutual authentication, One-way authentication, Digital signature standard.

Text Books

1. William Stallings : Cryptography and Network Security

Reference Books

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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√	√	√	√
CO3		√	√	√

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

Prerequisite: None

Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this lab is to provide basic concept of private and public key cryptosystem. This course also provides different cryptographic and key sharing algorithms for secure data communication.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Demonstrate the concept of private and public key cryptosystem.	**PO-1, PO-5**	Psychomotor Level 4 (Articulate)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☐ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☐ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)

CO-2	Analyze popular key sharing algorithms both for private and public key cryptosystem.	**PO-2**	Cognitive Level 4 (Analyze)	☒ Programming ☒ Experiment ☒ Open-ended Lab ☐ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☐ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-3	Apply cryptographic concepts to provide security in data communication.	**PO-2**	Cognitive Level 3 (Apply)	☒ Programming ☒ Experiment ☒ Open-ended Lab ☐ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☐ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)

Assessment and Evaluation Strategy:

Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab test, assignments, open-ended lab report, quizzes, viva)** (20%)
- **Final exam** (70%)

COs	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab test/ Assignments/ Quizzes/ Viva	**Open-ended lab report/ Viva**	**Class performance**	**Final exam**
CO1	√		√	√
CO2		√	√	

ICE4251: Robotics and Automation
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: None

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this course is to introduce the concepts of robotic system and its components, instrumentation and control of robotics. The course also provides the AI and machine learning approaches used in robot for human-robot interaction.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Explain the fundamentals of robotics and its components.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☒ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation
CO-2	Design robotic system using the kinematics and dynamics of robotics.	**PO-3**	Cognitive Level 4 (Create)	☒Lecture notes ☒ Text books ☐Discussion ☒ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation
CO-3	Explain the needs of	**PO-1**	Cognitive Level 2	☒Lecture notes	☒ Class test

	instrumentation and control for implementation of robotic system.		(Understand)	☒ Text books ☐Discussion ☒ Audio/video ☒ Web material	☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation
CO-4	Apply the AI and machine learning techniques in robotics for human-robot interaction.	**PO-2**	Cognitive Level 3 (Apply)	☒Lecture notes ☒ Text books ☐Discussion ☒ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation

Course Contents

Introduction to Robotics: Types and components of a robot, Classification of robots, Kinematics systems; Definition of mechanisms and manipulators, Degrees of Freedom.

Robot Kinematics and Dynamics: Kinematic modeling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Forward and inverse kinematics, Jacobian, Singularity, and Statics Dynamic Modeling: Forward and inverse dynamics, Equations of motion using Euler-Lagrange formulation, Newton Euler formulation.

Sensors: Contact and Proximity, Position, Velocity, Force, Tactile, Introduction to Cameras, Camera calibration, Geometry of Image formation, Euclidean /Affine /Projective transformations, Vision applications in robotics.

Robot Actuation Systems: Actuators: Electric, Hydraulic and Pneumatic, Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators.

Robotics Control: Transformation of Coordinates, Jacobians, Modeling Control, Control laws: P, PD, PID, Linear and Non-linear controls, Basics of control: open loop- closed loop, Transfer functions, Motion and path planning, Collision avoidance and navigation.

Control Hardware and Interfacing: Embedded systems: Microcontroller Architecture and integration with sensors, actuators, components, Programming Applications for Industrial robot - programming in – VAL II.

AI and Machine Learning for Robotics: Introduction to Machine Learning Theory Applications, Decision tree modeling, logical reasoning, Probability theory and Bayesian methods, Classification methods and clustering techniques, Bio-inspired artificial intelligence algorithms, Reinforcement learning.

Human-Robot Interaction: Introduction to Human-Robot Interaction, Human-Robot Interactive Systems, Natural User Interface, Natural Language User Interface, Safe Human-Robot Interaction, Robot programming for collaborative tasks.

Text Books:

1. Saeed. B. Niku : Introduction to Robotics: Analysis, Systems, Applications
2. Roland Siegwart, Illah Reza Nourbakhsh : Introduction to Autonomous Mobile Robots

Reference Books:

3. J. J Craig : Introduction to Robotics: Mechanics and Control
4. K.S. Fu, R.C. Gonzalez and C.S.G. Lee : Robotics: Control, Sensing, Vision and Intelligence

Assessment and Evaluation Strategy:

Students will be assessed on basis of their overall performance in the final examination, class tests/assignments/quizzes, and class participation. Final numeric reward will be the compilation of:

- **Four class tests/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final examination** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3	√	√	√	√
CO4		√	√	√

ICE4252: Robotics and Automation Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Prerequisite: None

Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this lab is to perform different types of transformations used for controlling the robotic system. This lab also includes controlling the robot movement, and using AI and machine learning algorithms for decision making by robot.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Write and debug programs to perform different types of transformations using ROS environment.	**PO-1, PO-5**	Psychomotor Level 4 (Articulate)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-2	Design and manipulate different component of a robotic system.	**PO-3**	Cognitive Level 4 (Create)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-3	Apply AI and machine learning algorithm for making decision by the robot.	**PO-2**	Cognitive Level 3 (Apply)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)

CO-4	Write individual and group report by solving open-ended problems.	**PO-9**	Affective Level 4 (Organize)	☐ Programming ☐ Experiment ☒ Open-ended Lab ☐Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☐ Lab Report ☒ Open-ended Lab Report ☐ Project(Presentation)

Assessment and Evaluation Strategy:

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

- **Continuous assessment** (lab test, assignments, open-ended lab report, quizzes, viva) (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab Test /Assignments /Quizzes	**Open-ended lab report/ Viva**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3	√		√	√
CO4		√	√	

ICE4261 Internet of Things
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: None

Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this course is to provide the basic concepts of the interconnection between of the physical world and the cyber space. This course includes IoT network, protocol and security of IoT systems. This course also covers Arduino and Raspberry Pi programming for IoT.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Explain the basic concepts of IoT.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☒ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation
CO-2	Recognize the building blocks and communication protocols of IoT.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☒ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation

CO-3	Design and program IoT devices using modern tools.	**PO-3, PO-5**	Cognitive Level 4 (Create)	☒Lecture notes ☒ Text books ☐Discussion ☒ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation
CO-4	Explain the security and safety issues of IoT.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☒ Audio/video ☒ Web material	☒ Class test ☒ Final exam ☒ Assignment ☒ Participation ☐ Presentation

Course Contents

Introduction and Applications: Key features, Technological trends of IoT, Design and modeling IoT systems, Smart and connected products and operation, Application of IoT in Smart homes, Smart cities, Smart manufacturing and automotive domains, etc.

IoT Architecture and Platform: Components of IoT architecture, IoT Service as a Platform, IoT Security and Interoperability, IoT system management. IoT platforms design methodology.

IoT Communication Protocols: HTTP, UPnp, LoRa, CoAP, MQTT, XMPP.

Industrial IoT (IIoT): Industry 4.0, IIoT architecture, Basic technologies, IIoT research and development, Research challenges and applications of IIoT.

IoT Devices: Sensors, Wearable devices, Embedded system and its components, Introduction to Adriano and Raspberry pi, Interactions of embedded systems with the physical world.

Arduino and Raspberry Pi Programming: Introduction, IDE, Exploring the programming languages (C/C++) syntax, Coding, Compiling, and uploading to the microcontroller for sensing and controlling devices, Working with communication modules such as Bluetooth and WiFi.

IoT Network Models and Events Analysis: Events, Networks, Devices and hubs, Single and multi-hub networks, Network models, Event populations, Stochastic event populations, Environmental interaction model, Event transport and migration.

Security and Safety: System security, Network security, Generic application security, Application process security, Run-time monitoring, ARMET approach, Privacy and dependability.

Text Books:

1. Dimitrios Serpanos and Marilyn Wolf : Internet-of-Things (IoT) Systems Architectures, Algorithms, Methodologies
2. Joe Biron and Jonathan Follett : Foundational Elements of an IoT Solution The Edge, The Cloud, and Application Development

Reference Books:

3. Mansaf Alam, Kashish Ara Shakil and Samiya Khan Editors : Internet of Things (IoT) Concepts and 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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√	√	√	√
CO3		√	√	√
CO4		√	√	√

ICE4262 Internet of Things Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Prerequisite: None
Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this lab is to explore the basic Arduino and Raspberry Pi Programming. The lab includes the programming to read data from sensor and control different IoT devices.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Write and debug programs to solve different practical problems with IDE.	**PO-5**	Psychomotor Level 4 (Articulate)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-2	Write individual and group report by solving open-ended problems using the IDE.	**PO-9**	Affective Level 4 (Organize)	☐ Programming ☐ Experiment ☒ Open-ended Lab ☐Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☐ Lab Report ☒ Open-ended Lab Report ☐ Project(Presentation)

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

- **Continuous assessment** (lab test, assignments, open-ended lab report, quizzes, viva) (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Lab Test /Assignments /Quizzes	Open-ended lab report/ viva	Class participation	Final exam
CO1	√		√	√
CO2		√	√	

ICE4271: Information Security
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: None
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this course is to provide an overview of information security. This course also covers various types of security incidents and attacks, and methods to prevent, detect and countermeasures against security incidents and attacks.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Correspond-ing PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Describe the fundamental concepts of information security, services, and mechanism.	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-2	Explain various Information security threat and controls for it.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Analyze a security incidents and design countermeasures.	**PO-2**	Cognitive Level 4 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-4	Apply the common key cryptography and public key cryptography to protect confidentiality, authenticity and completeness of data.	**PO-2**	Cognitive Level 3 (Apply)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

Introduction of Information Security: Definition, examples of information security incidents, Information Security management, The concept of information security (confidentiality, Integrity,

Availability), Basic terminologies of Information Security, Human Aspects of Information Security, Social Engineering.

Information Security for Server Systems and Client devices: Attacks to Server Systems connected to the Internet and Counter measures, Attacks to Web Servers and counter measures, Denial of Services Attacks, Attacks to Network Systems, Attacks to Personal Computers and smart phones, and counter measures, intrusion of malicious software, Stolen and lost devices.

Information Security Risk Management Exercise: Identify Information Assets, Identify Security Risk and evaluation, Risk Treatment, Presentation of exercise result, Information Security Governance, Information security management system (ISMS), Information Security Policy, Standards and Procedures, Information Security Evaluation.

Security Incident Response: What is Security Incident response, Computer Security Incident response team, Incident response exercise.

Information Security and Cryptography: Requirement for Secure Communication, a model for network security, classic cryptography, modern cryptography, *Number theory:* Modular arithmetic, Euclid's algorithm, Finite fields, Polynomial arithmetic, prime number, Fermat's and Euler's theorem, Testing for primality, The Chinese Remainder theorem, Discrete logarithms.

Private and Public Key Cryptography: Common key cryptography algorithms: DES, Triple DES, AES, Encryption modes, exercise on common key cryptography, public key cryptography, Applications for public-key cryptosystems, Requirements for public-key cryptography, the RSA algorithm, Elliptic Curve Cryptography (ECC), Exercise of public key cryptography.

Data Integrity and Digital Signature: Integrity of Data, Hash Function, *Cryptographic Hash Functions:* two simple hash function, applications, requirements and security, SHA; *Message Authentication Codes (MAC):* requirements, functions, HMAC; *Digital Signatures*: Digital signature, Digital signature standard, Mutual authentication, One-way authentication, Digital signature standard.

Mutual Trust: Symmetric key distribution using symmetric encryption and asymmetric encryption, distribution of public keys, public key infrastructure, X.509 Certificates, *Diffie-Hellman Key exchange:* The algorithm, key exchange protocols, Man-in-the-middle attack; key exchange using ECC, Key certificate: Digital Signature of Public key, Public key Infrastructure (PKI) and Certificate Authority, Exercise on PKI.

Text Books:

1. Michael E. Whitman and H. Mattord **:** Principles of Information Security
2. William Stallings **:** Cryptography and Network Security

Reference Books:

3. Christof Paa and Jan Pelzl : Understanding Cryptography: A Textbook for Students and Practitioners

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	Assessment Tools (Total 100%)			
	20%		10%	70%
	Class tests /Assignments /Quizzes 1 & 2	Class tests /Assignments /Quizzes 3 & 4	Class participation	Final exam
CO1	√	√	√	√
CO2	√		√	√
CO3	√	√	√	√
CO4	√	√	√	√

ICE4272: Information Security Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Prerequisite: None

Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective:

The objective of this lab is to provide an introduction to the broad field of computer, network, and information security. This course covers cryptographic algorithms and protocols for achieving network security.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Write programs to demonstrate the concepts related to applied cryptography, including plain-text, cipher-text.	**PO-5**	Psychomotor Level 4 (Articulate)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-2	Apply the algorithms of symmetric cryptography, asymmetric cryptography, and digital signatures for information security and authentication.	**PO-1**	Cognitive Level 3 (Apply)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-3	Analyze the security mechanism of different cryptographic algorithms.	**PO-2**	Cognitive Level 4 (Analyze)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-4	Analyze the common network vulnerabilities and attacks, defense mechanisms and cryptographic protection mechanisms.	**PO-2**	Cognitive Level 4 (Analyze)	☐ Programming ☐ Experiment ☒ Open-ended Lab ☐ Demonstration ☒ Practice Lab	☐ Lab Performance ☐ Lab Test ☐ Lab Report ☒ Open-ended Lab Report ☐ Project(Presentation)

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab test, assignments, quiz, viva-voce)** (20%)
- **Final exam** (70%)

COs	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab test/ Quiz/ Viva 1 & 2	**Open-ended lab report/ viva**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3	√		√	√
CO4		√	√	

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab test, assignments, quizzes, viva)** (20%)
- **Final exam** (70%)

COs	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab test 1/ Quizzes/ Viva	**Lab test 2/ Quizzes/ Viva**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3		√	√	√
CO4		√	√	√

ICE4281: Web Engineering
75 Marks, 3 Credits, 3 Hours/week, Lectures: 42, Exam time: 3 hours

Prerequisite: ICE3251
Course Type: ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objective of this course is to address the basic concept associated with web application development. It includes requirements analysis, architecture, modeling, design and testing of web application. The course also provides technologies for web application development and web project management.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Correspond-ing PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Describe engineering concept of developing web applications and	**PO-1**	Cognitive Level 1 (Remember)	☒Lecture notes ☒ Text books ☐Discussion	☒ Class test ☒ Final exam ☒ Assignment

	programming concepts used in web application development.			☐ Audio/video ☐ Web material	☐ Participation ☐ Presentation
CO-2	Explain web application programs with HTML, CSS, and JavaScript used in both client and server side.	**PO-1**	Cognitive Level 2 (Understand)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-3	Analyze programs with respect to their performance, correctness, possible output and errors.	**PO-2**	Cognitive Level 3 (Analyze)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation
CO-4	Apply knowledge and understanding to solve interactive web application problems and projects under specific requirements.	**PO-11**	Affective Level 3 (Value)	☒Lecture notes ☒ Text books ☐Discussion ☐ Audio/video ☐ Web material	☒ Class test ☒ Final exam ☒ Assignment ☐ Participation ☐ Presentation

Course Contents

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.

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.

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

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/Assignments/Quizzes** (20%)
- **Class participation** (10%)
- **Final exam** (70%)

COs	**Assessment Tools (Total 100%)**			
	20%		**10%**	**70%**
	Class tests /Assignments /Quizzes 1 & 2	**Class tests /Assignments /Quizzes 3 & 4**	**Class participation**	**Final exam**
CO1	√	√	√	√
CO2	√		√	√
CO3	√	√	√	√
CO4		√	√	√

ICE4282: Web Engineering Lab
37.5 Marks, 1.5 Credits, 3 Hours/week

Prerequisite: None

Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Course Objective

The objective of this lab is to develop web application programs using HTML, CSS, and Java Script. The lab also intended to design, implementation and testing the principles of Web-based applications using the Web engineering concepts.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Write web application programs with HTML, CSS, JavaScript to solve	**PO-5**	Psychomotor Level 4 (Articulate)	☒ Programming ☒ Experiment	☒ Lab Performance ☒ Lab Test

	problems.			☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-2	Apply knowledge and understanding to solve interactive web development problems and project with their solutions under specific requirements.	**PO-4**	Cognitive Level 4 (Create)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-3	Analyze programs with respect to their performance, correctness, possible output, and errors.	**PO-4**	Cognitive Level 4 (Create)	☒ Programming ☒ Experiment ☐ Open-ended Lab ☒ Demonstration ☒ Practice Lab	☒ Lab Performance ☒ Lab Test ☒ Lab Report ☐ Open-ended Lab Report ☐ Project(Presentation)
CO-4	Write individual or group report by solving open-ended web application projects with specific needs and requirements.	**PO-9**	Affective Level 4 (Organize)	☐ Programming ☐ Experiment ☒ Open-ended Lab ☐ Demonstration ☒ Practice Lab	☐ Lab Performance ☐ Lab Test ☐ Lab Report ☒ Open-ended Lab Report ☐ Project(Presentation)

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in the final exam, lab tests, assignments, class participation, quizzes and viva voice. Final numeric reward will be the compilation of:

- **Class participation** (10%)
- **Continuous assessment (lab test, assignments, quiz, viva-voce)** (20%)
- **Final exam** (70%)

COs	**Assessment tools (Total 100%)**			
	20%		**10%**	**70%**
	Lab test/ Quiz/ Viva 1 & 2	**Open-ended lab report/ viva**	**Class participation**	**Final exam**
CO1	√		√	√
CO2	√		√	√
CO3	√		√	√
CO4		√	√	

ICE 4254: Research Project – Phase II
75 Marks, 3 Credits, 6 Hours/week

Prerequisite: None
Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Course Objective
The objectives of the research project are to:

- Prepare students to systematically review the existing literatures and to find possibly real-world engineering problems,
- Provide students with opportunity to apply and integrate their previously acquired engineering knowledge to formulate and find the solution of engineering problems,

- Enhance students' creativity in analyzing and solving complex and possibly real-world engineering problems,
- Train students with skills on systematic design and development process and documentation to the solution of engineering project,
- Prepare students to develop and enhance self-learning ability,
- Aware students regarding professional practices, norms and ethical responsibilities in regards to designing engineering solution,
- Prepare students to understand and evaluate the impact of engineering solutions to the society, health, safety, reliability, legal, cultural, and social aspects,
- Prepare students to understand and evaluate the sustainability and impact of engineering solution towards environment,
- Create an environment to promote team approach in engineering problem solving,
- Develop communication skill among students through complex activities, technical report writing, oral presentations etc.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Correspon-ding PO	Domain/ level of learning taxonomy	Delivery methods and activities	Assessment tools
CO-1	Specify a solvable complex engineering problem preferably relevant to the current and future industry through appropriate research methodology.	**PO-2**	Cognitive Level 4 (Create)	☐Programming ☐ Experiment ☐ Open-ended Lab ☒Demonstration ☐ Practice Lab	☐ Lab Performance ☐ Lab Test ☐ Lab Report ☐ Open-ended Lab Report ☒ Project(Presentation)
CO-2	Specify the objectives, specifications, functional and non-functional requirements, and constraints as well as applicable compliance, standards and codes of practice to the solution of the engineering problem.	**PO-2**	Cognitive Level 4 (Create)	☐Programming ☐ Experiment ☐ Open-ended Lab ☒Demonstration ☐ Practice Lab	☐ Lab Performance ☐ Lab Test ☐ Lab Report ☐ Open-ended Lab Report ☒ Project(Presentation)
CO-3	Assess the impact of the solution of the engineering project in terms of societal, health, safety, legal and cultural context.	**PO-6**	Affective Level 4 (Organize)	☐Programming ☐ Experiment ☐ Open-ended Lab ☒Demonstration ☐ Practice Lab	☐ Lab Performance ☐ Lab Test ☐ Lab Report ☐ Open-ended Lab Report ☒ Project(Presentation)
CO-4	Evaluate the sustainability and impact of solution of the proposed project in terms of environmental consideration.	**PO-7**	Affective Level 5 (Internalize)	☐Programming ☐ Experiment ☐ Open-ended Lab ☒Demonstration ☐ Practice Lab	☐ Lab Performance ☐ Lab Test ☐ Lab Report ☐ Open-ended Lab Report ☒ Project(Presentation)
CO-5	Design multiple engineering solutions of the problem to meet the desired objectives, need and requirements within the given constraints.	**PO-4**	Psychomotor Level 5 (Embody)	☐Programming ☐ Experiment ☐ Open-ended Lab ☒Demonstration ☐ Practice Lab	☐ Lab Performance ☐ Lab Test ☐ Lab Report ☐ Open-ended Lab Report ☒ Project(Presentation)
CO-6	Analyze alternative design solutions of engineering	**PO-4**	Psychomotor Level 3	☐Programming ☐ Experiment	☐ Lab Performance ☐ Lab Test

	problem in order to find the most appropriate one considering cost, efficiency, usability, manufacturability, impact, sustainability, maintainability etc.		(Perfect)	☐ Open-ended Lab ☒Demonstration ☐ Practice Lab	☐ Lab Report ☐ Open-ended Lab Report ☒ Project(Presentation)
CO-7	Evaluate the performance of the developed solution with respect to the given specifications, requirements and standards.	**PO-4**	Psychomotor Level 4 (Articulate)	☐Programming ☐ Experiment ☐ Open-ended Lab ☒Demonstration ☐ Practice Lab	☐ Lab Performance ☐ Lab Test ☐ Lab Report ☐ Open-ended Lab Report ☒ Project(Presentation)
CO-8	Use modern engineering and IT tools to design, develop and validate the solution.	**PO-5**	Psychomotor Level 4 (Articulate)	☐Programming ☐ Experiment ☐ Open-ended Lab ☒Demonstration ☐ Practice Lab	☐ Lab Performance ☐ Lab Test ☐ Lab Report ☐ Open-ended Lab Report ☒ Project(Presentation)
CO-9	Conduct independent research, literature survey and learning of new technologies and concepts as appropriate to design, develop and validate the solution.	**PO-12**	Affective Level 5 (Internalize)	☐Programming ☐ Experiment ☐ Open-ended Lab ☒Demonstration ☐ Practice Lab	☐ Lab Performance ☐ Lab Test ☐ Lab Report ☐ Open-ended Lab Report ☒ Project(Presentation)
CO-10	Demonstrate project management skill in various stages of developing the solution of engineering design project.	**PO-11**	Affective Level 4 (Organize)	☐Programming ☐ Experiment ☐ Open-ended Lab ☒Demonstration ☐ Practice Lab	☐ Lab Performance ☐ Lab Test ☐ Lab Report ☐ Open-ended Lab Report ☒ Project(Presentation)
CO-11	Perform cost-benefit and economic analysis of the solution.	**PO-11**	Cognitive Level 4 (Analyze)	☐Programming ☐ Experiment ☐ Open-ended Lab ☒Demonstration ☐ Practice Lab	☐ Lab Performance ☐ Lab Test ☐ Lab Report ☐ Open-ended Lab Report ☒ Project(Presentation)
CO-12	Apply ethical considerations and professional responsibilities in designing the solution and throughout the project development phases.	**PO-8**	Affective Level 3 (Value)	☐Programming ☐ Experiment ☐ Open-ended Lab ☒Demonstration ☐ Practice Lab	☐ Lab Performance ☐ Lab Test ☐ Lab Report ☐ Open-ended Lab Report ☒ Project(Presentation)
CO-13	Perform effectively as an individual and as a team member for successfully completion of the project.	**PO-9**	Affective Level 4 (Organize)	☐Programming ☐ Experiment ☐ Open-ended Lab ☒Demonstration ☐ Practice Lab	☐ Lab Performance ☐ Lab Test ☐ Lab Report ☐ Open-ended Lab Report ☒ Project(Presentation)
CO-14	Communicate effectively through writings, journals, technical reports, deliverables, presentations	**PO-10**	Affective Level 5 (Internalize)	☐Programming ☐ Experiment ☐ Open-ended Lab ☒Demonstration	☐ Lab Performance ☐ Lab Test ☐ Lab Report ☐ Open-ended Lab

	and verbal communication as appropriate at various stages of project development.			☐ Practice Lab	Report ☒ Project(Presentation)

Teaching-Learning Strategies:
Teaching strategies for this course consist of project meetings with students as well as hands-on guidance sessions. The teaching-learning activities of the course comprises of two parts: Instructional part and technical demonstration part.
The Instructional Part includes the following activities:

• Concept of the research project, expected outcomes, assessment policy, project checklist etc.
• Introduction to engineering design process including formulation of problem, analysis of objectives, specifications and requirements, consideration of realistic constraints, engineering standards and impact of engineering solutions, design of solution, implementation, evaluation and validation of the solution
• Preparation of project report, estimation, project management and scheduling etc.
• Implication of engineering ethics and professional practices.
• Safety concern in engineering design.
• Contemporary issues and life-long learning
• Overview of project report writing and presentation techniques
• Guidelines for teamwork building

The Technical Demonstration part focuses the following activities:
• Literature review, technical reading and research process
• Identification and formulation of research project problem
• Analysis of objectives, requirements and specifications
• Project plan, project development and management
• Documentation, project report writing, oral presentation etc.

Assessment and Evaluation Strategy:
Student will be assessed on basis of their overall performance in the research project report and viva-voce. Final numeric reward will be the compilation of:

- **Research Project Report** (60%)
- **Presentation & Viva-Voce** (40%)

COs	**Assessment tools (Total 100%)**		
	30%	**30%**	**40%**
	Internal examination	**External examination**	**Presentation & Viva-Voce**
CO1	√	√	√
CO2	√	√	√
CO3	√	√	√
CO4	√	√	√
CO5	√	√	√
CO6	√	√	√
CO7	√	√	√
CO8	√	√	√
CO9	√	√	√
CO10	√	√	√
CO11	√	√	√
CO12	√	√	√

CO13	√	√	√
CO14	√	√	√

ICE4210: Viva-Voce
50 Marks, 2 Credits

Prerequisite:

Course Type: ☐ Theory ☐ Laboratory work ☐ Project work ☒ Viva Voce

Course Objective

The objective of the course is to enable students to express verbally their knowledge gained from the theory and lab courses of Fourth Year in an effective and clear manner.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain/ level of learning taxonomy	Assessment tools
CO-1	Communicate and express verbally the knowledge obtained in an effective and clear manner.	**PO-10**	Affective Level 2 (Respond)	☒ Viva Voce