BANGLADESH ARMY UNIVERSITY OF ENGINEERING & TECHNOLOGY (BAUET)
Qadirabad, Natore-6431

Outcome Based Education (OBE) Curriculum (Revised)

Effective from Session 2023-2024

Department of Information and Communication Engineering (ICE)

PREFACE TO THIRD EDITION

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

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

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

The rules and regulations in this syllabus are subject to periodic revision in accordance with administrative policy. Therefore, every concerned are strongly advised to be in touch with the department. Head, Department of Information and Communication Engineering (ICE), Bangladesh Army University of Engineering & Technology (BAUET).

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

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CHAPTER 1: GENERAL INFORMATION (PART-A)

1.1 Program Title

Bachelor of Science in Information and Communication Engineering.

1.2 Name of the University

Bangladesh Army University of Engineering & Technology (BAUET).

1.3 Vision of University

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

1.4 Missions of BAUET

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

1.5 Name of the Department

The name of program offering entity is "Department of Information and Communication Engineering" in abbreviated form "Dept. of ICE" which is under the Faculty of Electrical & Computer Engineering (Faculty of ECE) of Bangladesh Army University of Engineering & Technology (BAUET), Qadirabad Cantonment, Natore-6431, Bangladesh.

1.6 Vision of the Department

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

1.7 Missions of the Department

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

- M1: To provide high quality state of the art education and knowledge in Information and Communication Engineering, capable of solving real-world complex engineering problems to meet the needs of industry and society.
- M2: To contribute towards the creation of new knowledge through emerging research and higher study in ICE and allied fields to address emerging national and global issues for well-being of the society.

- M3: To enable students in attaining required ethics with an attitude of entrepreneurial skills, ethical values and social consciences.
- M4: To embed leadership qualities amongst the students to follow successful professional career paths in Communication Engineering and a life-long learner in cutting edge developments in the field of Information Technology.

1.8 Objective of the Department

Currently the Department of Information and Communication Engineering is working with following objectives:

- To produce skilled IT Engineers who will meet the demands of industry and society by solving real-world problems in the field of Information Technology.
- To produce proficient graduates to contribute new knowledge through emerging research and innovation in national and international circumstances.
- To transfer, apply, and adapt Information and Communication Technology based knowledge to the society.
- To develop skill graduates who can communicate effectively and work collaboratively maintaining high level of ethical and professional values for improving the society.

1.9 Name of the Degree

The name of the degree is Bachelor of Science in Information and Communication Engineering in abbreviated form "B.Sc. in ICE".

1.10 Description of the Program

The program, Bachelor of Science in Information and Communication Engineering, focus in the intersection of Information Technology based on Electrical, Computer, and Communication Engineering. This focus is reflected by the incorporation of cutting-edge course curriculum in the field of Information Technology and Communication Engineering. The curriculum is organized in away so that students can choose their field of specialization from any of the fields, i.e., IT/Software Engineering or Communication Engineering without sacrificing the fundamental and basic study of core courses. The core and specialized courses got more focus both on Hardware and Software Engineering including Internet and Web Programing, Software Programing, Software Quality Assurance, Mobile Apps and games, Artificial Intelligence, Cyber Security, Ethical Hacking, Cloud Computing, Computer Vision, Computer networking, Satellite, Mobile and Telecommunication, Optical Fiber Communication, Microwave, Antenna and Radar Engineering, Digital Signal Processing, Microprocessor, Analog and Digital Electronics. The whole curriculum is developed based on latest guideline of Outcome-Based Education (OBE), Bangladesh National Qualifications Framework (BNQF) and UGC. Overall, the program curriculum is designed to play a vibrant role in building skilled ICT professional and researchers not only inside Bangladesh but also all over the world. It has overwhelming dominance in ICT-based higher education and research.

1.11 Graduate Attributes

The B. Sc. in ICE program has twelve following graduate attributes. By the time of graduation, students will have to achieve an acceptable minimum level of certain knowledge on these attributes.

No	Graduate Attributes
GA-1	Engineering Knowledge
GA-2	Problem Analysis
GA-3	Design/Development of Solutions

GA-4	Conduct Investigations of Complex Problems
GA-5	Modern Tool Usage
GA-6	Engineer and Society
GA-7	Environment and Sustainability
GA-8	Ethics
GA-9	Individual Work and Teamwork
GA-10	Communication
GA-11	Project Management and Finance
GA-12	Life Long Learning

The curriculum encompasses all the attributes of the Knowledge Profile (K1 – K8), the ranges of Complex Problem Solving (P1 – P7) and Complex Engineering Activities (A1 – A5) as given in the following subsequent section, respectively.

Attributes of Knowledge Profile (K1-K8)		
K1	**Natural Sciences**	A systematic, theory-based understanding of the natural sciences applicable to the discipline
K2	**Mathematics**	Conceptually-based mathematics, numerical analysis, statistics and the formal aspects of computer and information science to support analysis and modeling applicable to the discipline
K3	**Engineering fundamentals**	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
K4	**Specialist knowledge**	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline
K5	**Engineering design**	Knowledge that supports engineering design in a practice area
K6	**Engineering practice**	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
K7	**Comprehension**	Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the professional responsibility of an engineer to public safety; the impacts of engineering activity: economic, social, cultural, environmental and sustainability
K8	**Research literature**	Engagement with selected knowledge in the research literature of the discipline

Attributes of Range of Complex Engineering Problem Solving (P1-P7)	
Attributes	**Complex Engineering Problems** have characteristic P1 and some or all of P2 to 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

Attributes of Range of Complex Engineering Activities (A1-A5)	
Attributes	**Complex activities** mean (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

Bloom's Taxonomy Domain:

Cognitive Domain		**Psychomotor Domain**		**Affective Domain**	
C1	Remembering	**P1**	Perception	**A1**	Receive
C2	Understanding	**P2**	Set	**A2**	Respond
C3	Applying	**P3**	Guided Response	**A3**	Value
C4	Analyzing	**P4**	Mechanism	**A4**	Organize
C5	Evaluating	**P5**	Complex Overt Response	**A5**	Internalize
C6	Creating/ Designing	**P6**	Adaption		
		P7	Origination		

1.12 Program Educational Objectives (PEOs)

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

1.13 Program Learning Outcomes (PLOs)

B.Sc. in ICE program of BAUET has 12 Program Learning Outcomes. They are briefly described in the following table.

PO	Category	Description
PLO1	**Engineering Knowledge**	Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in K1 to K4 respectively to the solution of complex engineering problems.
PLO2	**Problem Analysis**	Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. (K1 to K4)
PLO3	**Design/Development of Solutions**	Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. (K5)
PLO4	**Conduct Investigations of Complex Problems**	Conduct investigations of complex problems using research-based knowledge (K8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
PLO5	**Modern Tool Usage**	Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations. (K6)
PLO6	**Engineer and Society**	Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems. (K7)
PLO7	**Environment and Sustainability**	Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts. (K7)
PLO8	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. (K7)
PLO9	**Individual Work and Teamwork**	Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
PLO10	**Communication**	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PLO11	**Project Management and Finance**	Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PLO12	**Life Long Learning**	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

In order to access the 12 PLOs through CLOs, these PLOs has been subdivided, which are given with special code as Program Learning Outcome Indicator (PLOI), and been mapped with Knowledge

Profile (K), Complex Problem (P) and Complex Activity (A) in Table below. The PLOI to PLO mapping also has been shown in the Table below.

PLOs	PLOI Code	PLOI Statement	KP	CP	CA
PLO 1: Engineering Knowledge	P.01.1.C3	Apply information and concepts in natural science with the familiarity of	K1		
	P.01.2.C3	Apply information and concepts of mathematics to solve complex engineering problems with a range of conflicting requirements.	K2	P1 P2 P6	
	P.01.3.C3	Apply information and concepts in engineering fundamentals with the familiarity of issues.	K3		
	P.01.4.C3	Apply information and concepts in specialized engineering sciences with the in-depth of analysis of a complex engineering problem.	K4	P1 P3 P7	
PLO 2: Problem Analysis	P.02.1.C4	Identify and relate first principles of mathematics, natural sciences and engineering sciences to solve complex engineering problems.	K1 K2 K3	P1 P2 P6	
	P.02.2.C4	Formulate solutions, procedures, and methods to solve complex engineering problems.		P1 P4 P5	
	P.02.3.C4	Analyze and solves complex engineering problems reaching substantiated conclusion.	K4	P1 P2 P6	
	P.02.4.C5	Research literature and critically evaluates the validity and accuracy of existing solution methods using specialized engineering knowledge.	K4		
PLO 3: Design/ development of solutions	P.03.1.C2	Identify the different components or processes of complex engineering problems.		P1 P7 P3	
	P.03.2.C3	Develop solution for different components of complex engineering problem.		P1 P7 P3	
	P.03.3.C4	Develop probable solutions that meet specified needs with appropriate consideration for public health and safety, culture, societal and environmental considerations.	K5		
PLO 4: Investigation	P.04.1. P3	Design Experiment to test complex engineering problem for certain constrains through appropriate research.	K8	P1, P2, P6	
	P.04.2.C4	Analysis and Interpretation of collected data to provide valid conclusion acknowledging the limitations.			

	P.04.3.C6	Develop and Synthesis of complex engineering problems using substantial engineering knowledge.		P1 P4 P5	
PLO 5: Modern Tool Usage	P.05.1.C3	Select and apply appropriate techniques to solve complex engineering problems using modern engineering tools considering the limitations.		P1 P2 P6	
	P.05.2. P4	Use engineering tools for prediction and modeling of complex engineering problems considering the practice in Information and Communication Engineering discipline.		P1 P4 P5	
	P.05.3. P5	Create relevant resources for complex engineering problems using modern engineering tools.	K6	P1 P7 P3	
PO 6: The Engineer and Society	P.06.1.A3	Accepts and recognize the role of engineering in society, health, safety, legal and culture.			
	P.06.2.C5	Design solution for complex engineering problem in accordance with professional practices.	K7	P1 P3 P7	
PO 7: Environment and Sustainability	P.07.1.C5	Evaluate sustainability of complex engineering problems considering society and environment.	K7	P1 P2 P6	
	P.07.2.C5	Identify impact on society and environment for professional engineering solutions.	K7		
PO 8: Ethics	P.08.1. A5	Demonstrates knowledge of ethical standards (i.e. Code of Ethics)			
	P.08.2. A4	Demonstrates individual responsibilities based on norms of engineering practice.	K7		
PO 9: Individual and Teamwork	P.09.1.A2	Function as effective team leader/ member in multi-disciplinary problems.			
	P.09.2.A2	Displays good interpersonal skills as a member/leader.			
	P.09.3.A5	Demonstrate individual skills in solving multi- disciplinary problems.			
PO 10: Communication	P.10.1.A2	Demonstrates an ability to effectively give and respond to clear instructions.			A1 A3
	P.10.2.P3	Produces written engineering reports by applying principle-based approaches and design documentation on complex engineering activities for different stake holders.			A1 A5
	P.10.3.A2	Perform effective oral presentation on complex engineering activities.			A2 A4
	P.11.1.P4	Apply engineering management principles and economic decision making to solve engineering projects as a team.			

PO 11: Project Management and Finance	P.11.2.P4	Manage multi-disciplinary projects as a member/leader.			
	P.11.3.A5	Demonstrate competency in completing individual engineering project based on relevant management principles and economic models.			
PO 12: Lifelong Learning	P.12.1.A1	Investigate and gather information on a given engineering issue.			
	P.12.2.A4	Seek and use resources in solving engineering problems.			
	P.12.3.A5	Recognizing the need for continuing education and participation in the broadest context of technological change.			

1.14 PEO and their Mapping with Mission

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

No.	PEO Statements	Program Missions			
		M1	M2	M3	M4
PEO-1	Graduates of the program will have successful professional both in industry and government and/or will be able to successfully pursue advanced degrees.	Yes	Yes	No	No
PEO-2	Graduates will apply analysis, design, optimization and implementation skills in order to formulate and solve Information and Communication Engineering and multidisciplinary complex engineering problems.	Yes	Yes	No	No
PEO-3	Graduates will communicate effectively and work collaboratively maintaining high level of ethical and professional values for improving the society.	No	No	Yes	Yes
PEO-4	Graduates will take leadership positions in the industry and also initiate businesses offering innovative technical solutions to national and international problems.	No	No	Yes	Yes

1.15 Mapping PLOs with the PEOs

The relationship between the PLOs and PEOs are following:

No.	PO Statement	PEO-1	PEO-2	PEO-3	PEO-4
PLO-1	Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in K1 to K4 respectively to the solution of complex engineering problems.	**Yes**	No	No	No
PLO-2	Identify, formulate, research literature and analyse complex engineering problems reaching substantiated	**No**	**Yes**	No	No

No.	PO Statement	PEO-1	PEO-2	PEO-3	PEO-4
	conclusions using first principles of mathematics, natural sciences and engineering sciences. (K1 to K4)				
PLO-3	Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. (K5)	No	**Yes**	No	No
PLO-4	Conduct investigations of complex problems using research-based knowledge (K8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.	**Yes**	**Yes**	No	No
PLO-5	Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations. (K6)	**Yes**	No	**No**	No
PLO-6	Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems. (K7)	No	**Yes**	No	**No**
PLO-7	Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts. (K7)	**Yes**	No	**No**	**Yes**
PLO-8	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. (K7)	No	**Yes**	**Yes**	**No**
PLO-9	Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.	No	No	No	**Yes**
PLO-10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	**Yes**	No	No	**Yes**
PLO-11	Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	No	**No**	**No**	**Yes**
PLO-12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	**Yes**	**Yes**	No	No

1.16 Mapping Courses with the PLOs

The mapping among the course and PLOs are following:

Si	Courses	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
1st Year, 1st Semester													
1	Fundamental of ICT	✓	✓										
2	Fundamental of ICT Lab	✓	✓	✓									
3	Basic Electrical and Circuit Analysis	✓	✓										
4	Basic Electrical and Circuit Analysis Lab		✓			✓							
5	Engineering Physics	✓	✓										
6	Engineering Physics Lab	✓	✓			✓							
7	Differential and Integral Calculus	✓	✓	✓									
8	Technical Writing and Presentation									✓	✓		✓
9	Technical Writing and Presentation Lab										✓		✓
10	Bangladesh Studies: History and Culture						✓		✓				
1st Year, 2nd Semester													
11	Structured Programming Language	✓	✓	✓									
12	Structured Programming Language Lab	✓	✓	✓									
13	Analog Electronics	✓	✓	✓									
14	Analog Electronics Lab				✓	✓				✓			
15	Engineering Drawing & CAD Design	✓	✓	✓									
16	Linear Algebra and Vector Analysis	✓	✓										
17	Engineering Chemistry	✓		✓		✓							
18	Sociology and Economics						✓	✓	✓				
19	Financial and Managerial Accounting		✓			✓						✓	
2nd Year, 1st Semester													
20	Object Oriented Programming Languages	✓	✓	✓									
21	Object Oriented Programming Languages Lab	✓	✓	✓	✓								
22	Analog and Digital Communication	✓	✓	✓									
23	Analog and Digital Communication Lab	✓				✓							✓
24	Digital Logic Design	✓	✓	✓									
25	Digital Logic Design Lab			✓	✓					✓			
26	Discreate Mathematics	✓	✓	✓									
27	Numerical Methods	✓	✓										
28	Numerical Methods Lab	✓	✓										
2nd Year, 2nd Semester													
29	Data Structures and Algorithms	✓	✓	✓									
30	Data Structures and Algorithms Lab		✓	✓							✓		
31	Signals and Systems	✓	✓		✓								
32	Signals and Systems Lab	✓	✓			✓							
33	Optical Fiber Communication	✓	✓	✓									
34	Optical Fiber Communication Lab	✓				✓							✓
35	Electrical Drives and Instrumentation	✓		✓									
36	Electrical Drives and Instrumentation Lab					✓				✓	✓		
37	Differential Equation and Statistics	✓	✓	✓									
3rd Year, 1st Semester													

38	Operating System	✓	✓								✓		
39	Operating System Lab	✓									✓		
40	Database Management System	✓	✓										
41	Database Management System Lab	✓	✓			✓							
42	Java Programming	✓	✓	✓									
43	Java Programming Lab	✓				✓				✓			
44	Antenna Engineering and Satellite Com.	✓		✓									
45	Antenna Engineering and Satellite Com. Lab	✓			✓	✓							
46	Professional Ethics and Env. Protection			✓			✓		✓				✓
3rd Year, 2nd Semester													
47	Internet and Web Programming	✓	✓										
48	Internet and Web Programming Lab								✓		✓		
49	Microprocessor and Microcontroller	✓	✓	✓									
50	Microprocessor and Microcontroller Lab			✓		✓				✓		✓	
51	Digital Signal Processing	✓	✓	✓									
52	Digital Signal Processing Lab		✓	✓	✓	✓							
53	Computer Networking	✓		✓			✓						
54	Computer Networking Lab	✓	✓	✓			✓						
55	Mobile Application Development Lab					✓	✓			✓			
4th Year, 1st Semester													
56	Final Year Design Project/ Thesis		✓	✓					✓		✓	✓	✓
57	Seminar				✓						✓	✓	✓
58	Artificial Intelligence	✓	✓	✓									
59	Artificial Intelligence Lab					✓	✓	✓		✓			
63	Software Engineering	✓	✓	✓									
64	Software Engineering Lab				✓	✓				✓			
65	Computer and Cyber Security			✓					✓				
4th Year, 2nd Semester													
66	VLSI and Nanotechnology	✓	✓	✓									
67	VLSI and Nanotechnology Lab			✓		✓				✓			
68	Ethical hacking and System Security Lab			✓					✓				
69	Cellular and Wireless Communications	✓	✓	✓									
70	Software Testing and Quality Assurance Lab	✓				✓				✓			
71	Business strategy Management							✓	✓	✓	✓	✓	

CHAPTER 2: CURRICULUM OF BSC IN ICE (PART-B)

2.1 Duration of the Program

The Department of ICE offers Bachelor of Science in Information and Communication Engineering degree over a period of four academic Years, each of a normal duration of one calendar year. The four academic Years shall be designated as 1st Year, 2nd Year, 3rd Year, and 4th Year in succeeding higher Years of study. The academic Year will be divided into two Semesters (1st Semester and 2nd Semester or Summer Semester and Fall Semester) each having duration of around six months (23 weeks). Under no circumstances, any student shall be allowed to continue his/her study for B.Sc. Engineering degree for more than six academic years.

2.2 Admission Requirements

SSC/Dakhil and HSC/Alim Examinations: HSC/Alim or equivalent examination in Science Group with Mathematics, Physics and Chemistry scoring minium GPA 3.0 for each. The sum total GPA of SSC/Dakhil and HSC/Alim should be minimum 7.0 (with additional subject).

GCE Applicants

a) **Year:** Minimum C Grade in five subjects including, Mathematics, Physics and Chemistry (in the scale of A=5, B=4, C=3, D=2 and E=1)
b) **A Year:** Minimum C Grade in 2 subjects including Mathematics, Physics/Chemistry.
c) The sum total of GOA in GCE A and O Year should be 6.
d) The candidates with E grade in any subject will not be considered.

2.3 Minimum Credit Requirement

According to Bangladesh National Qualifications Framework (BNQF), minimum graduating credit for B. Sc. in ICE 4-years' program is 140 credits based on 40 notion hours/credit. However, awarding degree will be based on existing BAUET Examination Policy complying the minimum credit requirement by BNQF guideline.

2.4 Total Class Weeks in Semester

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

Summer Semester

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

Fall Semester

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

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

2.5 Minimum CGPA Requirements for Graduation

The minimum CGPA requirement for obtaining a 'Bachelor's degree in ICE discipline is 2.20.

2.6 Maximum Academic Years of Completion

A student must complete his/her studies within a maximum period of six years.

2.7 Category of Courses

2.7.1 General Education Courses

List of Courses on Language History & Culture

Si	Course Code		Course Titles	Credits
	BNQF	BAUET		
1	0231	ENG 1151	Technical Writing and Presentation	2.00
2	0231	ENG 1152	Technical Writing and Presentation Lab	1.00
3	0231	HUM 1153	Bangladesh Studies: History and Culture	2.00

List of Courses on Humanities and Business

Si	Course Code		Course Titles	Credits
	BNQF	BAUET		
1	0314	HUM 1281	Sociology and Economics	3
2	0411	BBA 2291	Financial and Managerial Accounting	3
3	0314	HUM 3183	Professional Ethics and Environmental Protection	2
4	0413	BBA 4295	Business strategy Management	3

List of Courses on Mathematics

Si	Course Code		Course Titles	Credits
	BNQF	BAUET		
1	0541	MATH 1141	Differential and Integral Calculus	3
2	0541	MATH 1243	Linear Algebra and Vector Analysis	3
3	0541	MATH 2145	Numerical Methods	2
4	0541	MATH 2146	Numerical Methods Lab	1
5	0541	MATH 2247	Differential Equation and Statistics	3

List of Courses on Basic Science

Si	Course Code		Course Titles	Credits
	BNQF	BAUET		
1	0533	PHY 1131	Engineering Physics	3
2	0533	PHY 1132	Engineering Physics Lab	1.5
3	0531	CHEM 1261	Engineering Chemistry	3

2.7.2 List of Engineering non-Departmental Courses

Si	Course Code		Course Titles	Credits
	BNQF	BAUET		
1	0713	EEE 1121	Basic Electrical and Circuit Analysis	3
2	0713	EEE 1122	Basic Electrical and Circuit Analysis Lab	1.5
3	0732	ME 1272	Engineering Drawing & CAD Design	1
4	0716	EEE 2223	Electrical Drives and Instrumentation	3
5	0716	EEE 2224	Electrical Drives and Instrumentation Lab	0.75
6	0613	CSE 3101	Operating System	3
7	0613	CSE 3102	Operating System Lab	1.5

2.7.3 List of Departmental Core Courses

Si	Course Code		Course Titles	Credits
	BNQF	BAUET		
1	0611	ICE 1111	Fundamental of ICT	3
2	0611	ICE 1112	Fundamental of ICT Lab	1
3	0613	ICE 1211	Structured Programming Language	3
4	0613	ICE 1212	Structured Programming Language Lab	1.5
5	0714	ICE 1213	Analog Electronics	3
6	0714	ICE 1214	Analog Electronics Lab	1.5
7	0613	ICE 2111	Object Oriented Programming Languages	3
8	0613	ICE 2112	Object Oriented Programming Languages Lab	1.5
9	0610	ICE 2113	Analog and Digital Communication	3
10	0610	ICE 2114	Analog and Digital Communication Lab	1.5
11	0714	ICE 2115	Digital Logic Design	3
12	0714	ICE 2116	Digital Logic Design Lab	1.5
13	0541	ICE 2117	Discreate Mathematics	2
14	0612	ICE 2211	Data Structures and Algorithms	3
15	0612	ICE 2212	Data Structures and Algorithms Lab	1.5
16	0714	ICE 2213	Signals and Systems	3
17	0714	ICE 2214	Signals and Systems Lab	1.5
18	0610	ICE 2215	Optical Fiber Communication	3
19	0610	ICE 2216	Optical Fiber Communication Lab	1.5
20	0612	ICE 3111	Database Management System	3
21	0612	ICE 3112	Database Management System Lab	1.5
22	0613	ICE 3113	Java Programming	3
23	0613	ICE 3114	Java Programming Lab	1.5
24	0610	ICE 3115	Antenna Engineering and Satellite Communication	3
25	0610	ICE 3116	Antenna Engineering and Satellite Communication Lab	1.5
26	0613	ICE 3211	Internet and Web Programming	3
27	0613	ICE 3212	Internet and Web Programming Lab	1.5
28	0714	ICE 3213	Microprocessor and Microcontroller	3
29	0714	ICE 3214	Microprocessor and Microcontroller Lab	1.5

30	0714	ICE 3215	Digital Signal Processing	3
31	0714	ICE 3216	Digital Signal Processing Lab	0.75
32	0612	ICE 3217	Computer Networking	3
33	0612	ICE 3218	Computer Networking Lab	1.5
34	0613	ICE 3220	Mobile Application Development Lab	1.5
35	0619	ICE 4111	Artificial Intelligence	3
36	0619	ICE 4112	Artificial Intelligence Lab	1.5
37	0613	ICE 4113	Software Engineering	3
38	0613	ICE 4114	Software Engineering Lab	1.5
39	0714	ICE 4211	VLSI and Nanotechnology	3
40	0714	ICE 4212	VLSI and Nanotechnology Sessional	1.5
41	0612	ICE 4213	Ethical hacking and System Security Sessional	1.5
42	0613	ICE 4219	Software Testing and Quality Assurance Sessional	1.5

2.7.4 List of Elective Courses

List of Elective Courses in the Field of Information Technology

Si.	Course Code		Course Titles	Credits
	BNQF	BAUET		
1	0619	ICE 4115	Machine Learning	3
2	0619	ICE 4116	Python Lab	1.5
3	0611	ICE 4117	Computer and Cyber Security	3
4	0613	ICE 4225	Big data Analytics	3
5	0613	ICE 4221	Natural Language Processing	3
6	0613	ICE 4121	Information system design and Management	3
7	0613	ICE 4125	Human Machine Interaction	3

List of Elective Courses in the Field of Communication Technology

Si.	Course Code		Course Titles	Credits
	BNQF	BAUET		
1	0610	ICE 4119	Microwave Engineering and Radar	3
2	0610	ICE 4120	Microwave Engineering and Radar Lab	1.5
3	0610	ICE 4215	Cellular and Wireless Communications	3
4	0613	ICE 4123	Information Theory and Coding	3
5	0714	ICE 4217	Biomedical Engineering	3
6	0613	ICE 4219	Internet of Thing (IoT)	3
7	0518	ICE 4223	Bioinformatics	3

2.7.5 Other Related Courses

Si	Course Code		Course Titles	Credits
	BNQF	BAUET		
1	0688	ICE 3200	Industrial Training	1
2	0688	ICE 4000	Final Year Design Project/ Thesis	4
3	0688	ICE 4100	Seminar	1

2.8 Year and Semester Wise Distribution of Courses

2.8.1 Overall Course Distribution

Based on the latest guideline of University Grants Commission (UGC), the overall curriculum structure for B. Sc. in Information and Commination Engineering (ICE) of BAUET is given below:

Year	Sem	Language History & Culture	General Education	Math	Basic Science	Engineering Courses		Elective Courses	Total Credits
						Dept	Non-Dept		
1st	1st	5.00	-	3.00	4.50	4.00	4.50	-	21.00
	2nd	-	6.00	3.00	3.00	9.00	1.00	-	22.00
2nd	1st	-	-	4.50	-	15.50	-	-	20.00
	2nd	-	-	3.00	-	13.50	3.75	-	20.25
3rd	1st	-	2.00	-	-	13.50	4.50	-	20.00
	2nd	-	-	-	-	18.75	-	-	18.75
4th	1st	-	-	-	-	11.00	-	7.50	18.50
	2nd	-	3.00	-	-	10.50	-	6.00	19.50
Percentage		3.13%	6.88%	8.44%	4.69%	59.84%	8.59%	8.44%	100.00%
Total Credit		**5.00**	**11.00**	**13.50**	**7.50**	**95.75**	**13.75**	**13.50**	**160.00**

2.8.2 Credit Hours and Contact Hours Distribution in Eight Semesters

Si	Year	Sem	No of Courses		Hours/Week		Total Contact Hours	Credits		Total Credits
			Theory	Lab	Theory	Lab		Theory	Lab	
1	1st	1st	6	4	16.00	10.00	26.00	16.00	5.00	21.00
2		2nd	6	3	18.00	8.00	26.00	18.00	4.00	22.00
3	2nd	1st	5	4	14.00	12.00	26.00	14.00	6.00	20.00
4		2nd	5	4	15.00	10.50	25.50	15.00	5.25	20.25
5	3rd	1st	5	4	14.00	12.00	26.00	14.00	6.00	20.00
6		2nd	4	6	12.00	13.50	25.50	12.00	6.75	18.75
7	4th	1st	4	4	12.00	13.00	25.00	12.00	6.50	18.50
8		2nd	4	5	12.00	15.00	27.00	12.00	7.50	19.50
Total			39	34	113.00	94.00	207.00	113.00	47.00	160.00

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

2.8.3 Course offered in 1st Year 1st Semester

Si.	Course Code		Course Titles	Hours/Week		Credits	Pre-requisite
	BNQF	BAUET		Theory	Lab		
1	0611	ICE 1111	Fundamental of ICT	3	-	3.00	
2	0611	ICE 1112	Fundamental of ICT Lab	-	2	1.00	
3	0713	EEE 1121	Basic Electrical and Circuit Analysis	3	-	3.00	
4	0713	EEE 1122	Basic Electrical and Circuit Analysis Lab	-	3	1.50	
5	0533	PHY 1131	Engineering Physics	3	-	3.00	
6	0533	PHY 1132	Engineering Physics Lab	-	3	1.50	
7	0541	MATH 1141	Differential and Integral Calculus	3	-	3.00	
8	0231	ENG 1151	Technical Writing and Presentation	2	-	2.00	
9	0231	ENG 1152	Technical Writing and Presentation Lab	-	2	1.00	
10	0231	HUM 1153	Bangladesh Studies: History and Culture	2	-	2.00	
Total				**16**	**10**	**21.00**	
				26			

2.8.4 Course offered in 1st Year 2nd Semester

Si.	Course Code		Course Titles	Hours/Week		Credits	Pre-requisite
	BNQF	BAUET		Theory	Lab		
1	0613	ICE 1211	Structured Programming Language	3	-	3.00	
2	0613	ICE 1212	Structured Programming Language Lab	-	3	1.50	
3	0714	ICE 1213	Analog Electronics	3	-	3.00	EEE 1121
4	0714	ICE 1214	Analog Electronics Lab	-	3	1.50	EEE 1122
5	0732	ME 1272	Engineering Drawing & CAD Design	-	2	1.00	
6	0541	MATH 1243	Linear Algebra and Vector Analysis	3	-	3.00	
7	0531	CHEM 1261	Engineering Chemistry	3	-	3.00	
8	0314	HUM 1281	Sociology and Economics	3	-	3.00	
9	0411	BBA 1291	Financial and Managerial Accounting	3	-	300	
Total				**18**	**8**	**22.00**	
				26			

2.8.5 Course offered in 2nd Year 1st Semester

Si.	Course Code		Course Titles	Hours/Week		Credits	Pre-requisite
	BNQF	BAUET		Theory	Lab		
1	0613	ICE 2111	Object Oriented Programming Languages	3	-	3.00	ICE1211
2	0613	ICE 2112	Object Oriented Programming Languages Lab	-	3	1.50	ICE1212
3	0610	ICE 2113	Analog and Digital Communication	3	-	3.00	
4	0610	ICE 2114	Analog and Digital Communication Lab	-	3	1.50	
5	0714	ICE 2115	Digital Logic Design	3	-	3.00	
6	0714	ICE 2116	Digital Logic Design Lab	-	3	1.50	
7	0541	ICE 2117	Discreate Mathematics	2	-	2.00	
8	0541	MATH 2145	Numerical Methods	3	-	3.00	
9	0541	MATH 2146	Numerical Methods Lab	-	3	1.50	
Total				**14**	**12**	**20**	
				26			

2.8.6 Course offered in 2nd Year 2nd Semester

Si.	Course Code		Course Titles	Hours/Week		Credits	Pre-requisite
	BNQF	BAUET		Theory	Lab		
1	0612	ICE 2211	Data Structures and Algorithms	3	-	3	ICE 2111
2	0612	ICE 2212	Data Structures and Algorithms Lab	-	3	1.5	ICE 2112
3	0714	ICE 2213	Signals and Systems	3	-	3	
4	0714	ICE 2214	Signals and Systems Lab	-	3	1.5	
5	0610	ICE 2215	Optical Fiber Communication	3	-	3	
6	0610	ICE 2216	Optical Fiber Communication Lab	-	3	1.5	
7	0716	EEE 2223	Electrical Drives and Instrumentation	3	-	3	
8	0716	EEE 2224	Electrical Drives and Instrumentation Lab	-	1.5	0.75	
9	0541	MATH 2247	Differential Equation and Statistics	3	-	3	
Total				**15**	**10.5**	**20.25**	

	25.5		

2.8.7 Course offered in 3rd Year, 1st Semester

Si.	Course Code		Course Titles	Hours/Week		Credits	Pre-requisite
	BNQF	BAUET		Theory	Lab		
1	0613	CSE 3101	Operating System	3	-	3	
2	0613	CSE 3102	Operating System Lab	-	3	1.5	
3	0612	ICE 3111	Database Management System	3	-	3	
4	0612	ICE 3112	Database Management System Lab	-	3	1.5	
5	0613	ICE 3113	Java Programming	3	-	3	ICE 2111
6	0613	ICE 3114	Java Programming Lab	-	3	1.5	ICE 2112
7	0610	ICE 3115	Antenna Engineering and Satellite Communication	3	-	3	
8	0610	ICE 3116	Antenna Engineering and Satellite Communication Lab	-	3	1.5	
9	0314	HUM 3183	Professional Ethics and Environmental Protection	2	-	2	
Total				**14**	**12**	**20**	
				26			

2.8.8 Course offered in 3rd Year, 2nd Semester

Si.	Course Code		Course Titles	Hours/Week		Credits	Pre-requisite
	BNQF	BAUET		Theory	Lab		
1	0613	ICE 3211	Internet and Web Programming	3		3	
2	0613	ICE 3212	Internet and Web Programming Lab		3	1.5	
3	0714	ICE 3213	Microprocessor and Microcontroller	3		3	
4	0714	ICE 3214	Microprocessor and Microcontroller Lab		3	1.5	
5	0714	ICE 3215	Digital Signal Processing	3		3	ICE 2213
6	0714	ICE 3216	Digital Signal Processing Lab		1.5	0.75	ICE 2214
7	0612	ICE 3217	Computer Networking	3		3	
8	0612	ICE 3218	Computer Networking Lab		3	1.5	
9	0613	ICE 3220	Mobile Application Development Lab		3	1.5	
10	0688	ICE 3200	Industrial Training	-	2	1.00	
Total				**12**	**15.5**	**19.75**	
				27.5			

***Note:** ICE 3200 (Industrial training) in a particular industry as arranged by the department will be conducted at any convenient time after the Semester final examination of 3rd Year, 2nd Semester for a duration of 4 weeks as applicable or decided by the department. Completion of industrial attachment is mandatory for issuing of B.Sc. degree. Evaluation report from industry is to be submitted at the end of the training and accordingly to be incorporated in the tabulation sheet.

2.8.9 Course offered in 4th Year, 1st Semester

Si.	Course Code		Course Titles	Hours/Week		Credits	Pre-requisite
	BNQF	BAUET		Theory	Lab		
1	0688	ICE 4000	Final Year Design Project/ Thesis	-	4	2.00	
2	0619	ICE 4111	Artificial Intelligence	3	-	3.00	
3	0619	ICE 4112	Artificial Intelligence Lab	-	3	1.50	
4	0613	ICE 4113	Software Engineering	3	-	3.00	

5	0613	ICE 4114	Software Engineering Lab	-	3	1.50	
6	xxxx	ICE 41**	Elective-I	3	-	3.00	
7	xxxx	ICE 41**	Elective-I Lab	-	3	1.50	
8	0611	ICE 4115	Computer and Cyber Security	3	-	3	
9	0688	ICE 4100	Seminar	-	2	1.00	
Total				**12**	**15**	**19.50**	
				27			

***Note**: Each student has to complete one Final Year Project or Thesis in the combined duration of two Semester in 4th Year (1st Semester & 2nd Semester). In course ICE- 4000 (Part-I), a student has to make a proposal defense at the end of the Semester. The defensed project/thesis has to be completed in the continuation course ICE-4000 (Part-II) in next Semester.

2.8.10 Course offered in 4th Year, 2nd Semester

Si.	Course Code		Course Titles	Hours/Week		Credits	Pre-requisite
	BNQF	BAUET		Theory	Lab		
1	0688	ICE 4000	Final Year Design Project/ Thesis	-	4	2.00	
2	0714	ICE 4211	VLSI and Nanotechnology	3	-	3.00	ICE 2115
3	0714	ICE 4212	VLSI and Nanotechnology Lab	-	3	1.50	ICE 2116
4	0612	ICE 4214	Ethical hacking and System Security Lab	-	3	1.50	
5	0610	ICE 4215	Cellular and Wireless Communications	3	-	3	
6	0613	ICE 4216	Software Testing and Quality Assurance Lab	-	3	1.50	
7	****	ICE 42**	Elective-II	3	-	3.00	
8	0413	BBA 4295	Business strategy Management	3	-	3.00	
Total				**12**	**13**	**18.50**	
				25			

2.8.11 List of Elective Courses

List of Elective Courses in the Field of Information Technology

Si.	Course Code		Course Titles	Hours/Week		Credits	Pre-requisite
	BNQF	BAUET		Theory	Lab		
1	0619	ICE 4*17	Machine Learning	3	-	3	
2	0619	ICE 4*18	Python Lab	-	3	1.5	
3	0613	ICE 4*19	Natural Language Processing	3	-	3	
4	0613	ICE 4*21	Information system design and Management	3	-	3	
5	0613	ICE 4*23	Human Machine Interaction	3	-	3	
6	0613	ICE 4*25	Big data Analytics	3	-	3	
7	0613	ICE 4*27	Data Science	3	-	3	

List of Elective Courses in the Field of Communication Engineering

Si.	Course Code		Course Titles	Hours/Week		Credits	Pre-requisite
	BNQF	BAUET		Theory	Lab		
1	0610	ICE 4*29	Microwave Engineering and Radar	3	-	3	
2	0610	ICE 4*30	Microwave Engineering and Radar Lab	-	3	1.5	
3	0610	ICE 4*31	Telecommunication Engineering	3	-	3	

4	0613	ICE 4*33	Information Theory and Coding	3	-	3	
5	0613	ICE 4*35	Internet of Thing (IoT)	3	-	3	

List of Elective Courses for Interdisciplinary

Si.	Course Code		Course Titles	Hours/Week		Credits	Pre-requisite
	BNQF	BAUET		Theory	Lab		
1	0613	ICE 4*37	Digital Image Processing	3	-	3	
2	0613	ICE 4*38	Digital Image Processing Lab	-	3	1.5	
3	0714	ICE 4*39	Biomedical Engineering	3	-	3	
4	0518	ICE 4*41	Bioinformatics	3	-	3	
5	0714	ICE 4*43	Robotics	3	-	3	

CHAPTER 3: YEAR AND SEMESTER WISE COURSE OUTLINE (PART-C)

3.1 Course Outline of 1st Year, 1st Semester

3.1.1 ICE 1111: Fundamental of ICT

Course Information			
Course Code Course Title	: ICE 1111 : Fundamentals of ICT.	Credit Hours Contact Hour	: 3.0 : 3.0

Pre-Requisite

None

Rationale

This is an introductory course on Information and Communication Technologies. Topics include ICT terminologies, hardware and software components, the internet and world wide web, and ICT based applications. In this course, the students will be exposed to ICT and shown how ICT is pervasively affecting all of us. The focus of this class would be on how ICT can be leveraged by electrical engineering students to develop their engineering skills and better perform their professional tasks. It is necessary to say that this course is a basic course that applies very widely. The importance of this course should motivate you all to take keen interest in the class proceedings and try to work hands on.

Objective

1. To be able to understand different terms associated with ICT.
2. To be able identify various components of a computer system.
3. To be able define the basic terms associated with communications and networking.
4. To be able to understand and apply the enabling/pervasive features of ICT.

Course Contents

Introduction: Data and information, Computer and Communication Technology, different types of computers, applications of ICT, Analog and Digital Computers, Basic operations: Input, Processing, Output, Storage and Basic components: Hardware, Software, Data, Users. **Data:** Transforming data into information, How computers represent data, How represent and process data, Type of storage devices, Measuring and Improving drive performance.

Operating Systems (OS): Definition, Types of Operating Systems, User interface of OS, Enhancing an OS with utility software, Applications of OS, Components of OS.

Networking basics: Networking basics, Uses of networks, Common types of networks, How networks are structured, Network media, Network hardware.

Data communications: Data communication on telephone lines (usage of modems), Using digital data connections, Broadband connections, DSL, Cable Modem, and ATM connections, Wireless networks, Wireless 802.11, Wi-Max

Internet: Introduction to TCP/ IP, The Internet and the World Wide Web, How WWW works - browsers, HTML, URLs/ How DNS works, Searching the web, Email and other programs, Web 2.0, Collaboration tools, Virtual computing, Online business

Application software: Kinds of software: commercial, freeware, public domain, open-source, Word-processing software, Spreadsheet programs, Presentation programs - issues of design, Graphics and Multimedia.

Introduction to Programming: Creating computer programs, what is a computer program, Hardware/ software interaction: code, machine code, Programming languages - Compilers and Interpreters, Planning a computer program, Program Control Flow, Algorithms.

Introduction to Databases: Databases and Database Management System, Types of Databases, Data warehouses, Survey of databases, Introduction to data mining.

Future trends in ICT: Artificial Intelligence, Focus on User Interface/ Design, wireless sensor networks, Cloud computing, Internet of Things (IoT), Robotics.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Understand and apply various terminologies associated with information and communication technology.	H											
CLO2	Identify and understand different components of a computer system.		H										
CLO3	Define basic terms associated with data communications and networking.		H										
CLO4	Understand and apply programming to solve various problems.	H											

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Understand and apply various terminologies associated with information and communication technology.	P.01.1	C3	K1			CT, SF, CP
CLO2	Identify and understand different components of a computer system.	P.02.1	C4	K1 K2 K3	P1 P2 P6		CT, SF
CLO3	Define basic terms associated with data communications and networking.	P.02.2	C4		P1 P4 P5		CT, SF
CLO4	Understand and apply programming to solve various problems.	P.01.3	C3	K3			ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20

Formal Assessment Continuous Assessment Final Examination	 2 3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2, C3
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3, C4
	ASG	5%	CLO4	C6
Semester Final (79%)	SF	70%	CLO1,2,3	C1, C2, C3, C4
Total Marks		100%		

Course Plan

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Basic ideas and example Data and information	1	CT1 CP SF	L D SDL
	L2	Computer and Communication Technology.	2		
	L3	Analog and Digital Computers	1		
W2	L4	Different types of computers	1,2		
	L5	The applications of ICT	2		
	L6	Basic operations: Input, Processing, Output, Storage	2		
W3	L7	Basic components: Hardware, Software, Data, Users	2		
	L8	Transforming data into information	3		
	L9	How computers represent data	1		
W4	L10	How represent and process data	1,2		
	L11	Type of storage devices	2,3		
	L12	Measuring and Improving drive performance	3		
W5	L13	Types of Operating Systems	3	CT2 CP SF	L D SDL
	L14	Components of OS	2,3		
	L15	User interface of OS	2		
W6	L16	Enhancing an OS with utility software	1		
	L17	Networking basics	2		
	L18	Uses of networks	2		
W7	L19	Common types of networks	2		
	L20	How networks are structured	2		
	L21	Network media and hardware	3		
Mid Break					
W8	L22	Data communication	1,2	CT3 CP SF	L D SDL
	L23	Using digital data connections	2		
	L24	Broadband connections	3		
W9	L25	Network Topologies	2		
	L26	Wireless networks	3		
	L 27	Wi-fi and Wi-Max.	3		
W10	L 28	Introduction to TCP/ IP	1,2		
	L 29	The Internet and the World Wide Web	1,2		
	L 30	How WWW works - browsers, HTML	2		
W11	L 31	URLs/ How DNS works	2	ASG SF	L D SDL
	L 32	Searching the web	2		
	L 33	Kinds of software: commercial, freeware, public domain, open source	1		
W12	L 34	Graphics and Multimedia	2		
	L 35	Creating computer programs	1		

	L 36	Hardware/ software interaction: code, machine code	3,4		
W13	L 37	Programming languages	2	CP SF	L D SDL
	L 38	Algorithms	1,2		
	L 39	Databases and Database Management System	3,4		
W14	L 40	Types of Databases	1		
	L 41	Future Trends in ICT	1,2		
	L 42	Review class	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. "Introduction to Computers", McGraw-Hill Education, Peter Norton.
2. "Using Information Technology: A Practical Introduction to Computer & Communications", McGraw Hill, Williams Sawyer
3. "Fundamentals of Information Technology", Alpha Science, Alexis Leon and Mathews Leon.

3.1.2 ICE 1112: Fundamentals of ICT Lab

Course Information

Course Code Course Title	: ICE 1112 : Fundamentals of ICT Lab	Credit Hours Contact Hour	: 1.0 : 2.0

Pre-Requisite

None

Rationale

ICT (information and communications technology – or technologies) is an umbrella term that includes any communication device, medium, application, or technologies that provide access to information through telecommunications. This includes the Internet, Fibre Optic Networks, Fixed and Mobile Wireless networks, and other communication mediums. In the past few decades, information and communication technologies have provided society with a vast array of new communication capabilities. As such modern information and communication technologies have created a "global village," in which people can communicate with others across the world as if they were living next door. This course is specifically designed for students who may have formal education in a different discipline but need to gain a high-level understanding of the rapidly changing world of the Information and Communications Technologies (ICT) industry.

Objective

1. To provide a basic understanding of ICT, networks and services and their technologies.
2. To cover the basic principles of storage, retrieval, manipulation; processing, access, transmission and switching of digital data
3. To understand the way people and organizations communicate and share information digitally with each other.

Course Contents

In this course, students will perform experiments to practically verify the theories and concepts that learned about computers, various hardware and software, cables, networks, database, networking related equipment etc. in the theoretical course of ICE 1111 Fundamentals of Information and Communication Technology.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO	CLOs	PLOs

(3-5)	(Upon completion of the course, the students will be able to)	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Apply the concepts to understand the working principles of various components and devices.	H											
CLO2	Formulate various solutions of problems regarding basic data communication, database, and networking.		H										
CLO3	Identify the procedures behind different methods, components.			H									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Use engineering tools efficiently to design, implement and test various analog electronics circuit.	P.01.1	C3	K3			LP, LT, Q
CLO2	Analysis and Interpretation of collected data to provide valid conclusion acknowledging the limitations.	P.02.2	C4		P1 P4 P5		R, Q
CLO3	Function as effective team leader/member in solving real life problem by a project work.	P.03.1	C2		P1 P3 P7		P, Q

*LP = Lab Performance, LT = Lab Test, Q = Quiz, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	5
Experiment	20
Self-directed learning	
Preparation for lab reports	18
Preparation for lab test	10
Preparation of quiz	5
Engagement in group project	-
Formal Assessment	
Continuous assessment	1
Final Quiz	1
Total	60

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO1	C3
Report Writing	20%	CLO2	C4
Project	20%	CLO3	C2
Lab Test	30%	CLO1	C3
Quiz	20%	CLO1,2,3	C2, C3, C4
Total Marks	100%		

Lab Schedule

Week	Topic

Week 1	Introduction to ICT fundamentals lab.
Week 2	Familiarization and Experimentation with basic components of computer.
Week 3	Familiarization with various types of wires/cables for network.
Week 4	Familiarization with various types of software.
Week 5	Familiarization with basic storage systems of computer.
Week 6	Review & Practice Lab-1
Week 7	Lab Test-1
Week 8	Familiarization with data communication.
Week 9	Familiarization with various types of networks.
Week 10	Familiarization with programming.
Week 11	Familiarization with database.
Week 12	Familiarization with algorithms.
Week 13	Review & Practice Lab-2
Week 14	Lab Test-2

Text and Reference Books

1. **"**Concise ICT Fundamentals Volume One**"**, Trafford Publishing**,** Bright Siaw Afriyie.
2. "Digital Planet Pearson New International Edition: Tomorrow's Technology and You, Complete", Pearson, George Beekman. Ben Beekman.
3."Using Information Technology: A Practical Introduction to Computer & Communications", McGraw Hill, Williams Sawyer.

3.1.3 EEE 1121: Basic Electrical and Circuit Analysis

Course Information

Course Code	: EEE 1121	Credit Hours	: 3.0
Course Title	: Basic Electrical and Circuit Analysis	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

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

Objective

1. To understand the basics of AC and DC circuits.
2 To apply different laws of circuit theorems for solving various engineering problems
3. To explain the behavior of different electrical machines.
4. To analyze different circuit-related complex engineering problems efficiently

Course Contents

Fundamentals of electrical circuit: Ohm's Law, Kirchhoff's voltage and current laws, Delta-wye transformation, Basic concept on AC and DC circuits, RL, RC, RLC-based AC circuit, Impedance in series, parallel branches, series-parallel circuits, Resonance in AC circuits, Transient response of capacitor and inductor circuits.
Electrical Networks: Network analysis methods of branch and loop currents, Nodal circuit analysis, Thevenin's, and Norton's theorems.
Effective current and voltage: Average values, Form factor, Crest factor, Concept of real and reactive power.
Introduction to phasor algebra: Impedance in polar and Cartesian forms, Sinusoidal single -phase circuit analysis, Impedance measuring by vector diagram.
Balanced polyphase circuits: Three -phase four- wire and three-phase three-wire system of electrical load, balanced wye loads, balanced delta loads, power in balanced systems, power factor. Balanced three-phase circuit analysis, and power measurement.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Be able to understand the basics of AC and DC circuits.	H											
CLO2	Be able to apply different laws of circuit theorems for solving various engineering problems		H										
CLO3	Be able to understand the behavior of different electrical machines.	H											
CLO4	Be able to analyze different circuit related complex engineering problems efficiently.		H										

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Be able to understand the basics of AC and DC circuits.	P.01.1	C3	K1		-	CT, SF,CP
CLO2	Be able to apply different laws of circuit theorems for solving various engineering problems	P.02.2	C4		P1 P4 P5	-	CT, SF
CLO3	Be able to understand the behavior of different electrical machines.	P.03.2	C3		P1 P3 P7	-	CT, SF
CLO4	Be able to analyze different circuit related complex engineering problems efficiently.	P.03.3	C6	K5		-	ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)

Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2, C3
	CT (1-3)	20%	CLO1,2,3	C3, C4
	ASG	5%	CLO4	C6
Semester Final (70%)	SF	70%	CLO1,2,3	C1, C2, C3, C4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Charge and Current, Voltage, Power and Energy	1	CT1 CP SF	L D SDL
	L2	Circuit Elements, Relevant Practice Problems	2		
	L3	Ohm's Law; Nodes, Branches and Loops; Kirchhoff's Laws	1		
W2	L4	Series Resistors and Voltage Division, Parallel Resistors and	1,2		
	L5	Current Division, Wye-Delta Transformations	2		
	L6	Nodal Analysis, Nodal Analysis in Circuits with Super nodes	2		
W3	L7	Nodal and Mesh Analysis problems	2		
	L8	Superposition Theorem	3		
	L9	Practice Problems Relevant to Superposition Theorem	1		
W4	L10	Thevenin's Theorem	1,2		
	L11	Practice Problems Relevant to Thevenin's Theorem	2,3		
	L12	Norton's Theorem	3		
W5	L13	Practice Problems Relevant to Norton's Theorem	3	CT2 CP SF	L D SDL
	L14	Electrical Properties of Capacitors, Series and Parallel	2,3		
	L15	Capacitors	2		
W6	L16	Source Free RC Circuits	1		
	L17	Source Free RL Circuits	2		
	L18	Source Free RLC Circuits	2		
W7	L19	Step Response of a RC Circuit	2		
	L20	Step Response of a RLCircuit	2		
	L21	Step Response of a RLC Circuit	3		
Mid Break					
W8	L22	Introduction time varying sinusoid excitations	1,2	CT3 CP SF	L D SDL
	L23	Concept of phasor and complex impedance / admittance	2		
	L24	Analysis of series and parallel circuits	3		
W9	L25	Network reduction; voltage and current division	2		
	L26	Basic idea about Source transformation	3		
	L 27	Introduction to Instantaneous power and Average power	3		
W10	L 28	Power factor, complex power, power triangle, maximum	1,2		

		average power			
	L 29	AC power measurement and power conservation	1,2		
	L 30	Tie-set and Cut- set schedules	2		
W11	L 31	Formulation of equilibrium equations in matrix form	2	ASG SF	L D SDL
	L 32	Solution of resistive networks	2		
	L 33	Maximum power transfer theorems for variable resistance load	1		
W12	L 34	Variable impedance load– Statement and applications	2		
	L 35	Introduction: Graph of a network, Concept of tree and co - tree, incidence matrix	1		
	L 36	Balanced Poly phase Circuits	3,4		
W13	L 37	Voltage current relations and power measurement.	2	CP SF	L D SDL
	L 38	Unbalanced poly phase circuit	1,2		
	L 39	Power measurement and faults analysis	3,4		
W14	L 40	Assorted problems on poly phase circuits	1		
	L 41	Practical Applications of Electrical Circuit analysis	1,2		
	L 42	Summary, Review and Open discussion	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Fundamentals of Electric Circuit, Morgan & Claypool Publishers, C. K. Alexander & M. N. Sadiku
2. Introductory Circuit Analysis, Pearson, R. L. Boylsted.
3. Alternating Current Circuits, Wiley & Sons, G. S. Corcoran & R. F. Kerchner.
4. Electric Circuits, Addison Wesley, James William Nilsson Inc.

3.1.4 EEE 1122: Basic Electrical and Circuit Analysis Lab

Course Information

Course Code	: EEE 1122	Credit Hours	: 1.50
Course Title	: Basic Electrical and Circuit Analysis Lab	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

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

Objective

1. To enable the students to apply the fundamental circuit laws (KVL, KCL, Ohm ‘s law) in hardware domain.
2. To develop students ‘skills to simplify complex electrical circuits into simpler circuits by Thevenin and Norton ‘s theorem and verify them in hardware.
3. To teach the students the basic operation of oscilloscope to measure AC quantities (magnitude and phase).
4. To impart the students the skills of analogue filter design by RLC circuit.

5. To familiarize the students with implementation of hardware electrical projects and a circuit simulation software (Proteus)

Course Contents

Construction and operation of simple electrical circuits (Ohm's Law, Series-Parallel, Voltage Divider etc.), KVL and KCL, Superposition Theorem, Thevenin's and Norton's theorem, alternating current (ac) waves and R -L-C series circuit, Series Resonance and Parallel Resonance,

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Be able to apply different laws of circuit theorems for solving various engineering problems		H										
CLO2	Produce desired ac waves and measure amplitude and phase of ac waves in oscilloscope, design analogue RLC filter that can produce desired frequency response.					H							
CLO3	Be able to analyze different circuit-related complex engineering problems efficiently.		H										

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Be able to **apply** different laws of circuit theorems for solving various engineering problems	P.02.2	C4		P1 P4 P5		LP, LT, Q
CLO2	**Produce** desired ac waves and measure amplitude and phase of ac waves in oscilloscope, **design** analogue RLC filter that can produce desired frequency response.	P.05.2	P4		P1 P4 P5		R, Q, LT
CLO3	Be able to **analyze** different circuit-related complex engineering problems efficiently.	P.02.1	C4	K1 K2 K3	P1 P1 P6		P, Q

*LP = Lab Performance, LT = Lab Test, Q = Quiz,R=Report, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30
Self-directed learning	
Preparation for lab reports	21
Preparation for lab test	5
Preparation of quiz	5
Engagement in project/Assignment	21

Formal Assessment	
Continuous assessment	-
Final Quiz	1
Lab Test/Project show	1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO1	C3
Report Writing	20%	CLO2	C6
Project	20%	CLO3	C4
Lab Test	30%	CLO1	C3
Quiz	20%	CLO1,2,3	C3, C6, C4
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Introductory Session on familiarization of basic electrical components, laboratory norms and safety measures.
Week 2	Study of Construction and operation of simple electrical circuits
Week 3	Verification of KVL and KCL
Week 4	Verification of Superposition Theorem
Week 5	Verification of Thevenin's and Norton's theorem
Week 6	Review & Practice Lab-1
Week 7	Lab Test-1
Week 8	Familiarization with alternating current (ac) waves and study of R-L-C series circuit.
Week 9	Study of Series Resonance and Parallel Resonance Circuit.
Week 10	Study of Star and Delta connected ac circuit.
Week 11	Study of power factor and power factor improvement.
Week 12	Study of different types of filters and its characteristics with different input frequency
Week 13	Review & Practice Lab-2
Week 14	Lab Test-2

Text and Reference Books

1. Fundamentals of Electric Circuit, Morgan & Claypool Publishers, C. K. Alexander & M. N. Sadiku
2. Introductory Circuit Analysis, Pearson, R. L. Boylsted.
3. Alternating Current Circuits, Wiley & Sons, G. S. Corcoran & R. F. Kerchner.
4. Electric Circuits, Addison Wesley, James William Nilsson Inc.

3.1.5 PHY 1131: Engineering Physics

Course Information

Course Code:	PHY 1141	Credit Hours:	3.0
Course Title:	Engineering Physics	Contact Hour:	3.0

Pre-Requisite

None

Rationale

To introduce the basic theories and concepts of Heat and Thermodynamics, Wave and Oscillation, Structure of Matters and Optics which will provide a foundation in physics knowledge, understanding and skills for those students who wish to pursue tertiary study in Information and Communication Engineering.

Objective

1. To enrich his/her Basic concepts on Physics.
2. To maintain the thermal stability in any room which has the setup of the sophisticated instruments to produce, transmit and receive information as signal.
3. To know light (EM wave) as wave; propagation of information as EM wave requires concepts on interference, diffraction and polarization of wave.
4. To understand the basic concepts on solids this will help them in making conscious of hardware components of digital instruments.
5. To introduce the details about Simple harmonic motion in free, damped and forced oscillations which help to produce, transmit and receive information as a signal; production and propagation of wave; making any room with good acoustic

Course Contents

Heat & Thermodynamics: Principle of temperature measurements: platinum resistance thermometer, thermo-electric thermometer, pyrometer, Kinetic theory of gases: Maxwell's distribution of molecular speeds, mean free path equipartition of energy, Brownian motion Van der Waal's equation of state, review of the First Law of thermodynamics and its application, reversible and irreversible processes, Second Law of thermodynamics. Carnot cycle: Efficiency of heat engines, Carnot Theorem, entropy and disorder, thermodynamic functions, Maxwell relations, Clausius-Clapeyron Equation. Gibbs Phase Rule. Third Law of thermodynamics,

Waves & Oscillations: Differential equation of a simple harmonic oscillator, total energy and average energy, combination of simple harmonic oscillations, Lissajous' figures, spring-mass system, calculation of time period of torsional pendulum, damped oscillations, damping co-efficient, forced oscillation, resonance, two-body oscillations, Reduced mass, differential equation of a progressive wave, power and intensity of wave motion, stationary waves, group velocity and phase velocity, architectural acoustics, reverberation and Sabine's formula

Physical Optics: Theories of light; Interference of light, Young's double slit experiment; Displacements of fringes andits uses; Fresnel Bi-prism, interference at wedge shaped films, Newton's rings, interferometers, Diffraction of light: Fresnel and Fraunhoffer diffraction, diffraction by single slit, diffraction from a circular aperture, resolving power of optical instruments, diffraction at double slit & N-slits, diffraction grating, Polarization: production and analysis of polarized light, Brewster's law, Malus law, Polarization by double refraction, retardation plates, Nicol prism, optical activity, polarimeters, Polaroid.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Define different parameters regarding waves and oscillations, optics, thermal physics and structure of matter.	H											
CLO2	Demonstrate different laws and theories related to waves and oscillations, optics, thermal physics and structure of matter.	H											

CLO3	Analyze different laws and theories to practical applications related to waves and oscillations, optics, thermal physics and structure of matter.		H										
CLO4	Solve different problems associated waves and oscillations, optics, thermal physics and structure of matter.		H										

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLOs	PLOs	BL	WK	WP	EA	Assessment Methods
CLO1	Define different parameters regarding waves and oscillations, optics, thermal physics and structure of matter.	1	C1	K1	P1		CO, ASG, CT, SF
CLO2	Demonstrate different laws and theories related to waves and oscillations, optics, thermal physics and structure of matter.	1	C2	K1			CO, ASG, CT, SF
CLO3	Analyze different laws and theories to practical applications related to waves and oscillations, optics, thermal physics and structure of matter.	2	C4	K1	P1 P1		CO, ASG, CT, SF
CLO4	Solve different problems associated waves and oscillations, optics, thermal physics and structure of matter.	2	C3	K1	P1		CO, ASG, CT, SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centered Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy(AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3, C4
	ASG	5%	CLO4	C6
Semester Final (70%)	SF	70%	CLO1,2,3,4	C1, C2, C3, C4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Heat, Temperature, Principle of measuring temperature.	1,4	CT1 CP SF	L D SDL
	L2	Types of thermometers, Temperature scales.	1		
	L3	Platinum Resistance Thermometer.	1		
W2	L4	Seebeck Effect, Thermo-Electric/Thermo-couple Thermometer.	1,2		
	L5	Thermodynamics, Thermodynamic system, Zeroth law of thermodynamics, Kinetic Model, Postulates of Kinetic Theory of Gases.	2		
	L6	Internal energy, Degrees of freedom, Principle of Equipartition of Energy, Brownian Motion.	1		
W3	L7	Van der waals equation of state, Mean Free Path, Mean free time.	1		
	L8	First Law of Thermodynamics, Applications of First Law of Thermodynamics.	3		
	L9	Reversible and Irreversible Process, Second Law of Thermodynamics	1		
W4	L10	Carnot Cycle, Carnot's Theorem, Entropy,	1,2		
	L11	Third law of thermodynamic, Maxwell-Boltzmann Distribution, Gibbs Phase Rule.	2,3		
	L12	Review Class on Heat & Thermodynamics	1		
W5	L13	Periodic Motion, Oscillatory Motion, Simple Harmonic Motion, Differential Equation of Simple Harmonic Motion.	4	CT2 CP SF	L D SDL
	L14	Solution to the Differential Equation of Simple Harmonic Motion.	1		
	L15	Quantities related to Simple Harmonic Motion, Average Kinetic Energy of a Vibrating Particle	1		
W6	L16	Free vibration, Forced vibration, Resonance.	1		
	L17	Damped Simple Harmonic Motion, Total Energy of a Simple harmonic motion.	1		
	L18	Wave, Categories of Waves, Few definitions regarding wave.	2		
W7	L19	Relation between Wave velocity, Frequency and Wavelength	2		
	L20	Travelling or Progressive Wave, Equation of a Progressive Wave.	2		
	L21	Standing or stationary wave, Equation of stationary wave, Antinodes, Nodes.	1		
Mid Break					
W8	L22	Differential Equation of Wave Motion, Intensity of Wave.	2	CT3 CP SF	L D SDL
	L23	Mathematical expression for intensity, Intensity of sound, Intensity level.	1,2		
	L24	Power of wave, Phase velocity / Wave velocity, Group velocity, Lissajous' Figures.	1		
W9	L25	Acoustics, Reverberation, Reverberation time	1,2		
	L26	Sabine's Reverberation Formula, Requisites for Good Acoustics.	3		
	L 27	Review Class on Wave & Oscillation	1		
W10	L 28	Theories of Light.	1,2		

	L 29	Coherent sources, Interference of light, Young's double-slit experiment.	3,4		
	L 30	Mathematical analysis of Young's experiment, Theory of interference fringes.	1,3		
W11	L 31	Interferometers, Fresnel's biprism.	1	ASG SF	L D SDL
	L 32	Newton's rings, Newton's rings by reflected & transmitted light.	2,3		
	L 33	Determination of the wavelength of sodium light using Newton's rings.	1		
W12	L 34	Diffraction grating, Resolving Power.	1,2		
	L 35	Diffraction of light, distinction between interference and diffraction	1		
	L 36	Mathematical treatment of diffraction at a circular aperture.	3,4		
W13	L 37	Fraunhofer diffraction at a single slit	2	CP SF	L D SDL
	L 38	Polarization and its categories	1,2		
	L 39	Some terms related to polarization, Brewster's law, Malus law.	3,4		
W14	L 40	Polarisation by double refraction, Nicol prism.	1		
	L 41	Production and analysis of polarized light, Optical activity, Polarimeter.	1,2		
	L 42	Review Class on Optics	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Heat, Thermodynamics and Statistical Physics, S. Chand, Brijlal, N. Subrahmanyam& P.S. Hemne
2. Waves and Oscillations, Vikas Publishing, N.Subra hmanyam & Brijlal
3. A Text Book of Optics, S. Chand & Company Ltd., N. Subra hmanyam & Brijlal
4. Solid State Physics, Kedarnath Ramnath, R.L. Singhal
5. Properties of Matters, S. Chand, Brijlal & N.Subrahmanyam

3.1.6 PHY 1132: Engineering Physics Lab

Course Information

Course Code Course Title	: PHY 1132 : Engineering Physics Lab	Credit Hours Contact Hour	:1.5 :3.0

Pre-Requisite

None

Rationale

Laboratory works based on PHY 1131.

Objective

1. **Moment of inertia:** To find the moment of inertia using conservation of energy principle as a quantity to store energy in fly-wheel.
2. **Compound pendulum:** Enables them to know a technique to find acceleration due to gravity at certain place in the universe and observing the motion of compound pendulum as simple harmonic motion
3. **Spring:** Verification of Hooke's law, spring-mass system as harmonic oscillator, measurement of stiffness of a spring affecting the periodicity of the motion

4. **J:** to use of conservation of energy principle as electrical energy transforms into heat.
5. **Newton's ring:** introduce them interference phenomenon of wave in thin film and finding wavelength of the light used as one conspicuous property of wave.
6. **Prism:** Changing the direction of the light ray as deviated due to the change of medium in the propagation of light
7. **Meter Bridge:** Conductor's intrinsic electrical property (resistivity) for the conduction of current through it.
8. **Thermal conductivity:** Conductor's intrinsic thermal property (thermal conductivity) for the conduction of heat through it.

Course Contents

Moment of inertia of a fly-wheel, refractive index of the material of a prism, modulus of rigidity of a spiral spring, velocity of sound in air by resonance, wavelength by Newton's rings, specific heat of a solid, acceleration due to gravity by compound pendulum, specific resistance of a wire by meter bridge.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	To find the moment of inertia using conservation of energy principle as a quantity to store energy in fly-wheel.	H											
CLO2	Enable to know a technique to find acceleration due to gravity at certain place in the universe and observing the motion of compound pendulum as simple harmonic motion.					H							
CLO3	Verifying Hooke's law, spring-mass system as harmonic oscillator, measurement of stiffness of a spring affecting the periodicity of the motion.		H										
CLO4	Introduce interference phenomenon of wave in thin film and finds wavelength of the light used as one conspicuous property of wave, Changes the direction of the light ray as deviated due to the change of medium in the propagation of light.	H											
CLO5	To measure conductor's intrinsic electrical property (resistivity) for the conduction of current through it and to find the thermal conductivity for the conduction of heat through it.					H							

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOs	BL	WK	WP	EA	Assessment Methods
CLO1	To find the moment of inertia using conservation of energy principle as a quantity to store energy in fly-wheel.	1	C2 C3		P1		LP, LR, LT, Q, VV
CLO2	Enable to know a technique to find acceleration due to gravity at certain place in the universe and observing the motion of compound pendulum as simple	5	C3 C4		P1		LP, LR, LT, Q, VV

	harmonic motion.						
CLO3	Verifying Hooke's law, spring-mass system as harmonic oscillator, measurement of stiffness of a spring affecting the periodicity of the motion.	2	C2 C3		P1		LP, LR, LT, Q, VV
CLO4	Introduce interference phenomenon of wave in thin film and finds wavelength of the light used as one conspicuous property of wave, Changes the direction of the light ray as deviated due to the change of medium in the propagation of light.	1	C2 C3 C4		P1		LP, LR, LT, Q, VV
CLO5	To measure conductor's intrinsic electrical property (resistivity) for the conduction of current through it and to find the thermal conductivity for the conduction of heat through it.	5	C3 C4		P1		LP, LR, LT, Q, VV

*LP = Lab Performance, LT = Lab Test, Q = Quiz, VV= Viva Voce, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom'sTaxonomyLevel, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30
Self-directed learning	21
Preparation for lab reports	5
Preparation for lab test	5
Preparation of quiz	21
Engagement in project/Assignment	
Formal Assessment	
Continuous assessment	-
Final Quiz	1
Lab Test/Project show	1
Total	90

Assessment Strategy(AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	20%	1-5	C4
Report Writing	20%	1-5	C2, C3
Central viva	10%	2-4	A2
Lab Test	30%	1-5	P4
Quiz	20%	2-4	P4, C4, A2
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Introductory Session on familiarization of basic instruments, laboratory norms and safety measures.
Week 2	Determination of the moment of inertia of a fly-wheel about its axis of rotation.
Week 3	Determination of angle of a prism and hence calculation of refractive index of the material of it.
Week 4	Determination of the mechanical equivalent of heat, J by Joule's Calorimeter.

Week 5	Determination of the spring constant and the effective mass of a loaded spring and hence to calculate the modulus of rigidity of it.
Week 6	Determination of velocity of sound in air by resonance tube method.
Week 7	Determination of the wavelength of the monochromatic light by Newton's ring method.
Week 8	Determination of the acceleration due to gravity "g" by means of a compound pendulum.
Week 9	Determination of the specific heat of a solid by the method of mixture.
Week 10	Determination of the thermal conductivity of a bad conductor by Lees method.
Week 11	Determination of the specific resistance of a wire by meter bridge.
Week 12	Review & Practice Lab-1
Week 13	Quiz Test, Review & Practice Lab-2
Week 14	Lab Test & Viva

Text and Reference Books

1. Practical Physics for degree students, Hafiz Book Centre, Dr. Giasuddin Ahmed & Md. Shahabuddin
2. Physics Lab Manuel, Dept. of Physics, Bangladesh Army University of Engineering & Technology

3.1.7 MATH 1141: Differential and Integral Calculus

Course Information

Course Code	: MATH-1141	Credit Hours	: 3.0
Course Title	: Differential and Integral Calculus	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

To get the basic idea of the rate at which one quantity changes relative to another, understand the concept of the word limit, continuity and differentiability and the relation between the area and antiderivatives and ability to calculate an antiderivative.

Objective

1. Build an understanding the rate at which one quantity changes relative to another.
2. Familiarize the student with the basic concept of the word limit, continuity and differentiability.
3. Introduce the student to the relation between the area and anti-derivatives and how to calculate an anti-derivative.
4. Allow the student to gain expertise in some specific areas of engineering using calculus.

Course Contents

Limit, Continuity and Differentiability:

Aim and objective of calculus, function, domain and range, existence of limit, continuous function and its property, differentiability

Differentiations:

Formula of differentiation, derivatives of different kind of functions, differentiations of explicit and implicit functions, successive differentiation, Leibnitz's theorem and differentiations using Leibnitz's theorem.

Expansion of Function:

Rolle's theorem, mean value theorem, Taylor's series, expanding of a function using Taylor's series indeterminant form.

Maximum and Minimum:

Increasing and decreasing of a function, turning point, point of inflation, concave up and down, maximum and minimum of different kind of functions.

Partial Differentiations and Geometric Applications of Differentiations:

Multivariable function, partial differentiations, tangent and normal equations in cartesian and polar co-ordinates.

Indefinite Integral:

Basic concept of integration, integration by methods of substitution, integration by parts, integration of special function, integration of partial fraction

Definite Integration and Applications of Integration:

Properties of definite integration, successive reduction, proper and improper integrals, beta and gamma function, multiple integrals. evaluate the arc length, surface area, area and volume.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Able to state various elementary function both algebraically and graphically.	H											
CLO2	Able to describe the behavior of a function and continuity of various types of functions.		H										
CLO3	Able to illustrate the application of differentiation in real world problem.	M											
CLO4	Describe the real understanding of the connection between the area and integration and manipulate different integration by various methods.			M									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLO	BL	WK	WP	EA	Assessment Methods
CLO1	Able to state various elementary function both algebraically and graphically.	1	C1 C3	K1	P1		CT, SF
CLO2	Able to describe the behavior of a function and continuity of various types of functions.	2	C2 C4	K3	P1 P3		CT, SF
CLO3	Able to illustrate the application of differentiation in real world problem.	1	C3 C5	K3	P1 P3		CT, SF, CP
CLO4	Describe the real understanding of the connection between the area and integration and manipulate different integration by various methods.	3	C2 C4 C5	K5	P1 P3		CT, SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO3	C3, C5
	CT (1-3)	20%	CLO1,2,3,4	C1, C2, C3, C4, C5
	ASG	5%	CLO4	C6
Semester Final (79%)	SF	70%	CLO1,2,3,4	C1, C2, C3, C4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Introduction to function and illustrations of different kind of functions. Finding the domain and range of different kind of functions.	1	CT1 CP SF	L D SDL
	L2	Condition for existing limit of a function. Whether exists limit of a function and evaluate the limiting value of different kind of function at a point.	1		
	L3	Formulas for limit and exercises of limiting value problems.	1,2		
W2	L4	Conditions for continuity of a function at a point. Identify whether a function is continuous or not, at a point.	1,2		
	L5	Exercises of continuity problems.	2		
	L6	Conditions for differentiability of a function at a point. Identify whether a function is differentiable or not, at a point.	2		
W3	L7	Exercises of differentiability problems.	2		
	L8	Formulas of differentiations and proof of some formulas	3		
	L9	Evaluate the differential coefficient of different kinds of functions	3		
W4	L10	Differentiations of various composite functions	3		
	L11	Formula and exercises of differentiations of the product and division of two or more functions	3		
	L12	Technic to evaluate differential coefficients using logarithm and some exercises	3		
W5	L13	Finding the differentiations of implicit functions.	3	CT2 CP SF	L D SDL
	L14	Technic of successive differentiation and calculation of successive differentiations of algebraic and trigonometric.	3		

	L15	Finding the successive differentiations of logarithmic, exponential functions and function with algebraic fraction.	3		
W6	L16	Statement of Leibnitz's theorem and finding the n-th derivatives of the product of two functions using Leibnitz's theorem	3		
	L17	Roll's theorem, mean value theorem and generalized mean value theorem	3		
	L18	Expansion and approximate of transcendental function using Taylor series	1, 3		
W7	L19	Identify a function is increasing or decreasing at a point. Also finding the turning point.	1,3		
	L20	Evaluate the local and global maximum and minimum of a function and some exercises.	3		
	L21	Finding the point of inflation and identify the range whether the function is concave up or down.	3		
Mid Break					
W8	L22	Introduce to multivariable function and partial derivatives and it's properties.	1,2	CT3 CP SF	L D SDL
	L23	Evaluate partial derivative of different kind of multivariable functions.	2		
	L24	Geometric applications of ordinary and partial derivatives.	3		
W9	L25	Introduce to anti-derivatives/integrations and it's physical meaning and formulas of integrations	3, 4		
	L26	Relations between derivative and anti-derivatives	3, 4		
	L 27	Integration by methods of substitution and exercises	4		
W10	L 28	Integration by parts and it's exercises	4		
	L 29	Integration of special function	4		
	L 30	Integration of partial fraction and exercises	4		
W11	L 31	Introduction to definite integral and it's properties	4	ASG SF	L D SDL
	L 32	Exercises of definite integrals	4		
	L 33	Introduce to the beta and gamma function	4		
W12	L 34	Successive reduction	4		
	L 35	Multiple integrals	4		
	L 36	Evaluate the arc length and exercises	3, 4		
W13	L 37	Evaluate the area integrals and exercises	4	CP SF	L D SDL
	L 38	Evaluate the surface integrals and exercises	4		
	L 39	Evaluate the volume integrals and exercises	4, 5		
W14	L 40	Review Class-I	1, 2		
	L 41	Review Class-II	2, 3		
	L 42	Review class-III	3,4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Calculus (10th edition), Wiley, Howard Anton, Irl Bivens and Stephen Dev.
2. Differential Calculus, U.N. Dhur & Sons Private LTD, B.C. Das and B.N. Mukherjee
3. Integral Calculus, U.N. Dhur & Sons Private LTD, B.C. Das and B.N. Mukherjee

*Additional reading material: PowerPoint slides & PDF provided by the teacher

3.1.8 ENG 1151: Technical Writing and Presentation

Course Information

Course Code	: HUM 1151	Credit Hours	: 2.0
Course Title	: Technical Writing and Presentation	Contact Hour	: 2.0

Pre-Requisite

None

Rationale

To help students obtain an ability to communicate fluently in English; to enable and enhance the students' skills in reading, writing, listening, and speaking; to impart an aesthetic sense and enhance creativity.

Objective

1. Communicate with proficiency, self-confidence and poise in public speaking situations.
2. Develop spoken words, skills and good speaking style.
3. Learn about vocabulary.
4. Learn about skimming, scanning, inferring & responding of passages of a text.
5. Describe, in writing or through presentation, something academically and professionally.
6. Present any written document.

Course Contents

Grammar: Grammatical principles, modals, phrases & idioms, prefixes & suffixes, sentence structures, why & yes/ no questions, conditional sentences.
Vocabulary: Technical & scientific vocabulary, defining terms.
Presentation: Basics of oral communication- formal and informal, dialogue, extempore speech, formal presentation- academic and official/corporate.
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.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	**Organize** them within the shortest possible time to present their ideas and opinions in individual or team.									H			H
CLO2	**Understand** and speak English quickly and smartly using the techniques learnt in the class.										H		H
CLO3	**Apply** the techniques to find out the main points of any long article within a very limited time as well as know the techniques of any effective writing.									M			M

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLO	BL	WK	WP	EA	Assessment Methods
CLO1	**Organize** them within the shortest possible time to present their ideas and opinions in individual or team.	9	C3				CT, ASG
CLO2	**Understand** and speak English quickly and smartly using the techniques learnt in the class.	10	C2				CP

CLO3	**Apply** the techniques to find out the main points of any long article within a very limited time as well as know the techniques of any effective writing.	12	C3				CT, ASG, SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	26
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	25
Revision	12
Assessment Preparations	12
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	80

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C3
	CT (1-3)	20%	CLO1,2,3	C2, C3
	ASG	5%	CLO3	C3
Semester Final (79%)	SF	70%	CLO1,2,3	C1, C2, C3
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Grammatical principles	2	CT1 CP SF	L D SDL
	L2	Modals, Idioms and phrases.	2		
W2	L3	Prefixes and suffixes	1,2		
	L4	Sentence structure, W-H and yes/no questions	1,2		
W3	L5	Conditionals sentences	1,2		
	L6	Introduction to phonetic symbols, dialogue, responding to particular situations, extempore speech.	2,3		
W4	L7	Introduction to phonetic symbols, dialogue, responding to particular situations, extempore speech.	2,3		
	L8	Introduction to phonetic symbols, dialogue, responding to particular situations, extempore speech.	2,3		
W5	L9	Paragraph Writing	2	CT2 CP SF	L D SDL
	L10	Paragraph Writing	2		
W6	L11	Composition Writing	1,3		
	L12	Composition Writing	2		
W7	L13	Report Writing	1,3		
	L14	Report Writing	2		
Mid Break					
W8	L15	Comprehension of technical & non-technical materials-skimming, scanning, inferring & responding to context.	2,3	CP SF	

	L16	Comprehension of technical & non-technical materials- skimming, scanning, inferring & responding to context.	2,3		L D SDL
W9	L17	Review	3		
	L18	Research Paper Writing	2		
W10	L 19	Research Paper Writing	1,2,3		
	L 20	Review	3		
W11	L 21	Library References	2	ASG SF	L D SDL
	L 22	Library References	1,2,3		
W12	L 23	Job application	1,3		
	L 24	Job application & CV Writing	1,3		
W13	L 25	Business letter	1,3	CT3 CP SF	L D SDL
	L 26	Business letter	1,3		
W14	L 27	Quotations	1,3		
	L 28	Tender Notice	1,3		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

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

3.1.9 ENG 1152: Technical Writing and Presentation Lab

Course Information

Course Code	: HUM 1152	Credit Hours	: 1.0
Course Title	: Technical Writing and Presentation Lab	Contact Hour	: 2.0

Pre-Requisite

None

Rationale

This course is designed to develop engineering student communication skills. With globalization, internationalization, inter-culturalization and IT revolution the English language has become one of the most essential element of the 21st century professional world. Acquiring merely the knowledge and skills of engineering is not enough for getting success in this competitive environment. Communication skill is also required. The course is designed to develop all the four dimensions of communication skills and to make learners proficient in employing them.

Objective

1. Introduce basic aspects of English communication.
2. Develop listening, reading, writing and speaking skills.
3. Facilitate dynamics of professional presentation.
4. Enhance art of technical communication.

Course Contents

Speaking & Presentation: Introduction to Language: Introducing basic skills of language, English for Science and Technology, Self-introduction and interpersonal communication, individual/group presentation, formal/corporate presentation.

Writing: Introductory discussion on writing, prewriting, drafting; Topic sentence, paragraph development, paragraph structure, describing a person/scene/picture, narrating an event Paragraph writing.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	**Understand** the basics of English language and use of basic language skills in informal, formal and academic contexts.										H		
CLO2	**Analyse** various types of communication.										H		
CLO3	**Apply** the obtained knowledge for the effective implementation of language in various situations.										H		H

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	**Understand** the basics of English language and use of basic language skills in informal, formal and academic contexts.	10	C2				Lecture, individual/group work
CLO2	**Analyse** various types of communication.	10	C4				Lecture, individual/group work
CLO3	**Apply** the obtained knowledge for the effective implementation of language in various situations.	12	C3				Presentation/ writing test

*LP = Lab Performance, LT = Lab Test, Q = Quiz, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	5
Experiment	20
Self-directed learning	
Preparation for lab reports	18
Preparation for lab test	10
Preparation of quiz	5
Engagement in group project	-
Formal Assessment	
Continuous assessment	1
Final Quiz	1
Total	60

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Written test/Quiz	10%	CLO1	C2
Viva Voce/ Presentation	20%	CLO2, CLO3	C4, C3
Home work/Assignment	20%	CLO3	C3
Continuous Assessment	30%	CLO3	C3
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Introductory Session on basics of English language.
Week 2	Instruction on two types of communication- formal and informal, and their implementation in speaking.
Week 3	Individual introduction and lessons on formal and informal conversations.
Week 4	Introduction to presentation techniques.
Week 5	Introduction to presentation techniques.
Week 6	Instructions on effective presentation.
Week 7	Individual presentation.
Week 8	Individual presentation
Week 9	Group presentation.
Week 10	**Review and Test on Presentation**
Week 11	Introduction to Writing.
Week 12	Lecture on different writing strategies.
Week 13	Practice different writing strategies.
Week 14	**Review and Test on Writing**

Text and Reference Books

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

3.1.10 HUM 1153: Bangladesh Studies: History and Culture

Course Information

Course Code	: HUM 1153	Credit Hours	: 2.0
Course Title	: Bangladesh Studies: History and Culture	Contact Hour	: 2.0

Pre-Requisite

None

Rationale

This course has been designed to help the students in obtaining comprehensive idea about the history, culture and heritage of Bangladesh. It will introduce students with economy, society, politics, diplomacy and foreign policy of Bangladesh. Students will learn about the challenges and potentials of Bangladesh in shaping its peaceful and sustainable future. It will also assist the students in assessing roles and contribution of Bangladesh in the regional and international bodies which are dedicated to establish world peace.

Objective

1. Introduce students with rich history, culture and heritage of Bangladesh.
2. Providing them in-depth knowledge on the major political events that shaped Bangladesh as an independent sovereign state.
3. Improve their understanding on political, economic and social development of Bangladesh.
4. Help them think critically and comprehensively about foreign policy of Bangladesh, its relationship with other countries and its important roles in the international organizations like UN, Common wealth and SAARC etc.
5. Increase understanding on the challenges and potentials of Bangladesh in shaping its peaceful and sustainable future.

Course Contents

Ancient period and Muslim period of Bengal, British period, Pakistan period: an overview (1952-1971), The problem of national integration under Ayub regime, Elite in crisis during Pakistan rule, nation-building in the new state, The ideals and philosophy of constitution- making of Bangladesh, Study on the coup and assassination of Bangabandhu Sheikh Mujib, Philosophy and fundamental changes of Zia regime, Constitutional amendments of Bangladesh, Corruption and good governance in Bangladesh, Issues of governance of Bangladesh, Bangladesh economy, Ideas on political and ethnic conflict in Bangladesh, Geographical setting of Bangladesh, environmental challenges of Bangladesh, Bangladesh foreign policy: realities and challenges, Foreign policy-decision-making process in Bangladesh.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	To **enrich** knowledge with brief history, culture and heritage of Bangladesh.						H						
CLO2	To **provide** in-depth knowledge on the major political events that shaped Bangladesh as an independent sovereign state.						H						
CLO3	To **improve** understanding on political, economic and social development of Bangladesh. To think critically and comprehensively about foreign policy of Bangladesh, its relationship with other countries and its important roles in the international organizations like UN, Commonwealth and SAARC etc.								H				
CLO4	To **think** critically and comprehensively about foreign policy of Bangladesh, its relationship with other countries and its important roles in the international organizations like UN, Commonwealth and SAARC etc.								M				

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	To **enrich** knowledge with brief history, culture and heritage of Bangladesh.	P.06.1	C1 C2	K7			CT, SF, CP

CLO2	To **provide** in-depth knowledge on the major political events that shaped Bangladesh as an independent sovereign state.	P.06.1	C4	K7			CT, SF
CLO3	To **improve** understanding on political, economic and social development of Bangladesh. To think critically and comprehensively about foreign policy of Bangladesh, its relationship with other countries and its important roles in the international organizations like UN, Commonwealth and SAARC etc.	P.08.1	C3	K7			CT, SF
CLO4	To **think** critically and comprehensively about foreign policy of Bangladesh, its relationship with other countries and its important roles in the international organizations like UN, Commonwealth and SAARC etc.	P.08.1	C6	K7			ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom'sTaxonomyLevel, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	26
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	25
Revision	12
Assessment Preparations	12
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	80

Assessment Strategy(AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3
	ASG	5%	CLO4	C6
Semester Final (79%)	SF	70%	CLO1,2,3	C1, C2, C3, C4
Total Marks		100%		

Course Plan

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Ancient and medieval history of Bengal	1,2	CT1 CP SF	L D SDL
	L2	Ethnic origin of Bengali nation Mauryan era Pala era	1,2		
W2	L3	Sena Era Muslim rule in Bengal	1,2		

	L4	British period and Pakistan period Permanent settlement	1,2		
W3	L5	Peasant revolutions	1,2		
	L6	Bengali renaissance	1,2		
W4	L7	End of British era	2		
	L8	Language movement	3		
W5	L9	The problem of national integration under Ayub regime, Elite in crisis during Pakistan rule	3		
	L10	Economic and political exploitation	3		
W6	L11	6 point program 1966	3		
	L12	Mass upsurge 1969	3		
W7	L13	General election 1970	3	CT2 CP SF	L D SDL
	L14	Liberation war 1971	3		
W8	L15	Genocide during The War of Liberation	3		
	L16	Contributions of Bangabandhu Sheikh Mujibur Rahman, provisional government, freedom fighters and foreign countries to the War of Liberation.	3		
W9	L17	Nation-building in the new state,	3		
	L18	The ideals and philosophy of constitution	4		
W10	L19	Study on the coup and assassination of Bangabandhu Sheikh Mujibur Rahman.	4		
	L20	Philosophy and fundamental changes of Zia regime,	4		
W11	L21	Constitutional amendments of Bangladesh	4		
	L22	Corruption and good governance in Bangladesh,	4	CT3 CP SF	L D SDL
W12	L23	Issues of governance of Bangladesh, Bangladesh economy	4		
	L24	Ideas on political and ethnic conflict in Bangladesh:	4		
W13	L25	Geographical setting of Bangladesh	4		
	L26	environmental challenges of Bangladesh, Bangladesh foreign policy: realities and challenges,	4		
W14	L 27	Foreign policy-decision-making process in Bangladesh.	4		
	L 28	Review			

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Bangladesh in International Politics ,1995, University Press Ltd, Muhammad Shamsul Huq
2. Constitution, Constitutional Law and Politics: Bangladesh Perspective, Beacon Publications, Md. Abdul Halim
3. Bangladesh in the Twenty-First Century: Towards an Industrial Society, University Press Ltd, A M A Muhith.
4. Bangladesh Foreign Policy: Realities, Priorities and Challenges, 2012, 2nd Edition, Academic Press and Publishers Library, Harunur Rashid.
5. History of Emergence of Bangladesh, Academic Press and Publishers Library, Muntasir Mamun & Mahbubur Rahman

3.2 Course Outline of 1st Year, 2nd Semester

3.2.1 ICE 1211: Structured Programming Language

Course Information

Course Code	: ICE 1211	Credit Hours	: 3.0
Course Title	: Structured Programming Language	Contact Hour	: 3.0

Pre-Requisite:

None

Rationale

The Structured Programming Language course is designed to introduce the fundamental principles, mechanism of programming skills and develop basic programming skills to program design and development. The course begins with introductory concepts of structured programming language and then covers other important topics related to structured programming language. It also deals with basic data structures like array, stack and queue.

Objective

1. To Understand various concepts of C programming language
2. To know about various syntax, semantics of structured programming languages.
3. To analyze various applications using different library functions of structured programming language.
4. To develop basic programming skills with respect to program design and development.

Course Contents

Introduction: Definition of Software, its classification, Problem solving steps, Introduction of C and its structure, history and Characteristics, Introduction to keywords, constants and identifiers, Fundamental of C variable and data types, Rules of constants, Introduction to arithmetic, relational and logical operators, Introduction to expressions, managing data input, managing data output.
Control statements: Decision making and branching. If and if… else statements, other control statements, switch and the conditional operator, Decision making and looping. While looping, do…while and for looping statements, jump statement go to, break and continue.
Array: Introduction to arrays. One-dimensional array, some sample programs, two-dimensional array, some sample programs, String handling in C and some examples.
String: Introduction to character Arrays and String, Declaring and Initializing String variables, Reading strings from Terminal, Writing String to Screen, Putting String Together, Comparison of Two Strings, String Handling Functions, Table of Strings.
Function: Need for multifunction programs, Definition of Function, return values, types and some examples, Function Calls, Function Declaration, calling functions and arguments, Nesting of Function, Recursions, passing arrays to functions, passing string to function, The Scope, Visibility and Lifetime of Variables, Storage class.
Structure: Definition of Structure, Union, Structure union applications, Declaring Structure Variables, Accessing Structures Members, Arrays within Structure, Self-referential Structure, Array of structure and some examples.
Pointer: Understanding pointers, Pointers and arrays, Pointers and functions, pointers and structures, Some special features of C (Macros, Enumerations), Bitwise operations.
Dynamic Memory Allocation: Malloc, Calloc, Free, Realloc.
File management: File management concept in C, Defining, opening and closing a file, Input/output operations in file, Error handling and command line arguments, Introduction to graphics, drawing some geometric objects.
Error Handling: Exception handling;
Basic Data Structures: Array, Stack, Queue and Review.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12

CLO1	Understand the fundamental principles, typical characteristics, and mechanisms of a structured programming language.	H											
CLO2	Apply basic programming skills with respect to Program design and development.	H											
CLO3	Analyze the fundamental principles, typical characteristics and mechanisms of a structured programming language.		H										
CLO4	Develop basic programming skills with respect to program design and development.			H									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Understand the fundamental principles, typical characteristics, and mechanisms of a structured programming language.	P.01.1	C3	K1			CT, SF, CP
CLO2	Apply basic programming skills with respect to Program design and development.	P.01.3	C3	K3			CT, SF
CLO3	Analyze the fundamental principles, typical characteristics and mechanisms of a structured programming language.	P.02.3	C4	K4	P1 P2 P6		ASG, SF
CLO4	Develop basic programming skills with respect to program design and development.	P.03.2	C6	K5	P1 P3 P7		ASG, SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2,C3
	CT (1-3)	20%	CLO1,2	C1, C2, C3

	ASG	5%	CLO3, CLO4	C4, C6
Semester Final (79%)	SF	70%	CLO1,2,3	C1, C2, C3, C4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Definition of Software, its classification, Problem solving steps.	1	CT 1 CP SF	L D SDL
	L2	Introduction of C and its structure, history and Characteristics.	2		
	L3	Introduction to keywords, constants and identifiers.	1		
W2	L4	Fundamental of C variable and data types, Rules of constants	1,2		
	L5	Introduction to arithmetic, relational and logical operators.	1,2		
	L6	Introduction to expressions, managing data input, managing data output.	1,2		
W3	L7	Decision making and branching. If and if… else statements.	2		
	L8	Control statements, switch and the conditional operator.	3,4		
	L9	Decision making and looping. While looping, do…while.	3,4		
W4	L10	For looping statements.	1,2,4		
	L11	Jump statement go to, break and continue.	2		
	L12	Introduction to arrays. One-dimensional array, some sample programs.	1,3,4		
W5	L13	Two-dimensional array, some sample programs.	1	CT 2 CP SF	L D SDL
	L14	String handling in C and some examples.	2		
	L15	Need for multifunction programs, Definition of Function, return values, types and some examples.	2		
W6	L16	Introduction to character Arrays and String, Declaring and Initializing String variables.	1		
	L17	Reading strings from Terminal, Writing String to Screen.	2		
	L18	Putting String Together, Comparison of Two Strings	2		
W7	L19	String Handling Functions, Table of Strings.	2		
	L20	Need for multifunction programs, Definition of Function, return values, types and some examples.	1		
	L21	Function Calls, Function Declaration, calling functions and arguments.	1,2		
Mid Break					
W8	L22	Nesting of Function.	3,4	CT 3 CP ASG	L D SDL
	L23	Recursions	3,4		
	L24	Passing arrays to functions, passing string to function.	2		
W9	L25	The Scope, Visibility and Lifetime of Variables, Storage class.	2		

	L26	Definition of Structure, Union, Structure union applications.	1	SF	
	L 27	Declaring Structure Variables, Accessing Structures Members, Arrays within Structure.	1,2		
W10	L 28	Self-referential Structure, Array of structure and some examples.	1,3		
	L 29	Understanding pointers, Pointers and arrays	1,2		
	L 30	Pointers and functions, pointers and structures.	2		
W11	L 31	Some special features of C (Macros, Enumerations), Bitwise operations.	1	SF	L D SDL
	L 32	Dynamic Memory Allocation: Malloc, Calloc, Free, Realloc.	3		
	L 33	File management concept in C, Defining, opening and closing a file.	1		
W12	L 34	Input/output operations in file, Error handling and command line arguments.	2		
	L 35	Introduction to graphics, drawing some geometric objects.	1		
	L 36	Exception handling	1,2		
W13	L 37	Exception handling Continuing	3	CP SF	L D SDL
	L 38	Stack	1		
	L 39	Stack Example in C	1,2		
W14	L 40	Queue	1,2		
	L 41	Review class	1-4		
	L 42	Review class	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Teach Yourself C (3rd Edition), McGraw-Hill, Herbert Schidlt.
2. Programming in Ansi C (6th Edition), MHE Publication, E Balagurusamy.
3. C: The Complete Reference (4th Edition), McGraw-Hill, Herbert Schildt.
4. C Programming Language (2nd Edition), Prentice Hall, Dennis M. Ritche.

3.2.2 ICE 1212: Structured Programming Language Lab

Course Information			
Course Code Course Title	: ICE 1212 : Structured Programming Lab	Credit Hours Contact Hour	: 1.5 : 3.0

Pre-Requisite:

None

Rationale

The Structured Programming Language Sessional course is designed to practically introduce the fundamental principles, mechanism of programming skills and develop basic programming skills to program design and development. The lab begins with practicing introductory concepts of structured programming language and then covers other important topics related to structured programming language.

Objective

1. To learn basic ideas of programming languages.
2. To learn how to program with C.
3. To learn how to think about the problems, their solutions and translating it to programming language.

Course Contents

Basic programming Structures: Mathematical problems using printf, scanf, Data types and their memory allocation, Operators, Expressions, Basic Input/output, Data type conversion;

Control Structure: Practice problems on ―if else‖, ―switch‖, Flow Charts, Loop, Nested Loop; **Arrays:** Practice problems on One dimensional array, multi-dimensional array, Character array/ string;

Function: Practice problems on Function, Parameter Passing Convention;

Recursion: Practice problems on recursion;

Pointer: Practice problems on Different types of pointers, Pass pointer as arguments, Call by value vs call by reference;

Dynamic Memory Allocation: Dynamically allocate memory using Malloc, Calloc, Free, Realloc;

User defined data types: Practice problems on Structures, Unions, Enumerations;

File I/O: Read, write, append in file;

Header Files and Preprocessors: Header files, Preprocessor;

Error Handling: Exception handling.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	**Apply** basic programming skills with respect to Program design and development to solve various complex engineering problems.	H											
CLO2	**Formulate** solutions, procedures, and methods in C language to solve complex engineering problems		H										
CLO3	**Design and develop** solution in C for complex engineering problems.			H									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	**Apply** basic programming skills with respect to Program design and development to solve various complex engineering problems.	P.01.4	C3	K4	P1 P3 P7		LP, LT, Q
CLO2	**Formulate** solutions, procedures, and methods in C language to solve complex engineering problems	P.02.2	C4		P1 P4 P5		LT
CLO3	**Design and develop** solution in C for complex engineering problems.	P.03.2	C6		P1 P3		LT

					P7		

*LP = Lab Performance, LT = Lab Test, Q = Quiz, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30
Self-directed learning	
Preparation for lab reports	21
Preparation for lab test	5
Preparation of quiz	5
Engagement in project/Assignment	21
Formal Assessment	
Continuous assessment	-
Final Quiz	1
Lab Test/Project show	1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	20%	CLO1	C3
Report Writing	20%	CLO2	C4
Lab Test	30%	CLO3	C6
Quiz	20%	CLO1,2	C3, C4
Viva	10%	CLO1,2	C3,C4
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Mathematical problems using printf, scanf.
Week 2	Introduction to data types, mathematical problems using data types, data type conversion.
Week 3	Practice Problems on if else, else if, switch.
Week 4	Practice Problems on Nested if else.
Week 5	Practice Problems on Problem on Loop- For, Do While, Nested Loop.
Week 6	Practice Problems on One-dimensional array, Multi-dimensional array.
Week 7	Practice Problems on Nested Loop, Character array/String.
Week 8	Practice Problems on Function, Parameter Passing Convention.
Week 9	Practice problems on Different types of pointers, Pass pointer as arguments, Dynamically allocate memory using calloc, malloc, free, realloc.
Week 10	Practice problem on Recursion.
Week 11	Practice problem on User Defined Data Types: Structure, Union
Week 12	File I/O.
Week 13	Error Handling & Review
Week 14	Lab Test & Quiz

Text and Reference Books

1. Teach Yourself C (3rd Edition), McGraw-Hill, Herbert Schidlt.
2. Programming in Ansi C (6th Edition), MHE Publication, E Balagurusamy.
3. C: The Complete Reference (4th Edition), McGraw-Hill, Herbert Schildt.

4. C Programming Language (2nd Edition), Prentice Hall, Dennis M. Ritche.

3.2.3 ICE 1213: Analog Electronics

Course Information

Course Code	: ICE 1213	Credit Hours	: 3.0
Course Title	: Analog Electronics	Contact Hour	: 3.0

Pre-Requisite

Course Code: ICE 1112
Course Title: Basic Electrical and Circuit Analysis

Rationale

To teach the students the concepts, principles and working of basic electronic circuits (Diodes, BJTs, JFETs and MOSFETs). It is targeted to provide a basic foundation for technology areas like electronics devices (rectifiers, voltage regulators and amplifiers), communication systems, industrial electronics as well as instrumentation, control systems and various electronic circuit design. Finally, this course is designed to develop a designing capability involving real life practical problems.

Objective

1. To be able to understand the basics of electronic devices like diode, Transistor, MOSFET etc and their applications.
2. To be able to differentiate between the working principal of different electronic components.
3. To become skilled at designing different electronic circuits like rectifier, amplifiers etc.
4. To apply theoretical knowledge for solving complex mathematical problems.

Course Contents

Introduction to semiconductors: p-type and n-type semiconductors, p-n junction diode characteristics.
Diode applications: Half and full wave rectifiers, clipping and clamping circuits, regulated power supply using Zener diode.

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

Field Effect Transistor (FET): Principle of operation of JFET and MOSFET, depletion and enhancement type NMOS and PMOS, biasing of FETs, low and high frequency models of FETs, switching circuits using FETs, introduction to CMOS.

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

Power Amplifiers: Classification of output stages, class A, B and AB output stages

Introduction to Filter, Oscillators, SCR, TRIAC, DIAC and UJT: Introduction, Classification, Characteristics, Applications; Introduction to IC fabrication processes.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12

CLO1	Define, understand and explain the basic operation of diodes, BJT, MOSFET, JFET, Op-Amp, oscillators, TRIAC, DIAC.	H											
CLO2	Analyze the characteristics of different types of diodes, transistors, OP-Amp and oscillators.		H										
CLO3	Solve various mathematical problems to meet specific design criteria.			H									
CLO4	Design the solution of real-life engineering problems such as rectification, switching and amplification by applying the knowledge of semiconductor diodes, BJT, MOSFET, JFET, Op-Amp etc.			M									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Define, understand and explain the basic operation of diodes, BJT, MOSFET, JFET, Op-Amp, oscillators, TRIAC, DIAC.	P.01.1	C3	K1			CT, SF, CP
CLO2	Analyze the characteristics of different types of diodes, transistors, OP-Amp and oscillators.	P.02.2	C4		P1 P4 P5		CT, SF
CLO3	Solve various mathematical problems to meet specific design criteria.	P.03.2	C3				CT, SF
CLO4	Design the solution of real-life engineering problems such as rectification, switching and amplification by applying the knowledge of semiconductor diodes, BJT, MOSFET, JFET, Op-Amp etc.	P.03.3	C6	K5	P1 P7 P3		ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy

Continuous Assessment (30%)	CP	5%	CLO1	C1, C2
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3, C4
	ASG	5%	CLO4	C6
Semester Final (79%)	SF	70%	CLO1,2,3	C1, C2, C3, C4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Basic ideas and example about Electronics	1	CT1 CP SF	L D SDL
	L2	Comparison between electronic and electrical equipment and their application.	2		
	L3	Introduction to semiconductor devices and its classifications	1		
W2	L4	P-type and N-type materials and doping	1,2		
	L5	Semiconductor diode and its band diagram	2		
	L6	Biasing of semiconductor diodes	2		
W3	L7	I-V characteristics of diode and equivalent circuit of diodes	2		
	L8	Shockley‘s equation, Zener diode and related math	3		
	L9	Applications of diode	1		
W4	L10	Diode rectifiers	1,2		
	L11	Ripple factor and related mathematical problems	2,3		
	L12	Clipper circuit and related problem	3		
W5	L13	Clamper circuit and related problems	3	CT2 CP SF	L D SDL
	L14	Diodes in voltage multiplier circuit	2,3		
	L15	Voltage doubler, Tripler and quadrupler circuit	2		
W6	L16	Introduction to BJT and construction	1		
	L17	Working principle, operating regions of BJT	2		
	L18	BJT configurations and characteristics curves	2		
W7	L19	BJT Biasing circuits, BJT as an amplifier, biasing the BJT for discrete circuits	2		
	L20	Small signal equivalent circuit models	2		
	L21	BJT as a switch and mathematical problems	3		
Mid Break					
W8	L22	Introduction to FET and comparative studies between BJT and FET	1,2	CT3 CP SF	L D SDL
	L23	Construction and operation of JFET	2		
	L24	Mathematical problems related to JFET	3		
W9	L25	Small signal analysis of JFET	2		
	L26	Mathematical problems	3		
	L 27	Mathematical problems	3		
W10	L 28	Introduction to MOSFET, Construction and operating principle	1,2		
	L 29	Types and Characteristics curve of MOSFET	1,2		
	L 30	Biasing of MOSFET and related problems	2		
W11	L 31	Threshold voltage, Body effect, current-voltage characteristics of enhancement MOSFET	2	ASG SF	L D SDL
	L 32	Single-stage MOSFET, multi stage MOSFET and application of MOSFET as switch.	2		
	L 33	Introduction to CMOS circuits	1		
W12	L 34	Basics of Operational Amplifier.	2		
	L 35	Different types of operational amplifier and introduction to Filters	1		

	L 36	Mathematical problems related to op-amp	3,4		
W13	L 37	Basic Principle of oscillation	2	CP SF	L D SDL
	L 38	Different type of oscillators	1,2		
	L 39	Mathematical problems	3,4		
W14	L 40	Concepts of negative feedback	1		
	L 41	Characteristics and applications of SCR, TRIAC, DIAC and UJT	1,2		
	L 42	Review class	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Electronic Devices and Circuit Theory, Pearson, Robert L. Boylestad and Louis Nashelsky.
2. Fundamental of Electric Circuits, MC GRAW HILL INDIA, Matthew N. O. Sadiku
3. A Textbook of Electrical Technology volume 4, HALL OF INDIA, B. L Theraja
4. Electronic Principles, MC GRAW HILL INDIA, Albert P. Malvino.
5. Microelectronics Circuits, Oxford University Press, Adel S. Sedra & Keneth C. Smith-.
6. Operation Amplifiers and Linear Integrated Circuits, Prentice Hall of India Private Limited, Robert F. Coughlin.

3.2.4 ICE 1214: Analog Electronics Lab

Course Information

Course Code	: ICE 1214	Credit Hours	: 1.5
Course Title	: Analog Electronics Lab	Contact Hour	: 3.0

Pre-Requisite

Course Code: EEE 1122
Course Title: Basic Electrical and Circuit Analysis Lab

Rationale

Analog Electronics Laboratory course is designed to familiarize the students with some basic electronic components and to examine the characteristics and working of these components in electronic circuits by hand-held experiments and computer aided simulation tool. After being acquainted with these basic components, students will be able to design, implement and test various analog electronics circuit.

Objective

1. To enable the students to implement circuits using different electronic components like diode, BJT and JFET and analyze working principles and input/output characteristics of these components.
2. To provide the students ability to implement electronic circuits like rectifier, OP-AMP circuits to perform different mathematical operations and oscillator circuits for applications in real life engineering.
3. To introduce the students with the use of circuit simulation software PSpice Schematics in analyzing electronic circuits and thereby enrich their skills in designing various complex electronic circuits.
4. To augment students' creative thinking, communication and project management skills through projects and presentations.

Course Contents

In this course, students will perform experiments to practically verify the theories and concepts that learned about diode characteristics, rectifier circuit, BJT, FET, OPAMP, Oscillator etc. in the theoretical course of ICE 1213 Analog electronics course using different hardware equipment and simulation software.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Use engineering tools efficiently to design, implement and test various analog electronics circuit.					H							
CLO2	Analysis and Interpretation of collected data to provide valid conclusion acknowledging the limitations.				H								
CLO3	Function as effective team leader/member in solving real life problem by a project work.									H			

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Use engineering tools efficiently to design, implement and test various analog electronics circuit.	P.05.2	P4		P1 P4 P5		LP, LT, Q
CLO2	Analysis and Interpretation of collected data to provide valid conclusion acknowledging the limitations.	P.04.2	C4				R, Q
CLO3	Function as effective team leader/member in solving real life problem by a project work.	P.09.1	A2				P, Q

*LP = Lab Performance, LT = Lab Test, Q = Quiz, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30
Self-directed learning	21
Preparation for lab reports	5
Preparation for lab test	5
Preparation of quiz	21
Engagement in project/Assignment	
Formal Assessment	
Continuous assessment	-
Final Quiz	1
Lab Test/Project show	1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO1	P4
Report Writing	20%	CLO2	C4
Project	20%	CLO3	A2
Lab Test	30%	CLO1	P4
Quiz	20%	CLO1,2,3	P4, C4, A2
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Introductory Session on familiarization of basic electronic components, laboratory norms and safety measures.
Week 2	Study of Diode Characteristics using Hardware implementation and Multisim software simulation.
Week 3	Implementation of Diode Rectifier Circuits and study their rectification characteristics for real life engineering problem using Hardware implementation and Multisim software simulation.
Week 4	Construction of n-p-n CB (common base) and n-p-n CE (common emitter) transistor and determine their input and output characteristics using Hardware implementation and Multisim software simulation.
Week 5	Determine the Characteristics of Bipolar Junction Transistor (BJT) in terms of Biasing using Hardware implementation and Multisim software simulation.
Week 6	Review & Practice Lab-1
Week 7	Lab Test-1
Week 8	Applications of Cascaded and Feedback Amplifier Circuits using BJT and Determine their Voltage and Current Gain.
Week 9	Study of Characteristics of Field Effect Transistor (FET) and its Application in CMOS Inverter.
Week 10	Implementation and investigation on Op Amp Inverting Voltage Amplifier.
Week 11	Implementation and investigation on Op-Amp Non-Integrator Voltage Amplifier.
Week 12	Implementation and Verification of the I/O Characteristics of High Pass and Low Pass.
Week 13	Review & Practice Lab-2
Week 14	Lab Test-2

Text and Reference Books

1. Electronic Devices and Circuit Theory, Pearson, Robert L. Boylestad and Louis Nashelsky.
2. Fundamental of Electric Circuits, MC GRAW HILL INDIA, Matthew N. O. Sadiku
3. A Textbook of Electrical Technology volume 4, HALL OF INDIA, B. L Theraja
4. Electronic Principles, MC GRAW HILL INDIA, Albert P. Malvino.
5. Microelectronics Circuits, Oxford University Press, Adel S. Sedra & Keneth C. Smith-.

Operation Amplifiers and Linear Integrated Circuits, Prentice Hall of India Private Limited, Robert F. Coughlin.

3.2.5 MATH-1243: Vector Analysis and Linear Algebra

Course Information

Course Code	: MATH-1231	Credit Hours	: 3.0
Course Title	: Vector Analysis and Linear Algebra	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

To get the basic idea of vectors and linear functions, understand the concept of the word gradient, divergence, curl, line integrals, surface integrals, volume integrals, and related theorem. Also, the basic knowledge of matrices, determinants, eigenvalues, eigenvectors and the relation between the operations on linear transformations and their corresponding matrices, and the ability to determine the physical characteristics of vectors.

Objective

1. To introduce and develop the methods of vector analysis.
2. To understanding of vector geometry and some physical concepts.
3. Find the matrix associated with a linear transformation with respect to given bases and understand the relationship between the operations on linear transformations and their corresponding matrices.
4. To acquaint with the elementary facts concerning eigenvalues and eigenvectors.

Course Contents

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

Linear Algebra: Definition of matrices, algebra of matrices, determinant, inverse of matrix, rank and elementary transformations of matrices, solution of system of linear equations, vector spaces and sub-spaces, basis and dimension, inner product spaces, linear transformations, eigenvalue and eigenvectors, Cayley–Hamilton theorem and applications of linear algebra.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Able to describe the behavior of a vector and illustrate their properties.	H											
CLO2	Able to state various terms related to linear algebra and demonstrate their characteristics.		H										
CLO3	Describe the real understanding of the connection between the vector and geometry.		H	M									
CLO4	Able to illustrate the application of linear algebra in real life problem.			M									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Able to describe the behavior of a vector and illustrate their properties.	P.01.2	C1 C3	K2			CT, SF
CLO2	Able to state various terms related to linear algebra and demonstrate their characteristics.	P.01.3	C2 C4	K3			CT, SF
CLO3	Describe the real understanding of the connection between the vector and geometry.	P.03.2	C3 C5				CT, SF, CP

CLO4	Able to illustrate the application of linear algebra in real life problem.	P.02.2	C2 C4 C5				CT, SF, ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO3	C3, C5
	CT (1-3)	20%	CLO1,2,3,4	C1, C2, C3, C4, C5
	ASG	5%	CLO4	C6
Semester Final (79%)	SF	70%	CLO1,2,3,4	C1, C2, C3, C4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Scalars, vectors, unit vectors, rectangular unit vectors, components of a vector, multiplications of vectors by scalar.	1	CT1 CP SF	L D SDL
	L2	Scalar fields, vector fields, linear dependence, and independence of vector.	1		
	L3	vector addition and subtraction, dot product and exercises.	1,2		
W2	L4	Cross product, physical interpretation of cross product and exercises.	1,2		
	L5	Triple product of vectors, physical interpretation of triple product and exercises.	1,2		
	L6	Ordinary and partial derivatives of vectors, physical interpretation of derivatives and exercises	1,2		
W3	L7	The vector differential operator, gradient, physical meanings of gradient and exercises.	1,2		
	L8	Divergence, curl, and their physical meanings and exercises.	1,2		
	L9	Ordinary integrals of vectors and exercises.	1,2		
W4	L10	Line integrals, physical interpretation of line integrals and exercises.	2		
	L11	Surface integrals, physical interpretation of surface integrals and exercises.	2		
	L12	Volume integrals, physical interpretation of volume integrals and exercises	2		

W5	L13	Statement of the divergence theorem of Gauss, Stokes' theorem, Green's theorem in the plane.	1,2	CT2 CP SF	L D SDL
	L14	Verifications of the above theorems.	1,2		
	L15	Applications of divergence theorem and Stokes' theorem.	1,2		
W6	L16	Introduction to matrix, types of matrices.	3,4		
	L17	Transpose matrix, matrix addition and subtractions and scalar multiplications of matrix.	3		
	L18	Matrix multiplications and exercises.	3		
W7	L19	Polynomial of matrix.	3		
	L20	Determinant of square matrix and solution of system of linear equations.	3		
	L21	Invertible matrix, inversion of matrix.	3		
Mid Break					
W8	L22	Exercises of inverse matrix.	3,4	CT3 CP SF	L D SDL
	L23	Polynomials of matrices, characteristic polynomial.	3		
	L24	Cayley–Hamilton theorem, eigenvalues, and eigenvectors.	3,4		
W9	L25	Computing eigenvalues and eigenvectors.	3		
	L26	Symmetric matrices and quadratic forms, minimal polynomial.	3		
	L 27	Characteristic and minimal polynomials of block matrices	3		
W10	L 28	Introduction to the system of linear equations, formulation of system of linear equations from real life problem.	3,4		
	L 29	Solutions of system of linear equations.	3,4		
	L 30	Systems in triangular and Echelon forms, Echelon matrices.	3,4		
W11	L 31	Row canonical form, row equivalence.	3,4	ASG SF	L D SDL
	L 32	Gaussian elimination methods.	3,4		
	L 33	Exercises.	3,4		
W12	L 34	Introduction to the vector spaces	3,4		
	L 35	Linear combinations, linear dependence and independence	3,4		
	L 36	Basis and dimension and exercises.	3, 4		
W13	L 37	Application to matrices, rank of a matrix.	3,4	CP SF	L D SDL
	L 38	Mappings and functions, linear mappings (linear transformations).	3,4		
	L 39	Kernel and image of a linear mapping.	4		
W14	L 40	Singular and nonsingular linear mappings, isomorphisms.	4		
	L 41	Review class-I	1,2		
	L 42	Review class-II	3,4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Linear Algebra, McGraw Hill, Seymour Lipschutz and Marc Lars Lipson.
2. Elementary Linear Algebra, John Wiley & Sons Inc, Howard Anton and Chris Rorres.
3. Vector Analysis, McGraw Hill Education, M. R. Spiezel.
4. A Text Book of Vector Analysis, SHREE RAM, Narayan Shanti and Mittal P K

*Additional reading material: PowerPoint slides & PDF provided by the teacher

3.2.6 CHEM 1261: Engineering Chemistry

Course Information

Course Code Course Title	: CHEM 1251 : Engineering Chemistry	Credit Hours Contact Hour	:3.0 :3.0

Pre-Requisite

Course Code: CHEM 1251
Course Title: Engineering Chemistry

Rationale

To learn and familiarize the basics of Chemistry and its application in Engineering study.

Objective

1. To learn the basic terms of Chemistry and their applications.
2. To study the different theorems of Chemistry and apply those theorems in developing various instruments.
3. Students will be able to define the different parameter and concepts regarding atomic structure, periodic table and chemical bonding.
4. Students will be able to know the application of different types of colloids and adsorbent.
5. Students will be able to apply different theory on chemical bonding and hybridization to evaluate structure of molecules.
6. Students will be able to classify and explain chemistry of halogen, alkali metals, alkaline earth metals, non-metals and heavy metals.
7. Students will be able to explain chemical equilibrium, chemical and ionic equilibria, electrochemical cells.

Course Contents

Atomic Structure: Atomic models, Spectrum, Series, Quantum number, Aufbau principle, Pauli's exclusion principle and Hund's rule.
Periodic Table: Modern concept of periodic table; Constitution and Periodic properties of elements Grouping of elements, their properties and uses.
Chemical Bonding: Different types of bonds, Atomic orbital's and their hybridization; Valence bond and Molecular orbital theories.
Electrochemistry: Conductors, Degree of ionization, Faradays Laws, Conductance, Kohlrausch's law, Transport number.
Oxidation-Reduction: Oxidation, Reduction, Oxidant, Reductant, Valency and oxidation number, Balancing of REDOX reaction, EMF series.
Chemical Equilibrium and Kinetics: Equilibrium and Equilibrium constants, Kc, Kp, Kx. Rate of reaction, Le Chatelier principle, Order and molecularity.
Surface Chemistry and Colloids: Adsorption and sorption; Characteristics of physical and chemical adsorptions, Fruendlich, Langmuir and Gibb's Adsorption isotherms; Crystalloids, Colloids, Emulsions and Gels.
Chemistry of Transition Elements, Lanthanides and Actinides: Definitions, electronic configurations, preparations (nuclear transformations), general properties and uses.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12

CLO1	**Apply** different laws and theorems of Chemistry to solve various engineering problems.	H										
CLO2	**Analyze** different electrochemical and electrolytic cell related to engineering problems efficiently.		H									
CLO3	**Design** various elementary cell and hardware related projects using suitable laws, theorems and materials.			M								

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	**Apply** different laws and theorems of Chemistry to solve various engineering problems.	P.01.1	C1 C2	K1			CT, SF, CP
CLO2	**Analyze** different electrochemical and electrolytic cell related to engineering problems efficiently.	P.02.2	C4	K3			CT, SF
CLO3	**Design** various elementary cell and hardware related projects using suitable laws, theorems and materials.	P.03.3	C6	K5	P1 P3 P7		ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom'sTaxonomyLevel, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centered Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy(AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3, C4
	ASG	5%	CLO3	C6
Semester Final (70%)	SF	70%	CLO1,2,3	C1, C2, C3, C4
Total Marks		100%		

Course Plan

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Atomic Structure, Atomic models	1	CT1 CP	
	L2	Spectrum	2,3		

	L3	Series	1	SF	L D SDL
W2	L4	Quantum number	1		
	L5	Aufbau principle	2,3		
	L6	Pauli's exclusion principle and Hund's rule	2,3		
W3	L7	Different types of bonds	2		
	L8	Atomic orbital's	3		
	L9	Hybridization	1		
W4	L10	Valence bond theory	1,2		
	L11	Molecular orbital theories	1		
	L12	Electrochemistry, Conductors	3		
W5	L13	Degree of ionization	1	CT2 CP SF	L D SDL
	L14	Faradays Laws	2,3		
	L15	Conductance	2		
W6	L16	Kohlrausch's law	1		
	L17	Transport number	1,2		
	L18	Oxidation, Reduction, Oxidant, Reductant	2		
W7	L19	Valency and oxidation number	2		
	L20	Balancing of REDOX reaction	2		
	L21	EMF series	1,2,3		
Mid Break					
W8	L22	Modern concept of periodic table	1,2	CT3 CP SF	L D SDL
	L23	Constitution and Periodic properties of elements	1,2		
	L24	Grouping of elements, their properties and uses	3		
W9	L25	Chemical Equilibrium and Kinetics	1,2		
	L26	Equilibrium and Equilibrium constants	1,2		
	L 27	Kc, Kp, Kx	3		
W10	L 28	Rate of reaction	1,2,3		
	L 29	Le Chatelier principle	1,2		
	L 30	Order and molecularity	2		
W11	L 31	Surface Chemistry and Colloids	2	ASG SF	L D SDL
	L 32	Adsorption and sorption	2		
	L 33	Characteristics of physical and chemical adsorptions	1,2		
W12	L 34	Fruendlich	1, 2,3		
	L 35	Langmuir and Gibb's Adsorption isotherms	1,2,3		
	L 36	Crystalloids	1		
W13	L 37	Colloids	1,2	CP SF	L D SDL
	L 38	Emulsions and Gels	1,2		
	L 39	Transition Elements, Lanthanides and Actinides	3		
W14	L 40	Definitions	1		
	L 41	Electronic configurations	1,2		
	L 42	General properties and uses	3		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Introduction to Modern Inorganic Chemistry, S. Chand and Company Limited, S. Z. Haider.
2. Modern Inorganic Chemistry, S. Chand and Company Limited, R. D. Madan.
3. Advanced Organic Chemistry, S. Chand and Company Limited, B. S. Bahl & Arun Bahl.
4. Fundamental concepts of Inorganic Chemistry, McGraw-Hill Education, S. Gilreath.
5. Advanced Inorganic Chemistry, S. Chand and Company Limited, S. Prakash & G. Tuli.

6. A Text Book of Organic Chemistry, S. Chand and Company Limited, B. S. Bahl& Arun Bahl
7. Physical Chemistry, Tata McGraw Hill Education Pvt. Ltd, G. M. Barrow.
8. Essentials of Physical Chemistry, S. Chand and Company Limited, B. S. Bahl and G. D. Tuli.
9. Principle of Physical chemistry, S. Chand and Company Limited, M. M. Haque and M. A. Nawab.
10. Physical Chemistry, Longmans, W. J. Moore.
11. A text book of Physical Chemistry, D. Van Nostrand company, S Glasstone.
12. Introduction to Electrochemistry, East-West Press (Pvt.) Ltd., S. Glsstone and D. Lewis.

3.2.7 ME 1272: Engineering Drawing and CAD Design.

Course Information

Course Code	: ME 1272	Credit Hours	: 1.0
Course Title	: Engineering Drawing and CAD Design.	Contact Hour	: 2.0

Pre-Requisite

N/A

Rationale

It will be useful for designing and drawing of schematics for simple blocks, orthographic and isometric representations, dimensioning, and basic civil engineering components manually as well as using AutoCAD, which will be helpful to the students during project work in professional life.

Objective

1. To know about basics engineering drawing formats.
2. To gain knowledge about the basic functions of AutoCAD efficiently.
3. To take data and transform it into graphic drawings.

Course Contents

Engineering Drawing & CAD Sessional Introduction. Lettering, Numbering and Heading drawing instruments and their use. Plan, Elevation, Section, and building service drawing of one-story building. Detailed drawing: Building service drawing (Electrical layout), using AutoCAD software.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Students will acquire **knowledge** about project a point, line, solid objects in a plane, different types of projectionists, and two-dimensional Building drawings.	M											
CLO2	Students will be able to **apply** the basic concept of two-dimensional Building drawings (plan, section, elevation, building service drawing).	M		L									
CLO3	Students will be able to prepare two-dimensional Building drawings using **modern tools** (Auto CAD).	M				L							

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Students will acquire **knowledge** about project a point, line, solid objects in a plane, different types of projectionists, and two-dimensional Building drawings.	P.01	C1				LP, Q
CLO2	Students will be able to **apply** the basic concept of two-dimensional Building drawings (plan, section, elevation, building service drawing).	P.01, 03	C3				LP, LT, Q
CLO3	Students will be able to prepare two-dimensional Building drawings using **modern tools** (Auto CAD).	P.01, 05	C3				LP, LT, Q

*LP = Lab Performance, LT = Lab Test, Q = Quiz, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom 's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30
Self-directed learning	
Preparation for lab reports	30
Preparation for lab test	6
Preparation of quiz	5
Engagement in group project	30
Formal Assessment	
Continuous assessment	12
Final Quiz	1
Total	120

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO2,3	C3
Report Writing	20%	CLO1,2,3	C1, C3
Project	20%	CLO3	C3
Lab Test	30%	CLO1,2,3	C1, C3
Quiz	20%	CLO1,2,3	C1, C3
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Introductory Session on familiarization of Engineering Drawing, laboratory norms and safety measures.
Week 2	Instrument and their use Lettering, Numbering and Heading.
Week 3	Sectional views and isometric views of solid geometrical figures.
Week 4	Plan, of one-story building.
Week 5	Elevation and Section of one-story building.
Week 6	Building service drawing (Electrical layout and Plumbing).

Week 7	Introduction to Auto CAD software. drawing editing and dimensioning of simple objects using Auto CAD.
Week 8	Drawing of plan of one-storied buildings.
Week 9	Drawing of Elevation and Section of one-storied buildings.
Week 10	Drawing of Elevation and Section of one-storied buildings.
Week 11	Building service drawing (Electrical layout).
Week 12	Building service drawing (Electrical layout).
Week 13	Review & Practice Lab-2
Week 14	Lab Test-2

Text and Reference Books

1. Prathomic Engineering Drawing by Hemanta Kumar Bhattacharyya.

3.2.8 BBA 1291: Financial and Managerial Accounting

Course Information

Course Code Course Title	: BBA 2291 : Financial and Managerial Accounting	Credit Hours Contact Hour	: 3.0 : 3.0

Pre-Requisite

Course Code: BBA 2291
Course Title: Financial and Managerial Accounting

Rationale

The course will contribute to the development of the students' managerial potential by explaining the techniques of financial and managerial accounting and examining their relevance to the broader issues of management evaluation and decision-making in the generic manufacturing and service sectors.

Objectives

1. Distinguish between the different users of accounting data and their informational requirements.
2. Recognize and apply different accounting conventions, formats and practices.
3. Evaluate the costing principles underlying the classification and processing of cost accounting data.
4. Specify the organizational context of management accounting, and evaluate strengths and limitations of management accounting data in improving organizational effectiveness.

Course Contents

Financial Accounting: Objectives and importance of accounting; Accounting as an information system. Computerized system applications in accounting. Recording system, double-entry mechanism; account and their classification

Accounting Equation: Accounting cycle: Journal, ledger, trial balance. Preparation of financial statements considering adjusting and closing entries; Accounting concepts (principles) and conventions

Financial Statement Analysis and Interpretation: Ratio analysis, Common Size Analysis

Cost and Management Accounting: Cost concepts and classification; Overhead cost: meaning and classification; Distribution of overhead cost: Overhead recover method/rate; Job order costing: preparation of job cost sheet and question price, Inventory valuation: absorption costing and marginal/variable costing technique

Cost Volume-Profit Analysis: Meaning, break-even analysis, contribution margin analysis sensitivity analysis. Short-term investment decisions; relevant and differential cost analysis.

Long-term Investment Decisions: Capital budgeting, various techniques of evaluation of investments.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Distinguish between the different users of accounting data and their informational requirements.		L										
CLO2	Recognize and apply different accounting conventions, formats and practices.					L							
CLO3	Evaluate the costing principles underlying the classification and processing of cost accounting data.					L							
CLO4	Specify the organizational context of management accounting, and evaluate strengths and limitations of management accounting data in improving organizational effectiveness.											L	

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Distinguish between the different users of accounting data and their informational requirements.	P.02.1	C4				CT, SF, CP
CLO2	Recognize and apply different accounting conventions, formats and practices.	P.05.1	C3				CT, SF
CLO3	Evaluate the costing principles underlying the classification and processing of cost accounting data.	P.05.1	C3				CT, SF
CLO4	Specify the organizational context of management accounting, and evaluate strengths and limitations of management accounting data in improving organizational effectiveness.	P.11.1	P4				ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom‘s Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-

Self-Directed Learning Non-face-to-face learning Revision Assessment Preparations	35 20 20
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3, C4
	ASG	5%	CLO4	C6
Semester Final (79%)	SF	70%	CLO1,2,3	C1, C2, C3, C4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Identify the activities and users associated with accounting	2	CT1 CP SF	L D SDL
	L2	Explain the building blocks of accounting	2		
	L3	State the accounting equation, and define its components	2		
W2	L4	Analyze the effects of business transactions on the Accounting Equation	5		
	L5	Describe the four financial statements and how they are prepared	2		
	L6	Describe how accounts, debits, and credits are used to record business transactions	2		
W3	L7	Indicate how a journal is used in the recording process	5		
	L8	Explain how a ledger and posting help in the recording process	5		
	L9	Prepare a trial balance	5		
W4	L10	Understand the uses and limitations of an income statement	2		
	L11	Describe the content of the income statement	2		
	L12	Prepare an income statement	5		
W5	L13	Explain how to report various income items	2	CT2 CP SF	L D SDL
	L14	Understand the reporting of accounting changes and errors	2		
	L15	Prepare a retained earnings statement	5		
W6	L16	Explain the uses and limitations of a balance sheet	2		
	L17	Identify the major classifications of the balance sheet	2		
	L18	Prepare a classified balance sheet using the report and account formats	5		
W7	L19	Identify the purpose and content of the statement of cash flows	2		
	L20	Prepare a basic statement of cash flows	5		
	L21	Identify and give examples of each of the three basic manufacturing cost categories.	2		
Mid Break					
W8	L22	Distinguish between product costs and period costs and give examples of each.	2	CT3 CP SF	L D SDL
	L23	Understand cost behavior patterns including variable costs, fixed costs, and mixed costs.	2		
	L24	Analyze a mixed cost using a scatter graph plot and the high-low method.	5		
W9	L25	Prepare income statements for a merchandising company using the traditional and contribution formats.	5		
	L26	Understand the differences between direct and indirect costs.	2		

	L 27	Understand cost classifications used in making decisions: differential costs, opportunity costs, and sunk costs.	2		
W10	L 28	Analyze a mixed cost using a scatter graph plot and the least-squares regression method.	2,5		
	L 29	Explain how changes in activity affect contribution margin and net operating income.	2		
	L 30	Prepare and interpret a cost-volume-profit (CVP) graph and a profit graph.	2,5		
W11	L 31	Use the contribution margin ratio (CM ratio) to compute changes in contribution margin and net operating income resulting from changes in sales volume.	5	ASG SF	L D SDL
	L 32	Show the effects on net operating income of changes in variable costs, fixed costs, selling price, and volume.	2,5		
	L 33	Determine the level of sales needed to achieve a desired target profit.	5		
W12	L 34	Determine the break-even point.	5		
	L 35	Compute the margin of safety and explain its significance.	5		
	L 36	Compute the degree of operating leverage at a particular level of sales and explain how it can be used to predict changes in net operating income.	5		
W13	L 37	Compute the break-even point for a multiproduct company and explain the effects of shifts in the sales mix on contribution margin and the break-even point.	5	CP SF	L D SDL
	L 38	Evaluate the acceptability of an investment project using the net present value method.	11		
	L 39	Evaluate the acceptability of an investment project using the internal rate of return method.	11		
W14	L 40	Determine the payback period for an investment.	11		
	L 41	Rank investment projects in order of preference.	11		
	L 42	Evaluate an investment project that has uncertain cash flows.	11		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Accounting. 3rd ed. National Curriculum and Textbook Board (NCTB), Bangladesh by Chowdhury, D., Ali, M. and Rahman, M., 2017.
2. Accounting Principles. 12th ed., Wiley Publishers, Weygandt, J., Kieso, D. and Kimmel, P.2017.
3. Intermediate Accounting. 16th ed. Wiley Publishers, Kieso, D., Weygandt, J., Wiecek, I., McConomy, B. and Warfield, T., 2016.
4. Managerial Accounting. 14th ed. McGraw-Hill, Garrison, R., Noreen, E. and Brewer, P., 2012.

3.3 Course Outline of 2nd Year, 1st Semester

3.3.1 ICE 2111: Object Oriented Programming Languages

Course Information			
Course Code	: ICE 2111	Credit Hours	: 3.0
Course Title	: Object Oriented Programming Language	Contact Hour	: 3.0

Pre-Requisite

Course Code: ICE 1211
Course Title: Structured Programming Language

Rationale

This is an introductory course on object-oriented programming, which is designed to develop understanding of fundamental concepts of object-oriented programming. The course covers a number of basic and advanced object-oriented concepts including classes, objects, inheritance, polymorphism, composition, encapsulation, templates etc. The course aims to illustrate the object-oriented concepts and develop solutions using C++The Object-oriented programming course is designed to provide a comprehensive understanding to a programming paradigm that includes or relies on the concept of objects, encapsulated data structures that have properties and functions and which interact with other objects.

Objective

1. To acquire knowledge of underlying concepts of object-oriented paradigm.
2. To develop an understanding of object-oriented design artifacts and their mapping to object-oriented programming.
3. To design and implement object-oriented solutions for small systems involving single/multiple objects.

Course Contents

Introduction to OOP: Introduction to OOP, Object oriented programming vs. procedural programming, advantages of object-oriented programming.
Introduction to C++: OOP in Java, basic intro to loop and conditional statements, arrays, Array List / Vectors.
Constructors and Destructors: Constructors, Destructors, Copy Constructors.
Pointers of objects: Array of objects, object pointers, and object references.
Functions: Member Functions, In-line functions, friend functions, static functions.
Introduction to Classes: Classes: data members and member functions. Member access, constructors and destructors, static data members, scope resolution operator. Memory allocated for objects.
Operator Overloading: Unary, binary, comparison, Arithmetic assignment operator overloading, Data conversion
Inheritance: Inheritance, base and derived classes, casting base class to derive class, public, protected, friendly and private inheritance, overriding member functions
Composition: Complex classes composed of objects of other classes
Polymorphism: Overridden functions, abstract base class, and this pointer.
Object Oriented Design: Class Diagram, Forward Engineering of class diagram to code, Reverse Engineering of code to class diagram.
Exception Handling: Exception handling, Error handling, try/catch/finally blocks, throwing an exception, re-throwing, and exception.
File Handling: Streams, Stream objects, Character and binary I/O, Object I/O, readers and writers, I/O with Multiple Objects, Position and offset.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Define and understand the fundamental features of an object-oriented programming language.	H											
CLO2	Understand the benefits of object-oriented design and analyses when it is an appropriate methodology to use.	H	M										
CLO3	Design object-oriented solutions for small problems, involving multiple objects.		M	H									

CLO4	Illustrate good programming style and identify the impact of style on developing and maintaining programs.		H									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Define and understand the fundamental features of an object-oriented programming language.	P.01.1	C3	K1			CT, SF, CP
CLO2	Understand the benefits of object-oriented design and analyses when it is an appropriate methodology to use.	P.01.3	C3	K3			CT, SF
CLO3	Design object-oriented solutions for small problems, involving multiple objects.	P.03.2	C3		P1 P3 P7		CT, SF
CLO4	Identify the impact of OOP on developing and maintaining programs.	P.02.2	C4		P1 P4 P5		ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3, C4
	ASG	5%	CLO4	C6
Semester Final (79%)	SF	70%	CLO1,2,3	C1, C2, C3, C4
Total Marks		100%		

Course Plan

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Introduction to Object Oriented Programming (OOP)	1	CT1 CP SF	L D SDL
	L2	Overview of Structured Programming (SP)	2		
	L3	Problems with Structured Programming	1		
W2	L4	Object Oriented Programming Approach	1,2		
	L5	Characteristics of Object-Oriented Programming	2		

	L6	Basics of C++	2		
W3	L7	Features of Object-Oriented Programming	2		
	L8	Introduction to class, objects and access specifiers.	3		
	L9		1		
W4	L10	Member Functions, In-line functions, Friend functions,	1,2		
	L11	Function Overloading	2,3		
	L12	Concept of Constructors	3		
W5	L13	Concept of Destructors	3	CT2 CP SF	L D SDL
	L14	Copy Constructor	2,3		
	L15	Character sets and Tokens	2		
W6	L16	Preprocessor derivatives and I/O Streams	1		
	L17	Control Statements	2		
	L18		2		
W7	L19	Functions, Scope	2		
	L20		2		
	L21	Arrary	3		
Mid Break					
W8	L22	String	1,2	CT3 CP SF	L D SDL
	L23	Pointers	2		
	L24	A simple class and object	3		
W9	L25	Accessing members of class	2		
	L26	Initializing class objects	3		
	L 27	Mathematical problems	3		
W10	L 28	Constructor and Destructor Initialization	1,2		
	L 29	Static Data members	1,2		
	L 30	Fundamental operator overloading	2		
W11	L 31	Various Data conversions	2	ASG SF	L D SDL
	L 32	Inheritance and types of inheritance	2		
	L 33	Access specifiers and function overriding	1		
W12	L 34	Virtual function and abstract class.	2		
	L 35	Friend function	1		
	L 36	Templates and Inheritance	3,4		
W13	L 37	Exception Handling	2	CP SF	L D SDL
	L 38	Use cases of exception Handling	1,2		
	L 39	Formatted and Unformatted input output.	3,4		
W14	L 40	File input/Output Streams	1		
	L 41	Read/Write from file	1,2		
	L 42	Review class	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Robert Lafore, Object-Oriented Programming in C++, Third Edition, The Waite's Group.
2. Stanley B. Lippman, C++ Primer, 2nd edition.
3. Herbert Schildt, C++ The Complete Reference, Fourth Edition, Tata McGraw Hill Publication.
4. Deitel and Deitel, C++ How to Program, Third Edition, Pearson Publication.

3.3.2 ICE 2112: Object Oriented Programming Languages Lab

Course Information

Course Code	: ICE 2112	Credit Hours	: 1.5
Course Title	: Object Oriented Programming Languages Lab	Contact Hour	: 3.0

Pre-Requisite

Course Code: ICE 1212
Course Title: Structured Programming Language Lab

Rationale

This course emphasizes current techniques in object-oriented design, analysis, and programming. Such topics as encapsulation, information hiding, inheritance and polymorphism are studied in class assignments and programming exercises. The C++ programming language is utilized along with the UML modeling language. This lab reinforces understanding of basic object-oriented programming concepts (objects, classes and subclasses, methods) and their expression in C++. It also provides practice using non-object aspects of Java (loops, conditionals, etc.)

Objective

1. To design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
2. To gain the ability to use current techniques, skills, and tools necessary for computing practice.
3. To apply design and development principles in the construction of software systems of varying complexity.

Course Contents

In this course, students will perform experiments to practically verify the theories and concepts that learned about class, object, loop, conditions, constructor, polymorphism, inheritance etc. in the theoretical course of ICE 2111 Object Oriented Programming Language course using software.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Apply information and knowledge of object-oriented programming language to demonstrate and analyze the various practical problems.	H	M										
CLO2	Design and develop solution for different components of complex engineering problem related to practical programming problems.			H									
CLO3	Analysis and Interpretation of problems and solutions using object oriented programming language to provide valid conclusion acknowledging the limitations.				H								

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessme

							nt Meth ods
CLO1	Apply information and knowledge of object-oriented programming language to demonstrate and analyze the various practical problems.	P.01.1	C3	K1			LP, LT, Q
CLO2	Design and develop solution for different components of complex engineering problem related to practical programming problems.	P.03.2	C3		P1 P3 P7		R, Q
CLO3	Analysis and Interpretation of problems and solutions using object-oriented programming language to provide valid conclusion acknowledging the limitations.	P.04.2	C4				P, Q

*LP = Lab Performance, LT = Lab Test, Q = Quiz, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30
Self-directed learning	21
Preparation for lab reports	5
Preparation for lab test	5
Preparation of quiz	21
Engagement in project/Assignment	
Formal Assessment	
Continuous assessment	-
Final Quiz	1
Lab Test/Project show	1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO1	P4
Report Writing	20%	CLO2	C4
Project	20%	CLO3	A2
Lab Test	30%	CLO1	P4
Quiz	20%	CLO1,2,3	P4, C4, A2
Total Marks	**100%**		

Lab Schedule

Week	Topic
Week 1	Familiarization with Basic C++ programs.
Week 2	Experimentation with the conditional statements in C++.
Week 3	Experimentation with the iteration in C++.
Week 4	Experimentation with non-numeric data types.
Week 5	Experimentation with pointer and dynamic memory allocation.
Week 6	Review & Practice Lab-1

Week 7	Lab Test-1
Week 8	Implementation of class declaration, definition, and access modifiers in C++.
Week 9	Implementation of constructor and destructor in C++.
Week 10	Experimentation with the inheritance in C++.
Week 11	Experimentation with function overloading and overriding in C++.
Week 12	Implementation of exception handling in C++.
Week 13	Review & Practice Lab-2
Week 14	Lab Test-2

Text and Reference Books

1. The C++ Programming Language (4th Edition) By Bjarne Stroustrup.
2. C++ Primer (5th Edition) By Stanley B. Lippman, Josee Lajoie, and Barbara E Moo
3. Practical C++ Programming (2nd Edition) By Steve Oualline
4. Effective Modern C++ (2014) By Scott Meyers

3.3.3 ICE 2113: Analog and Digital Communication

Course Information

Course Code	: ICE 2113	Credit Hours	: 3.0
Course Title	: Analog and Digital Communication	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

To teach the students the concepts, principles and working of basic in analog and digital communications.). It is targeted to provide a basic foundation for analog and digital modulation techniques, communication receiver and transmitter design, baseband and bandpass communication techniques, line coding techniques, and noise analysis in various transmission environments.. Finally, this course is designed to analytical techniques to evaluate the performance of analog and digital communication systems.

Objective

1. To build an understanding of the fundamental concepts on basic working principle of analog and digital communication.
2. To familiarize with the basic taxonomy and terminology of the communication system and different modulation.
3. To introduce the basics of information theory and the functions of multiplexing and multiple access.
4. To gain expertise in some specific areas of communication such as the design of the system.

Course Contents

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

Noise: Source, characteristics of various types of noise and signal to noise ratio, Intersymbol interference (ISI) .

Amplitude modulation: Introduction, double side band, single side band, vestigial side band, quadrature, spectral analysis of each type, envelope and synchronous detection. Frequency modulation (FM) and phase modulation (PM), demodulation of FM and PM.

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

Pulse code modulation (PCM): Quantization principle, quantization noise, non-uniform quantization, signal to quantization error ratio, Companded PCM, PSK, FSK, QPSK, BPSK, differential PCM, demodulation of PCM.
Delta modulation (DM): Principle, adaptive DM, line coding – formats and bandwidths.
Digital modulation: Amplitude-shift keying - principle, ON-OFF keying, bandwidth requirements, detection, noise performance, Demodulation and detection estimation.
Phase-shift keying (PSK): Principle, bandwidth requirements, detection. Coherent and Non-coherent Demodulation techniques.
Multiplexing: Frequency division multiplexing (FDM), Time division multiplexing (TDM) - principle, receiver synchronization, frame synchronization, PHD, SONET/SDH, wavelength division multiplexing, multiple-access network – time division multiple access, frequency-division multiple access, code-division multiple access (CDMA), spread spectrum techniques, coding techniques and constraints of CDMA.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Define, understand and explain the basic operation of different components of a communication system	H											
CLO2	Analyze the characteristics of different performance indicating parameters of that system	H											
CLO3	Identify and explain different methods of multiplexing for communication systems and contrast between different multiple access schemes for communication networks to solve complex engineering problems..		H										
CLO4	Design the communication system with defined design parameters and justify the selection of channel by generating the performance characteristics of the system for the real-life engineering problems.			H									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Define, understand and explain the basic operation of different components of a communication system	P.01.1	C3	K1			CT, SF, CP
CLO2	Analyze the characteristics of different performance indicating parameters of that system	P.01.3	C3	K3			CT, SF
CLO3	Identify and explain different methods of multiplexing for communication systems and contrast between different multiple access schemes for communication networks to solve complex engineering problems..	P.02.1	C4	K1, K2 K3	P1 P2 P6		CT, SF

CLO4	Design the communication system with defined design parameters and justify the selection of channel by generating the performance characteristics of the system for the real-life engineering problems.	P.03.3	C6	K5			ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3, C4
	ASG	5%	CLO4	C6
Semester Final (79%)	SF	70%	CLO1,2,3	C1, C2, C3, C4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Overview of communication systems: Basic principles	1	CT1 CP SF	L D SDL
	L2	Fundamental elements, system limitations	2		
	L3	Message source, bandwidth requirements	1		
W2	L4	Transmission media types, bandwidth and transmission capacity	1,2		
	L5	Noise: Source, characteristics of various types of noise and signal to noise ratio	2		
	L6	Information theory: Measure of information	2		
W3	L7	Source encoding, error free communication over a noisy channel	2		
	L8	Channel capacity of a continuous system	3		
	L9	Channel capacity of a discrete memory less system	1		
W4	L10	Communication systems: Analog and digital	1,2		
	L11	Continuous wave modulation: Transmission types	2,3		
	L12	Base-band transmission, carrier transmission	3		
W5	L13	Amplitude modulation: Introduction, double side band	3	CT2	

	L14	Single side band	2,3	CP SF	L D SDL
	L15	vestigial side band details	2		
W6	L16	Envelope and synchronous detection	1		
	L17	Angle modulation: Instantaneous frequency, frequency modulation (FM)	2		
	L18	Phase modulation (PM), spectral analysis	2		
W7	L19	Demodulation of FM and PM	2		
	L20	Pulse modulation: Sampling theorem, Nyquist criterion	2		
	L21	Aliasing, instantaneous and natural sampling. Principle, bandwidth requirements	3		
Mid Break					
W8	L22	Pulse code modulation (PCM): Quantization principle, quantization noise	1,2	CT3 CP SF	L D SDL
	L23	Non-uniform quantization, signal to quantization error ratio	2		
	L24	Companded PCM, PSK, FSK, QPSK, BPSK, differential PCM	3		
W9	L25	Demodulation of PCM. Delta modulation (DM)	2		
	L26	Pulse amplitude modulation Principle	3		
	L 27	Digital modulation: Amplitude-shift keying– principle	3		
W10	L 28	Amplitude-shift keying: ON-OFF keying, bandwidth requirements, detection, noise performance	1,2		
	L 29	Phase-shift keying (PSK): Principle, bandwidth requirements, detection	1,2		
	L 30	Coherent and Non-coherent Demodulation techniques	2		
W11	L 31	Multiplexing: Frequency division multiplexing (FDM)	2	ASG SF	L D SDL
	L 32	Time division multiplexing (TDM) -principle	2		
	L 33	TDM - receiver synchronization, frame synchronization	1		
W12	L 34	PHD, SONET/SDH, wavelength-division multiplexing	2		
	L 35	Multiple-access network – time-division multiple access	1		
	L 36	Frequency-division multiple access	3,4		
W13	L 37	Code-division multiple access (CDMA)	2	CP SF	L D SDL
	L 38	Spread spectrum techniques	1,2		
	L 39	Coding techniques and constraints of CDMA.	3,4		
W14	L 40	Communication system design: Design parameters	1		
	L 41	Channel selection criteria	1,2		
	L 42	Review class	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. S. Haykin and M. Moher, Communication Systems, 5th ed.
2. B. P. Lathi and Z. Ding, Modern Digital and Analog Communication Systems, 4th ed.,
3. S. Haykin and M. Moher, Introduction to Analog and Digital Communications, 2nd ed
4. M. P. Fitz, Fundamentals of Communications Systems.
5. J.G. Proakis, M. Salehi, Fundamentals of Communication Systems, 2nd ed.
6. 6. L. W. Couch, II, Digital and Analog Communication Systems, 8th ed.,

3.3.4 ICE 2114: Analog and Digital Communication Lab

Course Information			
Course Code	: ICE 2114	Credit Hours	: 1.5
Course Title	: Analog and Digital Communication Lab	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

Analog and Digital Communication Laboratory course is designed to teach the students to analyze the modulation and demodulation techniques implementing the circuit physically. The students are expected to be able to distinguish between the different multiplexing techniques. With necessary modules and equipment required, the target is to enable the students to demonstrate the characteristic waveforms of sampled and reconstructed signals.

Objective

1. To introduce the students with the basic concepts of modulation and demodulation.
2. To familiarize the students with the analogue modulation techniques and enable them to implement the circuits using necessary modules and oscilloscopes.
3. To impart knowledge on the multiplexing and demultiplexing techniques and teach them to implement the circuits for these for their better understanding
4. To acquaint the students with the digital modulation techniques with the help of the required modules and oscilloscopes.

Course Contents

In this course, students will perform experiments to practically verify the theories and concepts that learned about basic working principle of analog and digital communication system, modulation and demodulation of communication system and the basics of transmitter and receiver in the theoretical course of ICE 2113 Analog and digital communication course using different hardware equipment and simulation software.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Apply information and concepts of communication system and introduce its components.	H											
CLO2	Use resources effectively to perform Engineering activities related to communication system.												H
CLO3	Use resources effectively to perform Engineering activities related to communication system.					H							

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Apply information and concepts of communication system and introduce its components.	P.01.1	C3	K1			Q,V,R
CLO2	Use resources effectively to perform Engineering activities related to communication system.	P.12.1	A1				LP

CLO3	Select and apply appropriate tools to evaluate the wave shape of analog and digital communication system by using the modern tools.	P.05.1.	C3		P1 P4 P5		LT

*LP = Lab Performance, LT = Lab Test, Q = Quiz, V=Viva voce, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30
Self-directed learning	
Preparation for lab reports	21
Preparation for lab test	5
Preparation of quiz	5
Engagement in project/Assignment	21
Formal Assessment	
Continuous assessment	-
Final Quiz	1
Lab Test/Project show	1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	20%	CLO2	C2,A4
Report Writing	20%	CLO1	C4
Viva voca	10%	CLO1	C1
Lab Test	30%	CLO3	A4
Quiz	20%	CLO1	C1
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Introduction to ETT -101 telecom trainer kit and setting up an oscilloscope.
Week 2	Experimental study on amplitude modulation and demodulation.
Week 3	Experimental study on double side band modulation and demodulation.
Week 4	Experimental study on single side band modulation and demodulation.
Week 5	Experimental study on FM modulation and demodulation.
Week 6	Review & Practice Lab-1
Week 7	Lab Test-1
Week 8	Experimental study on sampling and reconstruction,
Week 9	Experimental study on PCM coding and decoding.
Week 10	Experimental study on Amplitude Shift Keying (ASK).
Week 11	Experimental study on Frequency Shift Keying (FSK).
Week 12	Experimental study on Phase Shift Keying (PSK).
Week 13	Review & Practice Lab-2
Week 14	Lab Test-2

Text and Reference Books

1. S. Haykin and M. Moher, Communication Systems, 5th ed.

2. B. P. Lathi and Z. Ding, Modern Digital and Analog Communication Systems, 4th ed.,
3. S. Haykin and M. Moher, Introduction to Analog and Digital Communications, 2nd ed
4. M. P. Fitz, Fundamentals of Communications Systems.
5. J.G. Proakis, M. Salehi, Fundamentals of Communication Systems, 2nd ed.
6. 6. L. W. Couch, II, Digital and Analog Communication Systems, 8th ed.,

3.3.5 ICE 2115: Digital Logic Design

Course Information

Course Code Course Title	: ICE 2115 : Digital Logic Design	Credit Hours Contact Hour	: 3.0 : 3.0

Pre-Requisite

None

Rationale

To learn and familiarize the basic logic gates as well as to be able to design various combinational and sequential circuits using logic gates.

Objective

a) To learn the fundamentals of number system.
b) To learn the basic of digital electronics circuits using diode and transistor.
c) To use the principles of Combinational Logic.
d) To understand the basic working principle of Sequential Logic in day to day life
e) To be acquainted with memory devices.

Course Contents

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

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

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

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

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

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

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Solve the mathematics regarding various number systems and Apply in digital design.	H											
CLO2	Design various combinational and sequential circuits.			H									

CLO3	Analyze different digital electronics circuit for real life applications.		H										
CLO4	Develop solution for different components of complex engineering problem using the Karnaugh map for a few variables and perform an algorithmic reduction of logic functions.		H										

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Solve the mathematics regarding various number systems and apply in digital design.	P.01.3	C3	K3			CT
CLO2	Design various combinational and sequential circuits.	P.03.1	C6				ASG
CLO3	Analyze different digital electronics circuit for real life applications.	P.02.3	C4	K4	P1 P2 P6		CT, SF
CLO4	Develop solution for different components of complex engineering problem using the Karnaugh map for a few variables and perform an algorithmic reduction of logic functions.	P.03.2	C3				SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C3
	CT (1-3)	20%	CLO1,4	C3
	ASG	5%	CLO2	C6
Semester Final (70%)	SF	70%	CLO3,4	C3,4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Basic definitions, Axiomatic definitions of Boolean algebra	1	CT1	

	L2	Basic theorem and properties, Boolean functions	1	SF	L D SDL
	L3	DeMorgan Theorem, Canonical and standard forms	1		
W2	L4	Binary numbers, Number base conversion	1		
	L5	Octal and Hexadecimal numbers	1		
	L6	2's complement, BCD codes	1		
W3	L7	DDL and relevant circuit analysis	3		
	L8	DTL and relevant circuit analysis	3		
	L9	RTL, TTL and relevant circuit analysis	3		
W4	L10	Map Method, Two and three variable maps, Four variable map,	4		
	L11	five and six variable maps, Sum of Product and Product of sum simplification,	4		
	L12	NAND implementation	4		
W5	L13	NOR implementation	4	CT2 CP SF ASG	L D SDL
	L14	Don't care conditions	4		
	L15	Tabulation Method	4		
W6	L16	Determination and selection of Prime implicants	2		
	L17	Half adder, full adder	2		
	L18	binary parallel adder	2		
W7	L19	decimal adder	2		
	L20	Half subtractor, full subtractor	2		
	L21	Coder	2		
Mid Break					
W8	L22	Encoder	2	CT3 CP SF ASG	L D SDL
	L23	Decoder	2		
	L24	Multiplexer	2		
W9	L25	De-multiplexer	2		
	L26	Magnitude Comparator	2		
	L 27	Magnitude Comparator mathematics	2		
W10	L 28	PLA	2		
	L 29	Flip-Flops	2		
	L 30	Basic types and fundamentals of Flip-Flops	2,3		
W11	L 31	Triggering of Flip-flop	2,3	ASG SF	L D SDL
	L 32	Master-Slave Flip-flop	2,3		
	L 33	Registers	2,3		
W12	L 34	Shift registers	2,3		
	L 35	Ripple Counters	2,3		
	L 36	Synchronous Counters	2,3		
W13	L 37	RAM	2,3	CP4 SF	L D SDL
	L 38	ROM	2,3		
	L 39	EPROM, EEPROM	2,3		
W14	L 40	A/D converters	2,3		
	L 41	D/A converters	2,3		
	L 42	Review class	2,3		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1 Digital Logic and Computer Design M-Morris Mano; Prentice Hall of India Private Ltd.
2 Digital Fundamentals-Thomas L Floyd; Prentice Hall International, Inc.

3 Pulse, Digital and Switching waveforms-Jacob Millman& Herbert Taub; Tata McGraw- Hil.

3.3.6 ICE 2116: Digital Logic Design Lab

Course Information

Course Code Course Title	: ICE 2116 : Digital Logic Design Lab	Credit Hours Contact Hour	: 1.5 : 3.0

Pre-Requisite

None

Rationale

To practically learn and familiarize with the basics and operation of various logic gates and different digital devices.

Objective

1. To build an **understanding** of the **fundamental concepts** on basic working principle of different operations of using logic gates.
2. To prepare students to **perform the analysis** of electronics circuit using logic gates.
3. To empower students to understand the **design and implementation** of various logical circuit.

Course Contents

Digital Electronics is the most advanced course with a combination of basic electronics and digital logic. This course seeks to incorporate the students with the advanced contents like binary logic, different sequential and combinational circuits in terms of experiments. Advanced digital devices like RAM, ROM and PLS are also included.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	**Identify** the different components or processes of complex engineering problems in terms of digital electronics.			H									
CLO2	Breadth and depth of investigation and experimentation for verifying the characteristics of digital devices.				M								
CLO3	**isplays good interpersonal skills as a** member/leader by developing mini projects for digital devices.									H			

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Identify the different components or processes of complex engineering problems in terms of digital electronics.	P.03.1	C2		P1 P3 P7		LT,Q
CLO2	Breadth and depth of investigation and experimentation for verifying the characteristics of digital devices.	P.04.1	P3	K8	P1 P2 P6		Q, R
CLO3	Displays good interpersonal skills as a	P.09.2	A2		P1		Q, Project

	member/leader by developing mini projects for digital devices.				P3 P7		

*LP = Lab Performance, LT = Lab Test, Q = Quiz, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30
Self-directed learning	21
Preparation for lab reports	5
Preparation for lab test	5
Preparation of quiz	21
Engagement in project/Assignment	
Formal Assessment	
Continuous assessment	-
Final Quiz	1
Lab Test/Project show	1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO1	C2
Report Writing	20%	CLO2	P3
Project	20%	CLO3	A2
Lab Test	30%	CLO1	C2
Quiz	20%	CLO1,2,3	C2, P3, A2
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Construction of AND & OR Gate and verification of the truth table
Week 2	Construction of NAND & NOR Gate and verification of the truth table
Week 3	Construction of NOT Gate and verification of the truth table of the fundamental and universal gate using IC
Week 4	Construction of Half Adder and Half Subtractor
Week 5	Prove of the universality of NAND & NOR gates
Week 6	Review & Practice Lab-1
Week 7	Lab Test-1
Week 8	Construction of Encoder and Decoder circuit
Week 9	Construction of Demultiplexer circuit.
Week 10	Construction of circuit from any logic expression
Week 11	Construction of Comparator circuit.
Week 12	Practice Test
Week 13	Lab Test-2
Week 14	Viva- voce and Quiz Test

Text and Reference Books

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

3.3.7 ICE 2117: Discrete Mathematics

Course Information

Course Code Course Title	: ICE 2117 : Discrete Mathematics	Credit Hours Contact Hour	: 2.0 : 2.0

Pre-Requisite

None

Rationale

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

Objective

1. To introduce Discrete Mathematics and its applications.
2. To introduce some of the problems of Discrete Mathematics.
3. To develop knowledge of a variety of mathematical tools applicable in computer science.
4. To understand some algorithms that will help us to identify shortest path of a graph and tree.

Course Contents

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

Basic Structures of Sets and Functions: Sets, Set Operations, Functions, Venn Diagram.

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

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

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

Tree: Tree and its Properties, Binary Search Tree, Spanning Trees, Kruskal's Algorithm, Prim's Algorithm.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Define an argument using logical notation and determine if the argument is or is not valid.	H											
CLO2	**Construct simple mathematical proofs and possess the ability to verify them.**		H										
CLO3	Demonstrate the understanding of sets, relations and functions and modeling problems using graphs and trees.			H									
CLO4	Develop the communication skill by presenting different topics on graphs and trees.			M									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Define an argument using logical notation and determine if the argument is or is not valid.	P.01.1	**C3**	WK1			CT, SF, CP
CLO2	**Construct simple mathematical proofs and possess the ability to verify them.**	P.02.1	C4	WK1 WK2 WK3	WP1 WP2 WP3		CT, SF
CLO3	Demonstrate the understanding of sets, relations and functions and modeling problems using graphs and trees.	P.03.2	C3		WP1 WP3 WP7		CT, SF
CLO4	Develop the communication skill by presenting different topics on graphs and trees.	P.03.3	C6	WK5	WP1 WP2 WP3 WP7		ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	26
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	25
Revision	12
Assessment Preparations	12
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	80

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C3
	CT (1-3)	20%	CLO1,2,3	C3, C4
	ASG	5%	CLO4	C6
Semester Final (79%)	SF	70%	CLO1,2,3,4	C3, C4,C6
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Introduction to set	1	CT1 CP SF	L D SDL
	L2	Set operation	2		
W2	L3	Set related math	1		
	L4	Venn Diagram	1,2		
W3	L5	Venn Diagram math	2		
	L6	Venn Diagram math	2		
W4	L7	Introduction to Graph and representation	2		

	L8	Graph classification	3		
W5	L9	Graph isomorphism.	1		
	L10	Graph traversal	1,2		
W6	L11	Minimum path calculation in graph	2,3	CT2 CP SF	L D SDL
	L12	Reach ability of a graph.	3		
W7	L13	Euler and Hamilton path	3		
	L14	Shortest path problems	2,3		
Mid Break					
W8	L15	Matrix representation of graph	1		
	L16	Introduction to tree	2		
W9	L17	Classification of tree	2		
	L18	Minimum path calculation of tree	2		
W10	L19	Minimum spanning tree algorithm.	2		
	L20	Introduction to mathematics logic	3		
W11	L21	Theory of inference for proposition calculus.	1,2	CT3 CP SF	L D SDL
	L22	Predicate Calculus	2		
W12	L23	Method of proof	3		
	L24	Mathematical induction	2		
W13	L25	Introduction to mathematics logic	3		
	L 26	Introduction to function, composition of function, inverse function.	3		
W14	L 27	Relation and properties binary relation in a set	1,2		
	L 28	Revision	1,2		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

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

3.3.8 MATH 2145: Numerical Methods

Course Information

Course Code	: MATH 2145	Credit Hours	: 3.0
Course Title	: Numerical Methods	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

To impart analytical ability to describe, analyze and solving mathematical problems as applied to the respective branches of Engineering in a logical and systematic fashion.

Objective

1. To be able to understand the accuracy, precision and different types of error.
2. To find roots of linear and nonlinear equations
3. To apply different numerical methods to fit tabular and non-tabular data points
4. To find the solutions of ordinary differential equations using numerical methods.

Course Contents

Approximations and Errors: Accuracy and precision, Absolute and Relative error, 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, Matrix Inversion

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.

Solution of Partial Differential Equation: Introduction to partial differential equation, Geometric Interpolation, Definition of Elliptic, Parabolic and Hyperbolic Partial Differential Equation

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Define different types of numerical methods with proper example.	H											
CLO2	Apply information and concepts of finding roots, interpolating of points and fitting curve to solve complex engineering problems with a range of conflicting requirements.	H											
CLO3	Formulate solutions, procedures, and methods of different ordinary differential equations to solve complex engineering problems		H										

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Define different types of numerical methods with proper example.	P.01.1	C1	K1			CT, SF, CP
CLO2	Apply information and concepts of finding roots, interpolating of points and fitting curve to solve complex engineering problems with a range of conflicting requirements.	P.01.2	C3	K2	P1 P2 P6		CT, SF
CLO3	Formulate solutions, procedures, and methods to solve complex engineering problems	P.02.2	C4		P1 P4 P5		CT, SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	

Practical/Tutorial/Studio Student-Centred Learning	40 - -
Self-Directed Learning Non-face-to-face learning Revision Assessment Preparations	 35 20 20
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C3
	CT (1-3)	20%	CLO1,2,3	C1, C3, C4
	ASG	5%	CLO3	C4
Semester Final (79%)	SF	70%	CLO1,2,3	C1, C3, C4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Accuracy and precision, Error definitions	1	CT1 CP SF	L D SDL
	L2	Round-off errors, Truncation errors.	2		
W2	L3	The bisection method, the false-position method	1,2		
	L4	The iteration method, the Newton-Raphson method.	2		
W3	L5	Newton's forward formula for interpolation with equal distance	2		
	L6	Newton's divided-difference interpolating polynomials,	3		
W4	L7	Linear regression	1,2		
	L8	Linear curve fitting methods	2,3		
W5	L9	Least square method	3	CT2 CP SF	L D SDL
	L10	Non-linear curve fitting methods	2,3		
W6	L11	Polynomial of *n*th degree	1		
	L12	Power function	2		
W7	L13	Exponential function	2		
	L 14	Polynomial regression	2		
Mid Break					
W8	L15	The trapezoidal rule	1,2	CT3 CP SF	L D SDL
	L16	Simpson's rules	2		
W9	L17	Integration with unequal segments.	2		
	L18	Solution by Taylor's series	3		
W10	L 19	Picard's method	1,2		
	L 20	Euler's method	1,2		
W11	L 21	Modifications, and improvements of Euler's methods	2	ASG SF	L D SDL
	L 22	Runge-Kutta methods.	2		
W12	L 23	Introduction to partial differential equation	2		
	L 24	Geometric Interpolation	1		
W13	L 25	Definition of Elliptic, Parabolic and Hyperbolic Partial Differential Equation	2	CP SF	L D SDL
	L 26	Lagrange interpolating polynomials.	1,2		
W14	L 27	Newton's backward formula for interpolation with equal distance	1		

	L 28	The false-position method	1,2		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Introductory Methods of Numerical Analysis S.S. Sastry.
2. Theory and Problems of Discrete Mathematics, Schanum's outline series Lipshutz
3. Numerical Methods E Balagurusamy

3.3.9 MATH 2146: Numerical Methods Lab

Course Information

Course Code Course Title	: ICE 2146 : Numerical Methods Lab	Credit Hours Contact Hour	: 1.0 : 2.0

Pre-Requisite

None

Rationale

Numerical Methods Lab. Is designed to familiarize the student about the mathematical analysis of different numerical methods to find the roots of linear and nonlinear equations, fitting a curve, solution of ordinary differential equations using MATLAB.

Objective

1. To be able to understand the accuracy, precision and different types of error.
2. To find roots roots of linear and nonlinear equations using MATLAB
3. To apply different numerical methods to fit tabular and non-tabular data points.
4. To find the solutions of ordinary differential equations using numerical methods.

Course Contents

In this course, students will perform experiments to practically verify the theories and concepts that learned about numerical methods in the theoretical course of ICE 2145

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Solve different types of numerical methods with proper example.		H										
CLO2	Apply information and concepts of finding roots, interpolating of points and fitting curve to solve complex engineering problems with a range of conflicting requirements.	H											
CLO3	Formulate solutions, procedures, and methods of different ordinary differential equations to solve complex engineering problems		H										

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Solve different types of numerical methods with proper example.	P.02.1	C4	K1 K2			LP, LT, Q

				K3			
CLO2	Apply information and concepts of finding roots, interpolating of points and fitting curve to solve complex engineering problems with a range of conflicting requirements.	P.01.2	C3	K2	P1 P2 P6		R, Q
CLO3	Formulate solutions, procedures, and methods of different ordinary differential equations to solve complex engineering problems	P.02.2	C4		P1 P4 P5		P, Q

*LP = Lab Performance, LT = Lab Test, Q = Quiz, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	5
Experiment	20
Self-directed learning	18
Preparation for lab reports	10
Preparation for lab test	5
Preparation of quiz	-
Engagement in group project	
Formal Assessment	
Continuous assessment	1
Final Quiz	1
Total	60

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO1	C4
Report Writing	20%	CLO2	C4
Project	20%	CLO3	C3
Lab Test	30%	CLO1	C4
Quiz	20%	CLO1,2,3	C3, C4
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Study on the problem analysis of Bisection method using MATLAB with exercise
Week 2	Study on the problem analysis of False Position method using MATLAB with exercise
Week 3	Study on the problem analysis of Newton Raphson method using MATLAB with exercise
Week 4	Study on the root finding of equations using linear interpolation method by MATLAB with exercise
Week 5	Study on the problem analysis of Lagrange Interpolation Polynomial using MATLAB with exercise
Week 6	Review & Practice Lab-1
Week 7	Lab Test-1
Week 8	Study on the problem analysis of Gregory newton forward difference formula using MATLAB with exercise
Week 9	Study on curve fitting using leasing least square regression by MATLAB with exercise
Week 10	Study on the problem analysis of fourth order Runge-Kutta method using MATLAB with exercise
Week 11	Study on Euler's method for solving numerical problem using MATLAB.
Week 12	Study on Picard method for solving numerical problem using MATLAB.
Week 13	Review & Practice Lab-2

Week 14	Lab Test-2

Text and Reference Books

1. Introductory Methods of Numerical Analysis, S.S. Sastry.
2. Theory and Problems of Discrete Mathematics, Schanum's outline series Lipshutz
3. Numerical Methods, E Balagurusamy

3.4 Course Outline of 2nd Year, 2nd Semester

3.4.1 ICE 2211: Data Structures and Algorithms

Course Information

Course Code	: ICE 2211	Credit Hours	: 3.0
Course Title	: Data Structures and Algorithms	Contact Hour	: 3.0

Pre-Requisite:

Course Code: ICE 1211
Course Title: Object Oriented Programming Languages.

Rationale

This Data Structures and Algorithms course is designed to provide a clear concept on the essential parts of the data structures and algorithms related to computing programming. This course begins with the introduction of basic concepts of some commonly used data structures and algorithms and then covers time complexity, linked list, stack, queue, tree, graph, sorting, different algorithms, dynamic programming and various relevant important topics. This course focuses on logical interpretation and presentation of data.

Objective

1. To **Develop knowledge** of basic data structures and algorithms for storage and retrieval of ordered or unordered data.
2. To **Analyze** and solves complex engineering problems reaching substantiated conclusion in programming design and development.
3. To **Develop** solutions for programming problems or improve existing code using learned algorithms and data structures.

Course Contents

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

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

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

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

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

Sorting & Searching algorithms: Basic strategies of Algorithm design, Time and space analysis of algorithms, Average, best and worst case analysis, different notations. Sorting, Insertion sort, Shell

sort, Heap sort, Radix sort, the general method of divide & conquer method, Merge sort, Quick sort, Selection sort, binary search, spanning trees, single source shortest paths.

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

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

String matching algorithm: Knuth–Morris–Pratt (KMP) algorithm.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Apply information and concepts in data structure and algorithms fundamentals with the familiarity of issues.	H											
CLO2	Analyze and solves complex engineering problems reaching substantiated conclusion in programming design and development.		H										
CLO3	Develop solution for different components of complex engineering problem using various data structures and algorithm.			M									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Apply information and concepts in data structure and algorithms fundamentals with the familiarity of issues.	P.01.3	C1 C2 C3	K1			CT, SF, CP
CLO2	Analyze and solves complex engineering problems reaching substantiated conclusion in programming design and development.	P.02.3	C4	K4	P1 P2 P6		ASG, CT, SF
CLO3	Develop solution for different components of complex engineering problem using various data structures and algorithm.	P.03.3	C6		P1 P3 P7		ASG, SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, P = Presentation, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	

Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2, C3
	CT (1-3)	20%	CLO1,2	C1, C2, C3, C4
	ASG	5%	CLO2,3	C4, C6
Semester Final (79%)	SF	70%	CLO1,2,3	C1, C2, C3, C4, C6
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Data types & data structures, data structure operations.	1	CT1 CP SF	L D SDL
	L2	Introduction to algorithms.	1		
	L3	Performance analysis.	1		
W2	L4	Linear arrays, Relationships of arrays.	1,2		
	L5	Operation on arrays.	1,2		
	L6	Multidimensional arrays, pointer arrays.	1,2		
W3	L7	Record structures, representation of records, Sparse matrices.	2		
	L8	Fundamentals, Different types of stacks and queues: circular, de-queues, etc.	1,2		
	L9	Evaluation of expressions, recursion.	3		
W4	L10	Direct and indirect recursion, depth of recursion.	1,2		
	L11	Implementation of recursive procedures by stacks.	3		
	L12	Linked lists, Representation of linked list.	1,3		
W5	L13	Traversing & searching a linked list.	2	CT2 CP SF	L D SDL
	L14	Doubly linked list.	2		
	L15	Dynamic storage management.	1,2		
W6	L16	Generalized list, Garbage collection & compaction.	1		
	L17	Basic Tree terminology, Binary trees, Binary tree representation	1,2		
	L18	Tree traversal, Extended binary tree.	2		
W7	L19	Huffman codes/algorithm.	3		
	L20	Graphs, Graph representation.	1,2		
	L21	Shortest path and transitive closure, Traversing a graph.	1,3		
Mid Break					
W8	L22	BFS	3	CT3 CP ASG SF	L D SDL
	L23	DFS	3		
	L24	Basic strategies of Algorithm design.	1		
W9	L25	Time and space analysis of algorithms, Average, best and worst case analysis, different notations.	2		

	L26	Sorting, Insertion sort.	1,2		
	L 27	Shell sort, Heap sort.	1,2		
W10	L 28	Radix sort, the general method of divide & conquer method.	1,2		
	L 29	Merge sort, Quick sort.	1,2		
	L 30	Selection sort, binary search.	1,2		
W11	L 31	Heap sort.	1,2	SF	L D SDL
	L 32	Spanning trees, Minimum Spanning tree.	2		
	L 33	Single source shortest paths	3		
W12	L 34	Static tree tables, Dynamic tree tables.	2		
	L 35	Hash tables overflow handling, Theoretical evaluation of overflow techniques.	1,3		
	L 36	Dynamic programming: The general method, multistage graphs.	1,2		
W13	L 37	Dynamic programming: all pairs shortest paths.	3	CP SF	L D SDL
	L 38	Dynamic programming: single source shortest paths problems.	3		
	L 39	A* search	3		
W14	L 40	Knuth–Morris–Pratt (KMP) algorithm.	1,3		
	L 41	Review class	1-3		
	L 42	Review class	1-3		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Computer Algorithm, UNIVERSITIES PRESS, E. Horowitz and S. Sahni
2. Theory and Problems of Data Structures by Seymour Lipschutz
3. Fundamentals of Data Structures, W. H. Freeman, E. Horowitz and S. Sahni
4. Data structures, Little, Brown, Reingold
5. Introduction to Algorithms, MIT Press, T. H. Cormen, C. E. Leiserson

3.4.2 ICE 2212: Data Structures and Algorithms Lab

Course Information

Course Code	: ICE 2212	Credit Hours	: 1.5
Course Title	: Data Structures and Algorithms Lab	Contact Hour	: 3.0

Pre-Requisite:

Course Code: ICE 2112
Course Title: Object-Oriented Programming Languages Lab

Rationale

This Data Structures and Algorithms course is designed to provide a clear concept on the essential parts of the data structures and algorithms related to computing programming practically. This course begins with the introduction of basic concepts of some commonly used data structures and algorithms and then covers time complexity, linked list, stack, queue, tree, graph, sorting, different algorithms, dynamic programming and various relevant important topics.

Objective

a) To **Develop knowledge** of basic data structures and algorithms for storage and retrieval of ordered or unordered data.
b) To **Analyze** and solves complex engineering problems reaching substantiated conclusion in programming design and development.
C) To **Develop** solutions for programming problems or improve existing code using learned algorithms and data structures.

Course Contents

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

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

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

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

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

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

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	**Analyze** and solves complex engineering problems reaching substantiated conclusion in programming design and development.		H										
CLO2	**Develop** solution for different components of complex engineering problem using various data structures and algorithm.			H									
CLO3	**Develop** the communication skill by presenting topics on Data Structures & Algorithms.										H		

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO2	**Analyze and solves** complex engineering problems reaching substantiated conclusion in programming design and development.	P.02.3	C4	K4	P1 P2 P6		LR, LT

CLO3	**Develop solution** for different components of complex engineering problem using various data structures and algorithm.	P.02.2	C4	2	P1 P4 P5		LP, LT, LR
CLO4	**Develop** the communication skill by presenting topics on Data Structures & Algorithms.	P.10.3				A2, A4	P

*LP = Lab Performance, LT = Lab Test, Q = Quiz, P = Presentation, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30
Self-directed learning	21
Preparation for lab reports	5
Preparation for lab test	5
Preparation of quiz	21
Engagement in project/Assignment	
Formal Assessment	
Continuous assessment	-
Final Quiz	1
Lab Test/Project show	1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance/ Presentation	20%	CLO3	A2, A4
Report Writing	20%	CLO2	C4
Lab Test	30%	CLO1,2	C4, C6
Quiz	20%	CLO1,2	C4, C1
Viva	10%	CLO1,2	C1,C3,C4
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Operations on static array list
Week 2	Operations on dynamic array list
Week 3	Single linked list
Week 4	Double linked lis
Week 5	Stack implementation by array and linked list.
Week 6	Queue, Circular Queue
Week 7	Binary Search
Week 8	Sorting Algorithms (Insertion sort, Merge Sort, Selection sort, Quick sort)
Week 9	Tree Construction Preorder, Inorder, Postorder traversal
Week 10	Binary search tree
Week 11	Graph Representation
Week 12	Breadth first search, Depth first search
Week 13	Knuth-Morris- Pratt pattern matching algorithm.
Week 14	Lab Test & Quiz

Text and Reference Books

1. Computer Algorithm, UNIVERSITIES PRESS, E. Horowitz and S. Sahni
2. Theory and Problems of Data Structures by Seymour Lipschutz
3. Fundamentals of Data Structures, W. H. Freeman, E. Horowitz and S. Sahni
4. Data structures, Little, Brown, Reingold
5. Introduction to Algorithms, MIT Press, T. H. Cormen, C. E. Leiserson

3.4.3 ICE 2213: Signals and Systems

Course Information

Course Code	: ICE 2213	Credit Hours	: 3.0
Course Title	: Signals and Systems	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

Signals and Systems course is designed to familiarize the students with some basic signals and their characteristics and application of these signals. After being acquainted with these basic operations, students will be able to identify, conversion of signals etc. To study on Fourier Series, Laplace Transform and z-Transform implementation.

Objective

1. Be able to describe signals mathematically and understand how to perform mathematical operations on signals. The operations should include operations on the dependent as well as independent variables.
2. Be familiar with commonly used signals such as unit step, ramp, impulse function, sinusoidal signal and complex exponentials.
3. Be able to classify signals as continuous-time vs. discrete-time, periodic vs. non-periodic, energy signal vs. power signal, odd vs. even, conjugate symmetric vs anti-symmetric.
4. Be able to describe system using linear constant coefficient differential equations and using their impulse response.
5. Understand system properties – linearity, time invariance, presence or absence of memory, causality, bounded-input bounded-output, stability and instability. Be able to identify whether a given system exhibits these properties and its implicit on for practical systems.

Course Contents

Signal Analysis: Analogy between Vectors and Signals, Orthogonal Signal Space, Signal approximation using Orthogonal functions, Mean Square Error, Closed or complete set of Orthogonal functions, Orthogonality in Complex functions, Classification of Signals and systems, Exponential and Sinusoidal signals, Concepts of Impulse function, Unit Step function, Signum function.

Sampling theorem: Graphical and analytical proof for Band Limited Signals, Impulse Sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, Effect of under sampling – Aliasing, Introduction to Band Pass Sampling.

Correlation: Cross Correlation and Auto Correlation of Functions, Properties of Correlation Functions, Energy Density Spectrum, Parsevals Theorem, Power Density Spectrum, Relation between Autocorrelation Function and Energy/Power Spectral Density Function, Relation between Convolution and Correlation, Detection of Periodic Signals in the presence of Noise by Correlation, Extraction of Signal from Noise by Filtering.

Fourier series: Representation of Fourier series, Continuous time periodic signals, Properties of Fourier Series, Dirichlet's conditions, Trigonometric Fourier Series and Exponential Fourier Series, Complex Fourier spectrum.

Fourier Transforms: Deriving Fourier Transform from Fourier series, Fourier Transform of arbitrary signal, Fourier Transform of standard signals, Fourier Transform of Periodic Signals, Properties of Fourier Transform, Fourier Transforms involving Impulse function and Signum function, Introduction to Hilbert Transform.

Laplace Transforms: Laplace Transforms (L.T), Inverse Laplace Transform, Concept of Region of Convergence (ROC) for Laplace Transforms, Properties of L.T, Relation between L.T and F.T of a signal, Laplace Transform of certain signals using waveform synthesis.

Z–Transforms: Concept of Z- Transform of a Discrete Sequence, Distinction between Laplace, Fourier and Z Transforms, Region of Convergence in Z-Transform, Constraints on ROC for various classes of signals, Inverse Z-transform, Properties of Z-transforms.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Define signals and systems basic to describe classification, properties, operation of signals, LTI system representation basic, equation, block diagram and its properties.	H											
CLO2	Analyze Fourier series, Fourier Transform, FT properties and its application to solve complex engineering problem reaching substantiated conclusion.		H										
CLO3	Develop mathematical concept of Laplace Transform and Z- Transform to solve complex engineering problem using engineering knowledge.				H								

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Define signals and systems basic to describe classification, properties, operation of signals, LTI system representation basic, equation, block diagram and its properties.	P.01.1	C1 C2 C3	K1			CT, SF, CP
CLO2	Analyze Fourier series, Fourier Transform, FT properties and its application to solve complex engineering problem reaching substantiated conclusion.	P.02.2	C4		P1 P4 P5		CT, SF, ASG
CLO3	Develop mathematical concept of Laplace Transform and Z- Transform to solve complex engineering problem using engineering knowledge.	P.04.3	C6		P1 P4 P5		CT, SF, ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom 's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2, C3
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3, C4, C6
	ASG	5%	CLO 2, 4	C4, C6
Semester Final (79%)	SF	70%	CLO1,2,3	C1, C2, C3, C4, C6
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Signal System definition, examples.	1	CT1 CP SF	L D SDL
	L2	Communication System block diagram, modes of communication.	1		
	L3	Classification of signal, control system and example.	1		
W2	L4	Different types of function.	1,2		
	L5	Concepts of Impulse function, Unit Step function, Signum function.	2		
	L6	Sampling basic, Impulse Sampling, Natural and Flat top Sampling.	2		
W3	L7	Reconstruction of signal from its samples.	2		
	L8	Introduction to Band Pass Sampling.	3		
	L9	Cross Correlation and Auto Correlation of Functions, Properties of Correlation Functions.	1		
W4	L10	Energy Density Spectrum, Parsevals Theorem.	1,2		
	L11	Power Density Spectrum, Relation between Autocorrelation Function and Energy.	2,3		
	L12	Relation between Convolution and Correlation.	3		
W5	L13	Detection of Periodic Signals in the presence of Noise by Correlation.	3	CT2 CP SF	L D SDL
	L14	Extraction of Signal from Noise by Filtering.	2,3		
	L15	Convolution Sum basic	2		
W6	L16	Convolution of Two signals procedure	1		
	L17	Convolution of two signals math solving	2		
	L18	Integration of two signals	2		
W7	L19	Representation of Fourier series	2		

	L20	Fourier series characteristics	2		
	L21	Continuous time periodic signals	3		
Mid Break					
W8	L22	Properties of Fourier Series, Dirichlet's conditions	1,2	CT3 CP SF	L D SDL
	L23	Trigonometric Fourier Series	2		
	L24	Exponential Fourier Series	3		
W9	L25	Complex Fourier spectrum.	2		
	L26	Deriving Fourier Transform from Fourier series	3		
	L 27	Fourier Transform of arbitrary signal	3		
W10	L 28	Fourier Transform of standard signals	1,2		
	L 29	Fourier Transform of Periodic Signals	1,2		
	L 30	Properties of Fourier Transform	2		
W11	L 31	Fourier Transforms involving Impulse function and Signum function	2	ASG SF	L D SDL
	L 32	Introduction to Hilbert Transform.	2		
	L 33	Laplace Transforms (L.T), Inverse Laplace Transform.	1		
W12	L 34	Concept of Region of Convergence (ROC) for Laplace Transforms	2		
	L 35	Properties of L.T, Relation between L.T and F.T of a signal	1		
	L 36	Laplace Transform of certain signals using waveform synthesis	3,4		
W13	L 37	Concept of Z- Transform of a Discrete Sequence	2	CP SF	L D SDL
	L 38	Distinction between Laplace, Fourier and Z Transforms	1,2		
	L 39	Region of Convergence in Z-Transform, Constraints on ROC for various classes of signals	3,4		
W14	L 40	Inverse Z-transform	1		
	L 41	Properties of Z-transforms.	1,2		
	L 42	Revision	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Signals and Systems, WILEY INDIA, Simon Haykin and Van Veen, Wiley 2 Ed.,
2. Signals, Systems & Communications, John Wiley & Sons, B.P. Lathi, 2013, BSP.
3. Signals and Systems by A.V. Oppenheim, A.S. Willsky and S.H. Nawabi, 2 Ed.
4. Fundamentals of Signals and Systems by Michel J. Robert, 2008, MGH International Edition.

3.4.4 ICE 2214: Signals and Systems Lab

Course Information

Course Code	: ICE 2214	Credit Hours	: 1.5
Course Title	: Signals and Systems Lab	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

Signals and Systems Laboratory course is designed to familiarize the students with some basic signals and to examine the characteristics and working of these signals in professional field by hand-held experiments and computer aided simulation tool. After being acquainted with these basic operations, students will be able to design, implement and test various types of signals.

Objective

1. To build an understanding of the fundamental concepts on basic signal generation and system working principle.
2. To learn signal design and testing criteria.
3. To study the characteristics of various types of signals.
4. To study on Fourier Series, Laplace Transform and z-Transform implementation.

Course Contents

In this course, students will perform experiments to practically verify the theories and concepts that learned about signal generation, implementation of Fourier Series, Laplace Transform and z-Transform, image processing, Digital Filter implementation etc. In the theoretical course of ICE-Signals and Systems using simulation software MATLAB.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Apply the knowledge of basic signals practically and formulate solution.	H											
CLO2	Generate different types of signals analyzing the necessity and utilization of different types of signals and systems to solve complex engineering problem.		H										
CLO3	Design different signals and systems using engineering tools for prediction and modeling of complex engineering problems.					H							

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Apply the knowledge of basic signals practically and formulate solution.	P.01.1	C3	K1			LP, LT, Q
CLO2	Generate different types of signals analyzing the necessity and utilization of different types of signals and systems to solve complex engineering problem.	P.02.2	C4		P1 P4 P5		LT, R, Q
CLO3	Design different signals and systems using engineering tools for prediction and modeling of complex engineering problems.	P.05.2	P4		P1 P4 P5		P, Q

*LP = Lab Performance, LT = Lab Test, Q = Quiz, R= Report; EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30

Self-directed learning Preparation for lab reports Preparation for lab test Preparation of quiz Engagement in project/Assignment	21 5 5 21
Formal Assessment Continuous assessment Final Quiz Lab Test/Project show	 - 1 1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO1	C3
Report Writing	20%	CLO2	C4
Project	20%	CLO3	P4
Lab Test	30%	CLO1	C3
Quiz	20%	CLO1,2,3	C3, C4, P4
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Familiarization with MATHLAB features and development of codes for generating simple signals.
Week 2	Study on various operation on basic signals in MATLAB.
Week 3	Study on properties of signals and their transformations.
Week 4	Study on systems and characterizations of system.
Week 5	Study on Convolution of Continuous Time and Discrete Time Signals.
Week 6	Study on basic operations on matrices.
Week 7	Study on Fourier Series and MATLAB Implementation of Fourier series.
Week 8	Study on Continuous Time Fourier Transform and MATLAB Implementation of Continuous Time Fourier Transform (CTFT).
Week 9	Study on Discrete Time Fourier Transform and MATLAB Implementation of Discrete Time Fourier Transform (DTFT).
Week 10	Study on Laplace Transform and MATLAB Implementation of Laplace Transform.
Week 11	Study on z-Transform and MATLAB Implementation of z-Transform.
Week 12	Study on Digital Filter and implementation of digital filter structures.
Week 13	Review & Practice Lab
Week 14	Lab Test

Text and Reference Books

1. Introduction to Signals and Systems, Macmillan Pub Co, Kamen, Edward W.
2. Signals and Systems, WILEY INDIA, Simon Haykin and Van Veen, Wiley 2 Ed.,
3. "Fundamentals of Signals and Systems", MC GRAW HILL, Michael Roberts and Govind Sharma.
4. "Problems and Solutions in Signals and Systems", Books WorldWide Express, R Gopal
5. "Circuits and Systems: A Modern Approach", Oxford University Press, A Papoulis

3.4.5 ICE 2215: Optical Fiber Communication

Course Information			
Course Code	: ICE 2215	Credit Hours	: 3.0
Course Title	: Optical Fiber Communication	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

The motto of Optical Fiber Communication course is to expose modern high-capacity telecommunications network based on optical fiber technology and its state-of-the-art advancements. Upon successful completion of this course, students will obtain the knowledge needed to perform fiber-optic communication system engineering calculations, identify system trade-offs and apply this knowledge to modern fiber optic networks. Accordingly, this will enable the students to understand the most recent literature in the field of fiber-optic communications as well as formulate the expertise in their future professional engineering practice.

Objective

1. To build an understanding of the fundamental concepts on basic working principle of various optical fiber modes, configurations and transmission characteristics of optical fibers.
2. To familiarize with various optical fiber modes, configurations and transmission characteristics of optical fibers.
3. To introduce the basics modulation, multiplexing and demultiplexing in fiber optic systems along with various coupling techniques.
4. To enrich the knowledge about optical communication systems as well as fiber optic access networks.

Course Contents

Introduction: Evolution and background of optical fiber communication, light propagation theories

Light propagation through optical fiber: Ray optics theory and mode theory.

Optical fiber Characteristics: Types and characteristics, transmission characteristics, fiber joints and fiber couplers.

Light sources: Light emitting diodes and laser diodes.

Detectors: PIN photo-detector and avalanche photo-detectors.

Receiver analysis: Direct detection and coherent detection, noise and limitations.

Transmission limitations: Chromatic dispersion, nonlinear refraction, four wave mixing and laser phase noises.

Optical amplifier: Laser and fiber amplifiers, applications and limitations.

Multi-channel optical system: Frequency division multiplexing, wavelength division multiplexing and optical CDMA. Radio on fiber technology, Fiber optic access network.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Define, understand and explain the basic knowledge of ray optics theory and the transmission characteristics of fiber	H											
CLO2	Analyze the transmission characteristics of fiber and solves complex engineering problems		H										
CLO3	Identify and explain different characteristics of optical sources and detectors and compare the different types of optical amplifier in basis of		H										

	their principles, applications and receiver analysis.												
CLO4	Design the fiber optic link based on budgets for the real-life engineering problems			H									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Define, understand and explain the basic knowledge of ray optics theory and the transmission characteristics of fiber	P.01.1	C1 C2	K1			CT, SF, CP
CLO2	Analyze the transmission characteristics of fiber and solves complex engineering problems	P.02.3	C4	K4	P1 P2 P6		CT, SF
CLO3	Identify and explain different characteristics of optical sources and detectors and compare the different types of optical amplifier in basis of their principles, applications and receiver analysis.	P.02.1	C4	K1 K2 K3			CT, SF
CLO4	Design the fiber optic link based on budgets for the real-life engineering problems.	P.03.3	C6	K5	P1 P3 P7		ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3, C4
	ASG	5%	CLO4	C6
Semester Final (79%)	SF	70%	CLO1,2,3	C1, C2, C3, C4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Introductions and evolution of optical fiber communication	1	CT1	

	L2	Background and different theories behind light propagation	2	CP SF	L D SDL
	L3	Advantages and applications optical fiber communication	1		
W2	L4	Ray optics theory	1,2		
	L5	Mode theory	2		
	L6	Total internal reflection, ideal characteristics of optical fiber	2		
W3	L7	Qualities of real optical fibers, transmission characteristics	2		
	L8	Qualities of real optical fibers, transmission characteristics	3		
	L9	Mathematical modelling of optical fibers	1		
W4	L10	Introduction, types and requirements	1,2		
	L11	Light sources: LEDs	2,3		
	L12	Light sources: Lasers	3		
W5	L13	Detectors: PIN photo-detector	3	CT2 CP SF	L D SDL
	L14	Detectors: Avalanche photo-detector	2,3		
	L15	Transmission Limitations	2		
W6	L16	Fundamental receiver operation-preamplifiers	1		
	L17	Direct detection and coherent detection	2		
	L18	Noise and limitations	2		
W7	L19	Attenuation, absorption, scattering losses	2		
	L20	Bending losses, core and cladding losses, signal dispersion	2		
	L21	Inter symbol interference and bandwidth-intra model dispersion	3		
Mid Break					
W8	L22	Material dispersion, waveguide dispersion, polarization mode dispersion	1,2	CT3 CP SF	L D SDL
	L23	Chromatic dispersion, intermodal dispersion	2		
	L24	Nonlinear refraction	3		
W9	L25	How noise effects transmission and detection in optical fibers	2		
	L26	Nonlinear effects, limitations in practical transmission and detection systems	3		
	L 27	Four wave mixing, laser phase noises	3		
W10	L 28	Introduction to optical amplifiers	1,2		
	L 29	How amplifiers used to improve real systems	1,2		
	L 30	Different types of optical amplifiers	2		
W11	L 31	Laser amplifiers, fiber amplifiers	2	ASG SF	L D SDL
	L 32	Different approaches to improve amplifiers	2		
	L 33	Mathematical problems regarding transmission and detection systems	1		
W12	L 34	Optical fiber based communication	2		
	L 35	Multi-channel using optical fibers: FDMA	1		
	L 36	Multi-channel using optical fibers: WDMA	3,4		
W13	L 37	Multi-channel using optical fibers: CDMA	2	CP SF	L D SDL
	L 38	Design problems regarding multi-channel using optical fiber	1,2		
	L 39	Fiber optic access networks: Ideas	3,4		
W14	L 40	Fiber optic access networks: Implementations and Limitations	1		
	L 41	Scope of research in optical communication system	1,2		
	L 42	Review class	1-4		
*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.					
Text and Reference Books					

1. Fiber Optic Communication, Wiley, Fiber Optic Communication
2. Optical Fiber Communications- Principles & Practice, Pearson, John M. Senior.
3. Fiber Optic Communication System, McGraw-Hill Education, Gerd Keis.
4. Fiber Optic Communications, Wiley India, D C Agrawal.

3.4.6 ICE 2216: Optical Fiber Communication Lab

Course Information

Course Code Course Title	: ICE 2216 : Optical Fiber Communication Lab	Credit Hours Contact Hour	: 1.5 : 3.0

Pre-Requisite

None

Rationale

Optical Fiber Communication Laboratory course is designed to teach the students on different experiments regarding characteristics of optical fiber as well as optical fiber communication. These different experiments regarding characteristics of optical fiber as well as optical fiber communication becomes very essential to have clear theoretical, practical and designing aspects.

Objective

1. To build an understanding of the fundamental concepts on basic working principle of optical fiber communication and optical devices.
2. To familiarize with the propagation of ray through optical devices, optical communication system and network Structure.
3. To introduce the basics of fiber transmitter and detector in Systems.

Course Contents

In this course, students will perform experiments to practically verify the theories and concepts that learned about basic working principle of optical fiber communication system, light source, light detection, network establishment, budget calculation in the theoretical course of ICE 3115 optical fiber communication course using different hardware equipment and simulation software.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Apply information and concepts of optical fiber communication to describe and optical fiber communication system and introduce its components.	H											
CLO2	Seek and use resources effectively to perform Engineering activities related to optical fiber communication system.												H
CLO3	Select and apply appropriate tools to evaluate and determine the propagation characteristics of optical signal for optical fiber communication system					H							

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Apply information and concepts of optical fiber communication to describe and optical fiber communication system and introduce its components.	P.01.1	C2	K1			Q,V,R
CLO2	Seek and use resources effectively to perform Engineering activities related to optical fiber communication system.	P.12.1	A4				LP
CLO3	Select and apply appropriate tools to evaluate and determine the propagation characteristics of optical signal for optical fiber communication system	P.05.1.	C3		P1 P2 P6		LT

*LP = Lab Performance, LT = Lab Test, Q = Quiz, V=Viva voce, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30
Self-directed learning	21
Preparation for lab reports	5
Preparation for lab test	5
Preparation of quiz	21
Engagement in project/Assignment	
Formal Assessment	
Continuous assessment	-
Final Quiz	1
Lab Test/Project show	1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	20%	CLO2	C2,A4
Report Writing	20%	CLO1	C4
Viva voca	10%	CLO1	C1
Lab Test	30%	CLO3	A4
Quiz	20%	CLO1	C1
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Study on basics of Optical fiber mechanism
Week 2	Introduction to optical fiber trainer kit.
Week 3	Experimental study on how to communicate the voice signal through optical fiber.
Week 4	Experimental study on how to convert the letter and words to morse code as a sign over the fiber optic link.
Week 5	Experimental study on transmit the audio signal from the FM radio using fiber cable
Week 6	Review & Practice Lab-1

Week 7	Lab Test-1
Week 8	Experimental study on Light source of optical fiber as transmitter.
Week 9	Experimental study on data transmission of optical fiber through one module
Week 10	Experimental study on data transmission of optical fiber through module to module
Week 11	Experimental study on network expansion through optical fiber.
Week 12	Experimental study on optical fiber interaction with different object for measuring the N.A.
Week 13	Review & Practice Lab-2
Week 14	Lab Test-2

Text and Reference Books

1. Fiber Optic Communication, Wiley, Fiber Optic Communication
2. Optical Fiber Communications- Principles & Practice, Pearson, John M. Senior.
3. Fiber Optic Communication System, McGraw-Hill Education, Gerd Keis.
4. Fiber Optic Communications, Wiley India, D C Agrawal.

3.4.7 EEE 2223: Electrical Drives and Instrumentation

Course Information

Course Code	: EEE 2223	Credit Hours	: 3.0
Course Title	: Electrical Drives and Instrumentation	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

Electrical drives and instrumentation is a basic course to acquire knowledge on electro mechanical energy conversion by electrical machines, their constructions, operating principles, characteristics and applications. Students will be able to exemplify the concepts on energy conversion by renewable energy sources and their impact on our environment as an alternative to the nonrenewable sources and supplementary sources in smart grid

Objective

1.To convey basic knowledge of electromagnetic induction in different electrical machineries.
2. To appraise the operating principle and constructional details of electrical machines like transformer, motor, generator.
3. To demonstrate the performance indicating parameters of electrical machines and develop understanding on practical use of electrical machines at social and economic context.

Course Contents

Generator (AC and DC): Construction, winding, types of losses, no-load voltage characteristics, build-up of a self-excited shunt generator, critical field resistance, load-voltage characteristic, effect of speed on no-load and load characteristics, voltage regulation, armature reaction and commutation.
DC motor (AC and DC): Torque, counter emf, rotational speed, torque-speed characteristics, starting and speed control, regulation, braking, bio gas systems.
Transformer: Principle, construction of ideal transformer, practical transformer, transformation ratio, no-load and load vector diagrams; actual transformer‘s equivalent circuit, regulation, short circuit and open circuit tests, parallel operation of transformers, auto transformer, instrument transformers, 3- phase transformers, different connection and their applications.

Instrumentation: Resistive-, capacitive-, inductive-, piezoelectric-, Hall effect sensors and associated signal conditioning circuits; transducers for industrial instrumentation: displacement (linear and angular), velocity, acceleration, force, torque, vibration, shock, pressure (including low pressure), flow (variable head, variable area, electromagnetic, ultrasonic, turbine and open channel flow meters) temperature (thermocouple, bolometer, RTD (3/4 wire), thermistor, pyrometer and semiconductor); liquid level, pH, conductivity and viscosity measurement. 4-20 mAtwo-wire transmitter.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Attain proficiency in describing the physics of electromagnetic induction and constructions and operating principles of different Electrical Machines to infer the fundamental ideas about common energy conversion devices	H											
CLO2	Gain ability to develop equivalent circuits, compare vector diagrams and torque speed characteristics of different electrical machineries.			H									
CLO3	Demonstrate the concepts of renewable energy, their environmental impacts, advantages and conversion to electrical energy to solve the real life engineering problems.	H											
CLO4	Develop potential in analyzing the uses of starter circuits and control circuits of different electrical machines.			H									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Attain proficiency in describing the physics of electromagnetic induction and constructions and operating principles of different Electrical Machines to infer the fundamental ideas about common energy conversion devices.	P.01.3	C3	K1			CT, SF, CP
CLO2	Gain ability to develop equivalent circuits, compare vector diagrams and torque speed characteristics of different electrical machineries.	P.03.2	C3		P1 P7 P3		CT, SF
CLO3	Demonstrate the concepts of renewable energy, their environmental impacts, advantages and conversion to electrical energy to solve the real-life engineering problems.	P.01.2	C3	K2	P1 P2 P6		CT, SF
CLO4	Develop potential in analyzing the uses of starter circuits and control circuits of different electrical machines.	P.03.3	C6	K5			SF,CT

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C2
	CT (1-3)	20%	CLO1,2,3,4	C2, C3, C4
	ASG	5%	CLO3	C3
Semester Final (79%)	SF	70%	CLO1,2,3,4	C2, C3, C4
Total Marks		100%		

Course Plan

Week	Lec	Topic	CLO	AS	TLS
W1	L1	**DC generator:** Construction.	1	CT1 CP SF	L D SDL
	L2	Winding of DC generator.	2		
	L3	Types of losses in winding of generator.	1		
W2	L4	No-load voltage characteristics.	1,2		
	L5	Build-up of a self-excited shunt generator.	2		
	L6	Critical field resistance of generator.	4		
W3	L7	Load-voltage characteristic of generator.	2		
	L8	Effect of speed on no-load and load characteristics.	3		
	L9	Voltage regulation of generator.	4		
W4	L10	Armature reaction of generator.	1,2		
	L11 L12	Commutation of generator.	2,3		
W5	L13	Torque in DC motor.	3	CT2 CP SF	L D SDL
	L14	Counter emf in DC motor.	2,3		
	L15	Rotational speed of motor.	2		
W6	L16	Torque-speed characteristics of motor.	1		
	L17	Starting and speed control of motor.	2		
	L18	Regulation of motor.	2		
W7	L19	Braking of motor.	2		
	L20	Bio gas systems.	2		
	L21	Construction of ideal transformer.	3		
Mid Break					
W8	L22	Principle of transformer.	1,2	CT3 CP	
	L23	Practical transformer.	2		

	L24	Transformation ratio of transformer.	3	SF	L D SDL
W9	L25	No-load and load vector of transformer.	2		
	L26	Vector diagrams of transformer.	3		
	L 27	Actual transformer 's equivalent circuit.	3		
W10	L 28	Regulation of transformer.	1,2		
	L 29	Short circuit tests of transformer.	1,2		
	L 30	Open circuit tests of transformer.	2		
W11	L 31	Parallel operation of transformers.	2	ASG SF	L D SDL
	L 32	Auto transformer, instrument transformers.	2		
	L 33	3- phase transformers.	1		
W12	L 34	Different connection and their applications.	2		
	L 35	Resistive and capacitive material.	1		
	L 36	Inductive and piezoelectric material.	3,4		
W13	L 37	Hall effect sensors and associated signal conditioning circuits.	2	CP SF	L D SDL
	L 38	Transducers for industrial instrumentation: displacement (linear and angular), velocity, acceleration.	1,2		
	L 39	Force, torque, vibration, shock, pressure (including low pressure).	3,4		
W14	L 40	Flow (variable head, variable area, electromagnetic, ultrasonic, turbine and open channel flow meters).	1		
	L 41	Temperature (thermocouple, bolometer, RTD (3/4 wire), thermistor, pyrometer and semiconductor).	1,2		
	L 42	Liquid level, pH, conductivity and viscosity measurement. 4-20 mA two-wire transmitter.	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1 Electrical Machinery Fundamentals, McGraw-Hill, Stephen J Chapman.
2 Electrical machinery and Transformer, Pearson College Div, Irving L. Kosow.
3 Electrical machines, Pearson, Samarjit Ghosh.
4 A Textbook of Electrical Technology, Chand (S.) & Co Ltd, B.L Theraja.

3.4.8 EEE 2224: Electrical Drives and Instrumentation Lab

Course Information

Course Code	: EEE 2224	Credit Hours	: 0.75
Course Title	: Electrical Drives and Instrumentation Lab	Contact Hour	: 1.50

Pre-Requisite

None

Rationale

This course is designed to help the students to explore various DC and AC machines and put theory in practice. Our mission is to expose students to the constructions of electrical machines and analyses their performance. This course is targeted to verify the properties of generator, motor etc. and relate them with their theoretical knowledge. Our aim is to give the students the basic idea of how these machines fit in large context. This course is also designed to give the students the basic idea of electronic instrumentation system.

Objective

1.To familiarize the students with the basic electrical machines like transformer, dc generator, dc motor, alternator etc.
2. To calculate various parameters of machines like voltage regulation, efficiency etc., observe their behavior under various load conditions and compare them.
3. To impart the basic knowledge of electrical control system and instrumentation.
4. To impart practical knowledge on electrical machine crafting and develop collaborative learning skill.

Course Contents

In this course, students will perform experiments to practically verify the theories and concepts learned in EEE 2223 using different hardware equipment and simulation software.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Compute the voltage regulation and efficiency of electrical machine, like transformer, alternator, dc motor etc. and justify these characteristics under various loading condition.									H			
CLO2	Identify the characteristics of electrical machines like dc generator, dc motor etc. and trace various curves like armature voltage vs. armature current curve for dc generator or torque-speed curve of dc motor.					M							
CLO3	Apply the basic idea of control system through the controlling of water level and water flow by feedback transducer.									H			
CLO4	Perform project task and design electrical machine adapting to requirement.										M		

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Compute the voltage regulation and efficiency of electrical machine, like transformer, alternator, dc motor etc. and justify these characteristics under various loading condition	P.09.1	P3				R, L, P, Q
CLO2	Identify the characteristics of electrical machines like dc generator, dc motor etc. and trace various curves like armature voltage vs. armature current curve for dc generator or torque-speed curve of dc motor.	P.05.2	P4		P1 P4 P5		L, T, R
CLO3	Apply the basic idea of control system through the controlling of water level and water flow by feedback transducer.	P.09.1	P4				R, L, T

CLO4	Perform project task and design electrical machine adapting to requirement.	P.10.1	P6				P, L, T, Pr

*LP = Lab Performance, LT = Lab Test, Q = Quiz, R=Report, P= Project, Pr=Presentation, CA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom 's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	4
Experiment	20
Self-directed learning	10
Preparation for lab reports	4
Preparation for lab test	4
Preparation of quiz	-
Engagement in project/Assignment	
Formal Assessment	
Continuous assessment	-
Final Quiz	1
Lab Test/Project show	1
Total	45

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO1	P3
Lab Test	20%	CLO2	P4
Project	20%	CLO3, CLO4	P4, P6
Quiz	30%	CLO1	P3
Lab Report	20%	CLO1,2,3	P3, P4, P6
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Computing the regulation of the Transformer in Various Loads.
Week 2	
Week 3	Study the properties of DC self and separately excited shunt generator.
Week 4	
Week 5	Identifying the characteristics of DC shunt motor & calculating the efficiency.
Week 6	Review & Practice Lab-1
Week 7	Lab Test-1
Week 8	Study the properties of Three-Phase Alternator in various loads
Week 9	
Week 10	Flow rate control of water by feedback transducer
Week 11	
Week 12	Water level control by feedback transducer
Week 13	Review & Practice Lab-2
Week 14	Lab Test-2

Text and Reference Books

1. Digital Signal Processing, PEARSON INDIA, John G. Proakis & Dimitris Manolakis
2. Discrete-Time Signal processing, Prentice Hall, Allan Oppenheim & Ronald Schafer
3. Digital Signal Processing-A practical approach, Prentice Hall, Emmanuel C. Ifeachor Barrie W. Jervis

4. Signals and Systems, Pearson, Rodger Ziemer & William Tranter

3.4.9 MATH 2247: Differential Equations and Statistics

Course Information

Course Code	: MATH 2247	Credit Hours	:3.0
Course Title	: Differential Equations and Statistics	Contact Hour	:3.0

Pre-Requisite

None

Rationale

A differential equation is a mathematical equation for an unknown function of one or several variables that relates the values of the function itself and its derivatives of various orders. It plays an important role in engineering, physics, economics, waves in composite media, motion of a space vehicle, heat transfer, and aircraft landing field length, the growth of a plant, the fluctuations of the stock market, the spread of diseases and other discipline. To learn and familiarize the basics of Statistics which are commonly used in Engineering.

Objective

1. To provide a platform to obtain necessary basic information regarding differential equations.
2. To learn the classifications of differential equations and many method and techniques to solve those.
3. To solve the related physical problem using concept of differential equation and demonstrate the various aspects of geometry.
4. To learn the basics of Statistical analysis and their applications in Engineering Sector.
5. To study how to analyze any statistical problem and solve it.

Course Content:

Ordinary Differential Equations:
Introduction to differential equations & their formulations, solutions of first order & first degree ordinary differential equations by various methods, solutions of ordinary differential equations of first order but not first degree, solutions of linear ordinary differential equations of second & higher orders with constant & variable coefficients, initial & boundary value problems and application of ordinary differential equations.

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

Statistics: Measures of central tendency, measures of dispersion, standard deviation, moments, skewness and kurtosis, correlation and regression, elementary probability theory and distribution.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO	CLOs	PLOs

(3-5)	(Upon completion of the course, the students will be able to)	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Define, understand and identify differential equations by order, linearity and homogeneity.	H											
CLO2	Describe higher order linear and nonlinear differential equations with constant and variable coefficients.	H	H										
CLO3	Analyze and solve various differential equations.		H	H									
CLO4	Apply different laws of Statistics to solve various engineering problems.	H											
CLO5	Analyze different Statistics and probability related engineering problems efficiently.		H										

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Define, understand and identify differential equations by order, linearity and homogeneity.	P.01.2	C1 C2	K1			CT, SF, CP
CLO2	Describe higher order linear and nonlinear differential equations with constant and variable coefficients.	P.01.1	C1 C2	K3			CT, SF
CLO3	Analyze and solve various differential equations.	P.02.3	C4 C5	K5			ASG, CT, SF
CLO4	Apply different laws of Statistics to solve various engineering problems.	P.01.3	C1 C3 C5	K1			CT, SF, CP
CLO5	Analyze different Statistics and probability related engineering problems efficiently.	P.02.3	C1 C4	K4			CT, SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centered Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy(AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy

Continuous Assessment (30%)	CP	5%	CLO1	C1, C2
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3, C4
	ASG	5%	CLO3,4	C1, C3, C4, C5
Semester Final (70%)	SF	70%	CLO1,2,3	C1, C2, C3, C4, C5
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Basic ideas and example about differential equation, order, degree, general solution, particular solution, singular solution.	1	CT1 CP SF ASG	L D SDL
	L2	Formation of differential equation, variable separable ordinary differential equations, Convert to variable separable ordinary differential equations.	2		
	L3	Formation of ordinary differential equation, variable separable ordinary differential equations, Convert to variable separable ordinary differential equations.	1,2		
W2	L4	Homogeneous ordinary differential equations, Convert to homogeneous ordinary differential equations.	1, 2		
	L5	Homogeneous ordinary differential equations, Convert to homogeneous ordinary differential equations.	2		
	L6	Linear ordinary differential equations, Convert to Linear ordinary differential equations	2		
W3	L7	Linear ordinary differential equations of first order, Convert to Linear ordinary differential equations.	2		
	L8	Linear ordinary differential equations of first order, Convert to Linear ordinary differential equations.	2		
	L9	Clairaut's ordinary differential equations, Solvable for p, Solvable for y, Solvable for x	1,2		
W4	L10	Clairaut's ordinary differential equations, Solvable for p, Solvable for y, Solvable for x	2		
	L11	Solution of Higher-Order linear ordinary differential equations	1,2,3		
	L12	Solution of Higher-Order linear ordinary differential equations	2,3		
W5	L13	Solution of Higher-Order linear ordinary differential equations	2,3	CT2 CP SF ASG	L D SDL
	L14	Solution of Higher-Order linear ordinary differential equations	2,3		
	L15	Applications of 1^{st} and 2^{nd} order ordinary differential equations	3		
W6	L16	Applications of 1^{st} and 2^{nd} order ordinary differential equations	3		
	L17	Formation of Partial differential equation., Standard form	1, 2		
	L18	Formation of Partial differential equation., Standard form	2		
W7	L19	Linear Partial Differential Equations of order one	2		
	L20	Linear Partial Differential Equations of order one	2,3		
	L21	Linear Partial Differential Equations of order one	3		
Mid Break					
W8	L22	Non-Linear Partial Differential Equations of order one	1,2	CT3 CP SF	L D SDL
	L23	Non-Linear Partial Differential Equations of order one	2		
	L24	Non-Linear Partial Differential Equations of order one	2, 3		
W9	L25	Non-Linear Partial Differential Equations of order one	3		

	L26	Solution of Linear Partial Differential Equations of higher order	1,2,3		
	L 27	Solution of Linear Partial Differential Equations of higher order	2,3		
W10	L 28	Solution of Linear Partial Differential Equations of higher order	2,3		
	L 29	Application of PDE (heat equation, wave equation, Laplace equation, Poisson's equation, Helmholtz's equation, diffusion equation)	3		
	L 30	Application of PDE (heat equation, wave equation, Laplace equation, Poisson's equation, Helmholtz's equation, diffusion equation)	3		
W11	L 31	Introduction and basic concept of statistics, Measures of central tendency and measure of dispersion	4,5	ASG SF	L D SDL
	L 32	Introduction and basic concept of statistics, Measures of central tendency and measure of dispersion	4,5		
	L 33	Introduction and basic concept of statistics, Measures of central tendency and measure of dispersion	5		
W12	L 34	Measures of dispersion and standard deviation	4,5		
	L 35	Measures of dispersion and standard deviation	5		
	L 36	Moments, Skewness, Kurtosis	4,5		
W13	L 37	Correlation and regression	5	CP SF	L D SDL
	L 38	Correlation and regression	4,5		
	L 39	Elementary probability theory	4,5		
W14	L 40	Elementary probability theory	5		
	L 41	Discontinuous probability distribution	5		
	L 42	Review class	1-5		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Introduction of ordinary Differential Equations, Pearson, S. L. Ross
2. Differential Equations, Kedar Nath Ram Nath, B.D. Sharma
3. Ordinary and Partial differential Equations, S Chand & Co Ltd, M.D. Raisenghania
4. Introduction to Partial Differential Equations and Boundary Value Problems, McGraw Hill, Rene Dennemeyer.
5. Probability and Statistics for Engineers and Scientists, Pearson Education, Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and KeyingYe
6. Probability and Statistics for Engineers, Pearson Education, Irwin Miller and John E. Freund
7. A Introduction to Statistics and Probability by M. Nurul Islam

3.5 Course Outline of 3rd Year, 1st Semester

3.5.1 CSE 3101: Operating System

Course Information			
Course Code	: CSE 3101	Credit Hours	: 3.0
Course Title	: Operating System	Contact Hour	: 3.0

Pre-Requisite
None

Rationale

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

Objective

1. To develop the basic idea about internals and design principles of Operating System.
2. To learn the techniques for achieving protection and security in multi-level complex environment.

Course Contents

OS introduction: Introduction of Operating System, Types of OS

Process: process managements, process states, job and process scheduling, CPU scheduling algorithms, process coordination, critical section problems, semaphores, Inter-Process Communication (IPC), classical IPC problems, multiprocessing and time sharing

Memory management: swapping, memory allocation schemes, Paging and segmentation, virtual memory, page replacement strategies, working sets, demand paging

Input/output: hardware/software, disk, disk scheduling algorithms, Secondary storage management, terminals, clocks

Deadlock: resource allocation, detection, prevention, avoidance and recovery; File management

Virtualization: Types and techniques for efficient virtualization, memory and i/o virtualizations, virtual appliances

Cloud: clouds as a service, virtual machine migration, Check pointing;

Multiple Processor Systems: Multiprocessor, Multicomputer, Distributed Systems, Research on Multiple Processor Systems

Operating system security and protection: case study of some operating systems.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Understand and analyze process, thread, memory and file management systems.	H											
CLO2	Apply algorithms for process, thread, deadlock and memory management.	H											
CLO3	Classify, identify and analyze modern operating systems; concept for virtualization, cloud and multiple processor systems.		H										
CLO4	Develop the communication skill by presenting topics on operating systems.										L		

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods

CLO1	Understand and analyze process, thread, memory and file management systems.	P.01.3	C2	WK3			CT, SF, CP
CLO2	Apply algorithms for process, thread, deadlock and memory management.	P.01.4	C3	WK4			CT, SF
CLO3	Classify, identify and analyze modern operating systems; concept for virtualization, cloud and multiple processor systems.	P.02.3	C4	WK4	WP1, WP2, WP6		CT, SF
CLO4	Develop the communication skill by presenting topics on operating systems.	P.10.3	A2			A2, A4	Presentation

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3, C4
	Presentation	5%	CLO4	A2, A4
Semester Final (70%)	SF	70%	CLO1,2,3	C1, C2, C3, C4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Introduction evolution, goals and Components of OS, types of OS	1	CT1 CP SF	L D SDL
	L2		2		
	L3		1		
W2	L4	Process managements, process states and state transition, process control blocks	1,2		
	L5		2		
	L6		2		
W3	L7	Job and process scheduling, scheduling levels, objective and criteria CPU scheduling algorithms	2		
	L8		3		
	L9		1		
W4	L10	Process coordination, critical section problems, semaphores	1,2		
	L11		2,3		
	L12		3		
W5	L13	Language constructs, classical problems of	3	CT2	

	L14	process coordination, Inter-process	2,3	CP	
	L15	communication, message and mailbox etc.	2	SF	
W6	L16	Memory management memory allocation	1		L
	L17	schemes, Paging and segmentation, virtual	2		D
	L18	memory	2		SDL
W7	L19	Page replacement strategies, working sets,	2		
	L20	demand paging	2		
	L21		3		
Mid Break					
W8	L22	File system functions file organization logical and	1,2		
	L23	physical file maps, tree structure filesystems	2		
	L24		3		
W9	L25	I/O programming Device management techniques,	2	CT3	L
	L26	Interrupts processing parallel processing.	3	CP	D
	L 27		3	SF	SDL
W10	L 28	Secondary storage management, disk scheduling	1,2		
	L 29	algorithms	1,2		
	L 30		2		
W11	L 31	Space allocation, catalogs, file access control	2		
	L 32	mechanism	2		
	L 33		1		L
W12	L 34	Deadlock, deadlock prevention. avoidance	2	SF	D
	L 35	direction and recovery	1		SDL
	L 36		3		
W13	L 37	Operating system security, timesharing, Types and	2		
	L 38	techniques for efficient virtualization, memory and	1,2		
	L 39	i/o virtualizations, virtual appliances	3		
W14	L 40	Clouds as a service, virtual machine migration,	1		
	L 41	Check pointing; Multiple Processor Systems: Multiprocessor, Multicomputer, Distributed Systems, Research on Multiple Processor Systems; Operating system security and protection; case study of some operating systems.	1,2	CP SF	L D SDL
	L 42	Review class	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Modern Operating Systems (4th), Prentice Hall, Andrew S. Tanenbaum;
2. Operating Systems: Internals and Design Principles – (9th), Pearson, William Stallings.
3. Operating System concepts, Wiley, A. Silberschatz, P.B. Galvin, Greg Gagne

3.5.2 CSE 3102: Operating System Lab

Course Information			
Course Code	: CSE 3102	Credit Hours	: 1.5
Course Title	: Operating System Lab	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

The Operating System (OS) Sessional course is designed to provide hands on understanding on basic components of Operating Systems. The lab begins with the activities related to development of operating systems like UNIX and WINDOWS. Subsequently the course deals with virtualization and different key components of Operating System e.g., kernel compilation, process and thread scheduling, deadlocks, memory management, synchronization and system call etc.

Objective

1. To learn basic OS concepts and to be familiar with the design principles of Operating System
2. To know the internal and design principles of Operating System

Course Contents

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

Linux Kernels and Office Environments: Compilation;

Shell Programing: variables, statements, loop, array, functions etc.;

Memory management: preemptive and non- preemptive algorithms and implementation;

Inter process communication and Process scheduling: algorithms and implementation;

Mutual exclusion and deadlock: algorithms and implementation;

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

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Understand and respond to major operating systems like Windows, Linux etc.	H											
CLO2	Apply and modify algorithms for process, thread and memory management through group project work	H											
CLO3	Develop the communication skill by presenting topics on operating systems										H		
CLO4	Enhance security of Windows and Unix like operating systems	H											

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Understand and respond to major operating systems like Windows, Linux etc.	P.01.3	C2	K3			LP, LT, R, Q
CLO2	Apply and modify algorithms for process, thread and memory management through group project work	P.01.4	C3	K4			LP, LT, R, Q
CLO3	Develop the communication skill by presenting topics on operating systems	P.10.3	A2			A2, A4	Presentation

CLO4	Enhance security of Windows and Unix like operating systems	P.01.4	C3	K4			LP, LT, R, Q

*LP = Lab Performance, LT = Lab Test, Q = Quiz, R=Report, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30
Self-directed learning	
Preparation for lab reports	21
Preparation for lab test	5
Preparation of quiz	5
Engagement in project/Assignment	21
Formal Assessment	
Continuous assessment	-
Final Quiz	1
Lab Test/Project show	1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO1	C2, C3
Report Writing	20%	CLO2	C2, C3
Project & Presentation	20%	CLO3	A2
Lab Test	30%	CLO1	C2, C3
Quiz	20%	CLO1,2,3	C2, C3
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Introduction of Linux Operating System, Installation of Linux in various modes, Installation of windows application programs on Linux, Basic Linux Command
Week 2	Introduction of Linux Operating System, Installation of Linux in various modes, Installation of windows application programs on Linux, Basic Linux Command
Week 3	Compilation of Linux Kernels and Office Environments
Week 4	Compilation of Linux Kernels and Office Environments
Week 5	Variables, statements, loop, array, functions etc. in Shell Programing
Week 6	Review & Practice Lab-1
Week 7	Lab Test-1
Week 8	Preemptive and non- preemptive algorithms and implementation in Memory management
Week 9	Inter process communication and Process scheduling algorithms and implementation
Week 10	Mutual exclusion and deadlock algorithms and implementation
Week 11	Security of Windows and UNIX like OS, hardening and security issues
Week 12	Security of Windows and UNIX like OS, hardening and security issues
Week 13	Review & Practice Lab-2
Week 14	Lab Test-2

Text and Reference Books

1. Modern Operating Systems (4th), Prentice Hall, Andrew S. Tanenbaum;
2. Operating Systems: Internals and Design Principles – (9th), Pearson, William Stallings.
3. Operating System concepts, Wiley, A. Silberschatz, P.B. Galvin, Greg Gagne

3.5.3 ICE 3111: Database Management System

Course Information

Course Code Course Title	: ICE 3111 : Database Management System	Credit Hours Contact Hour	: 3.0 : 3.0

Pre-Requisite

None

Rationale

To introduce the basic concepts of data, database, database management system, entity-relationship model, relational algebra and sql, storage file and structure etc.

Objective

1. To understand DBMS concepts, Data models and Architecture
2. To give a good formal foundation on the relational model of data and usage of Relational Algebra.
3. To introduce the concepts of basic SQL as a universal Database language
4. To enhance knowledge to advanced SQL topics like embedded SQL, procedures connectivity through JDBC

Course Contents

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

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

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

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

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

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

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

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

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12

CLO1	Apply the basic concepts of relational data model, entity relationship model, relational database design, relational algebra and SQL.	H											
CLO2	Execute various advance SQL queries related to databases, Transaction Processing & Locking using concept of Concurrency control.	H											
CLO3	Analyze database requirements and determine the entities involved in the system and their relationship to one another.		H										

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Apply the basic concepts of relational data model, entity relationship model, relational database design, relational algebra and SQL.	P.01.3	C3	K3			CT, SF, CP
CLO2	Execute various advance SQL queries related to databases, Transaction Processing & Locking using concept of Concurrency control.	P.01.4	C3	K4	P1, P3, P7		CT, SF, ASG
CLO3	Analyze database requirements and determine the entities involved in the system and their relationship to one another.	P.02.3	C4	K4	P1, P2, P6		CT, SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3
	ASG	5%	CLO2	C3
Semester Final (70%)	SF	70%	CLO1,2,3	C1, C2, C3, C4

Total Marks	100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Introduction to data, database, database management system	1	CT1 CP SF	L D SDL
	L2	Database system versus file system	2		
	L3	Data model, Database language	1		
W2	L4	Database user administration	1,2		
	L5	Database system structure	2		
	L6	Storage manager, Overview of Physical storage medium	2		
W3	L7	The Relational Algebra and SQL	2		
	L8	Selection, Projection	3		
	L9	Union, Set-difference, Set-intersection	1		
W4	L10	Cartesian-product, Natural-join	1,2		
	L11	Rename, Division, Assignment	2,3		
	L12	Aggregate functions	3		
W5	L13	Deletion, Insertion, Updating	3	CT2 CP SF	L D SDL
	L14	Views, Nested sub-queries	2,3		
	L15	Set membership, Set comparison	2		
W6	L16	Integrity and Security and Relational Database Design	1		
	L17	Domain constraint	2		
	L18	Integrity	2		
W7	L19	Assertions, Triggers	2		
	L20	Authorization, Authentication, Security	2		
	L21	Encryption-Decryption Algorithm	3		
Mid Break					
W8	L22	Normalization, Decomposition	1,2	CT3 CP SF	L D SDL
	L23	Functional Dependencies	2		
	L24	Closure of a set of Functional dependencies	3		
W9	L25	Entity sets, Relationship sets	2		
	L26	Mapping Cardinalities	3		
	L 27	Keys, Attributes	3		
W10	L 28	Entity relationship diagram	1,2		
	L 29	Weak entity sets	1,2		
	L 30	Specialization, Generalization	2		
W11	L 31	Structure of Relational databases	2	ASG SF	L D SDL
	L 32	Database Schema	2		
	L 33	Database Design and E-R model	1		
W12	L 34	The Entity Relationship Model	2		
	L 35	Entity Relationship Diagram, Entity Relationship Design Issues	1		
	L 36	Weak Entity Set, Extended E-R Features	3		
W13	L 37	Physical Storage Media, Magnetic Disk, RAID, Storage Access	2	CP SF	L D SDL
	L 38	File Organization, Organization of Record in Files	1,2		
	L 39	Mathematical problems, Data Dictionary Storage	3		
W14	L 40	Concurrency control and Recovery System: Lock based protocols; Timestamp based protocols	1		
	L 41	Deadlock handling, Failure classification, Storage structure, Recovery and atomicity	1,2		
	L 42	Review class	1-3		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Database System Concepts, McGraw-Hill Higher Education, Silberschatz, Korth & Sudarshan
2. Fundamentals of Database Systems by Ramez E. Marsi.
3. SQL, PL/SQL by Ivan Bayross
4. Database Management Systems by BOU

3.5.4 ICE 3112: Database Management System Lab

Course Information

Course Code Course Title	: ICE 3112 : Database Management System Lab	Credit Hours Contact Hour	: 1.5 : 3.0

Pre-Requisite

None

Rationale

This course is designed to introduce the basic concepts of database, learn how to design database and gain first-hand experience of database application. Also, to learn the design of a database starting from the conceptual design to the implementation of database schemas and user interfaces to a database.

Objective

1. To introduce the basic concepts of database.
2. To develop a real-world database application.
3. To learn the design of a database starting from the conceptual design to the implementation of database schemas and user interfaces to a database.

Course Contents

In this course, students will perform experiments to practically verify the theories and concepts that learned about Structured Query Language; theoretical course of ICE 3111 Database Management System course using MySQL software.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	**Use** engineering tools efficiently to design, implement and test database.					H							
CLO2	**Analyze** database requirements and determine the entities involved in the system and their relationship to one another.		H										
CLO3	**Execute** various advance SQL queries by developing practical experience and skill on modern tools.	H											

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods

CLO1	**Use** engineering tools efficiently to design, implement and test database.	P.05.2	P4		P1 P4 P5		LP, LT
CLO2	**Analyze** database requirements and determine the entities involved in the system and their relationship to one another.	P.02.3	C4				R, Q
CLO3	**Execute** various advance SQL queries by developing practical experience and skill on modern tools.	P.01.4	C3				LP, LT, Q

*LP = Lab Performance, LT = Lab Test, Q = Quiz, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30
Self-directed learning	
Preparation for lab reports	21
Preparation for lab test	5
Preparation of quiz	5
Engagement in project/Assignment	21
Formal Assessment	
Continuous assessment	-
Final Quiz	1
Lab Test/Project show	1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO1	P4
Report Writing	20%	CLO2	C4
Lab Test	40%	CLO1,2,3	P4, C4, C3
Quiz	20%	CLO2,3	C4, C3
Viva	10%	CLO2	C4
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Introduction to Database and MySQL Installation.
Week 2	Create DB, create table, discussion on different data types
Week 3	Implementation of Apply SQL constraints to MYSQL Tables.
Week 4	Implementation of Drop tables, adding new table in an old database, insert data, delete row/tuple, show data, update fields, basic idea about ALTER TABLE query.
Week 5	Study of Some practices on Alter Table queries.
Week 6	Review & Practice Lab-1
Week 7	Lab Test-1
Week 8	Study of Select Queries and Constraints (Add, Drop)
Week 9	Study of Statements regarding some Aggregate functions, GROUP BY and ORDER BY.
Week 10	Implementation of Statements regarding Subqueries.
Week 11	Implementation of Sql Queries on Cartesian products and natural Join.
Week 12	Implementation of Sql Queries on different types of Joins

Week 13	Review & Practice Lab-2
Week 14	Lab Test-2

Text and Reference Books

1. Database System Concepts, McGraw-Hill Higher Education, Silberschatz, Korth & Sudarshan
2. Fundamentals of Database Systems by Ramez E. Marsi.
3. SQL, PL/SQL by Ivan Bayross
4. Database Management Systems by BOU

3.5.5 ICE 3113: Java Programming

Course Information

Course Code Course Title	: ICE 3113 : Java Programming	Credit Hours Contact Hour	: 3.0 : 3.0

Pre-Requisite

Course Code: ICE 2111
Course Title: Object Oriented Programming Language

Rationale

The Java Programming course is designed to provide a comprehensive knowledge about Inheritance, Polymorphism, Thread, Exception Handling, Encapsulation, JDBC, Spring, AWT to do programming in an effective manner and solve practical life problems with the theoretical knowledge of java programming.

Objective

1. To learn the concept of OOP with a pure object-oriented programming language (Java).
2. To learn how to use advance programming features such as GUI design, exception handling and multithreading.
3. To learn Inheritance, Polymorphism, Thread, Exception Handling, Encapsulation, JDBC, Spring, AWT.
4. To learn how to design and develop a complete real-world software solution.

Course Contents

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

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

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

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

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

Spring Framework and Hibernate: Understanding Inversion of Control (IoC), Aspect Oriented Programming (AOP) and Dependency Injection, MVC pattern for Web Applications, Spring Framework, Understanding Application Context, Bootstrapping Spring framework, Configuring Spring framework, Data Persistence, Object/relational Mapping, Hibernate ORM, Mapping Entities to Tables.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Understand the fundamental knowledge and information of Java theory	H											
CLO2	Illustrate and apply information and concepts of fundamental knowledge of different techniques to identify, formulate, and solve complex engineering problems.	M											
CLO3	Evaluate, formulate and analyze the appropriate solutions of engineering Java code application.		H										
CLO4	Develop probable solutions that meet specified needs with appropriate consideration limited network resources.			M									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Understand the fundamental knowledge and information of Java theory	P.01.3	C3	K3			CT, SF, CP
CLO2	Illustrate and apply information and concepts of fundamental knowledge of different techniques to identify, formulate, and solve complex engineering problems.	P.01.2	C3	K2			CT, SF
CLO3	Evaluate, formulate and analyze the appropriate solutions of engineering Java code application.	P.02.2	C4		P1 P3		CT, SF
CLO4	Develop probable solutions that meet specified needs with appropriate consideration limited network resources.	P.03.2	C3		P1 P3 P7		ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-

Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C3
	CT (1-3)	20%	CLO1,2,3	C3, C4
	ASG	5%	CLO4	C3
Semester Final (70%)	SF	70%	CLO1,2,3	C3, C4
Total Marks		100%		

Course Plan

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Introduction to subject: Objectives, Outcomes	1	CT1 CP SF	L D SDL
	L2	Object Oriented Programming Concepts.	2		
	L3	Procedural and Object-Oriented Paradigms	1		
W2	L4	History of JAVA	1,2		
	L5	Data Types, Variables, constants, Scope and lifetime of java	2		
	L6	Control Statements	2		
W3	L7	Arrays, console input and output	2		
	L8	Threads, Thread life cycle, creating multiple threads by using thread	3		
	L9	Access control, this keyword, garbage collection	1		
W4	L10	Overloading methods and constructors	1,2		
	L11	Recursion, String handling	2,3		
	L12	Inheritance definition, single inheritance, benefits of Inheritance	3		
W5	L13	Super classes and subclass Member access rules	3	CT2 CP SF	L D SDL
	L14	Preventing inheritance: final class and methods	2,3		
	L15	Base class object and its methods	2		
W6	L16	Polymorphism: dynamic Binding	1		
	L17	Method overriding	2		
	L18	Abstract classes and methods	2		
W7	L19	Defining an interface, implementing interface	2		
	L20	Implements and extends keywords	2		
	L21	An application using an interfaces and uses of interfaces	3		
W8	L22	Differences between abstract classes and interfaces	1,2	CT3 CP SF	L D SDL
	L23	Inner classes(local and Anonymous and static)	2		
	L24	Examples: Inner classes(local and Anonymous and static)	3		
W9	L25	Defining, Creating and Accessing a Package, Types of Packages	2		
	L26	Understanding CLASSPATH, importing packages	3		
	L 27	Dealing with errors and benefits of Exception Handling	3		
W10	L 28	Concepts of Exception handling, Exception hierarchy	1,2		
	L 29	Types of exceptions, usage of try, catch, throw, throws, finally keywords	1,2		
	L 30	Built in Exceptions, Creating own Exception sub classes	2		
W11	L 31	Differences between multiple Processes and Multiple threads	2	ASG SF	L D SDL
	L 32	Connecting to database: drivers – 4 types	2		
	L 33	Connection and querying the database, Updating data with JDBC	1		

W12	L 34	Advantages of GUI over CUI, The AWT class hierarchy	2		
	L 35	Introduction to swing and Swing VS AWT	1		
	L 36	Hierarchy for swing components	3,4		
W13	L 37	Containers	2	CP SF	L D SDL
	L 38	Jbutton, jtextfield, jtextarea with example	1,2		
	L 39	Layout managers (border, grid and flow)	3,4		
W14	L 40	Event handling, Events, sources, classes, listeners	1		
	L 41	Relationship between event sources and listeners	1,2		
	L 42	Delegation Event model, Handling button click, Handling mouse events	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

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

3.5.6 ICE 3114: Java Programming Lab

Course Information

Course Code	: ICE 3114	Credit Hours	: 3.0
Course Title	: Java Programming Lab	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

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

Objective

1. To learn the concept of OOP with a pure object-oriented programming language (Java).
2. To learn how to use advance programming features such as GUI design, exception handling and multithreading.
3. To learn how to design and develop a complete real-world software solution.

Course Contents

Object-Oriented Programming (JAVA): Basic concepts on java, basic operation, command line, objects and classes in Java, class inheritance, polymorphism, exception handling, abstract classes, interfaces, thread, Java Array, String, JAVA I/O (serialization) and stream, Generic Class and methods, JDBC;

Collection Frameworks; Concurrency; GUI: Swing components and swing Layouts.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Identify the concept of OOP with a pure object- oriented programming language (Java).	H											

CLO2	Identify and express how to use advance programming features such as GUI design, exception handling and multi-threading using modern engineering tools.					H							
CLO3	Demonstrate how to design and develop a complete real-world software solution forming a team member or leader.									H			

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Identify the concept of OOP with a pure object- oriented programming language (Java).	P.01.3.	C3	K3			LP, LT, Q
CLO2	Identify and express how to use advance programming features such as GUI design, exception handling and multi-threading using modern engineering tools.	P.05.3	P5	K6	P1 P3 P7		R, Q
CLO3	Demonstrate how to design and develop a complete real-world software solution forming a team member or leader.	P.09.2	A2				P, R

*LP = Lab Performance, LT = Lab Test, Q = Quiz, EA = Engineering Activities, WP = Complex Engineering Activities, P=Project, R=Report, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30
Self-directed learning	21
Preparation for lab reports	5
Preparation for lab test	5
Preparation of quiz	21
Engagement in project/Assignment	
Formal Assessment	
Continuous assessment	-
Final Quiz	1
Lab Test/Project show	1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO1	C3
Report Writing	20%	CLO2	P5
Project	20%	CLO3	A2
Lab Test	30%	CLO1	C3
Quiz	20%	CLO1,2,3	P5, C3, A2
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	To study byte code generation, role of JDK, JRE, JVM, class, object, data types, various operators.
Week 2	Experimental study of object instantiation, constructors, methods (defining & calling), types of constructors, parameter passing to methods.
Week 3	To study and implementation of, method overloading, constructor overloading.
Week 4	To study and implementation of polymorphism.
Week 5	To study and implementation of single inheritance, multiple, hybrid inheritance, super, order of constructor calling method overriding.
Week 6	Review & Practice Lab-1
Week 7	Lab Test-1
Week 8	To study and implementation of simple programs using Array
Week 9	To study and implementation of exception handling through-try, catch, throw, throws, finally block.
Week 10	To study and implementation of simple programs of multithreading.
Week 11	To study and implementation of applets drawing various shapes through applets, string scrolling in applet.
Week 12	To study and implementation of java database connection, insert operation, update operation, delete operation.
Week 13	Review & Practice Lab-2
Week 14	Lab Test-2

Text and Reference Books

1. Java, The Complete Reference (9th ed), McGraw-Hill Education, Herbert Schildt (2014)
2. Introduction To Java Programming Comprehensive Version 10th Edition, Pearson, Y. Daniel Liang

3.5.7 ICE 3115: Antenna Engineering and Satellite Communication

Course Information

Course Code	: ICE 3115	Credit Hours	: 3.0
Course Title	: Antenna Engineering and Satellite Communication	Contact Hour	: 3.0

Pre-Requisite

Course Code: ICE 2113
Course Title: Analog and Digital Communication

Rationale

This course covers basics of antenna theory, electromagnetic radiation principle, antenna designs and implementations of in modern wireless communication systems. In addition, students will acquire knowledge of satellite communication, orbital mechanics, earth station and their various elements. It is also targeted to provide them basic understanding on multiple access along with understanding of VSAT networks and some basic of Radar.

Objective

1. To familiarize the students about the basic of antenna, radiation mechanism, satellite communication and Radar.
2. To enhance students' skill on design of antenna and analysis of antennas basic parameter equivalent circuit.
3. To enhance students' knowledge access techniques and digital modulation techniques.
4. To provide the students with detailed working procedure of a working VSAT network system.

Course Contents

Fundamental of Antenna: Introduction, Antenna and its Clasificaiton, Radiation mechanism, Fundamental Antenna Parameters, Polarization, Friis Transmission Equation, Matching techniques, Antenna Measurements, Balun transformers.

Microstrip Antennas: Basic characteristics, Feeding method, Transmission line model of rectangular patch, Design method, Conductance, Resonant input resistance, Antenna Miniaturization, Smart Antennas.

Antenna Arrays: Array, Array types, Two element array, N-element linear array, field calculation, radiation pattern of array, pattern multiplication.

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

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

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

Access Techniques in Satellite Communication: Random access, Multiple access, TDMA, Efficient technique.

VSAT Networks: Technology and recent advancements, Mobile Satellite Networks

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Define and understand the basic principle of antenna engineering, satellite communication and radar.	H											
CLO2	Explain different technique and theoretical aspect of antenna engineering and satellite communication.	H											
CLO3	Solve various mathematical problems to meet specific criteria of antenna engineering and satellite communication issue.			M									
CLO4	Design the solution of real-life engineering problems such as antenna design to meet specific criteria, link power budget for satellites			H									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy							
No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	**Define** and understand the basic principle of antenna engineering, satellite communication and radar.	P.01.1	C3	K1			CT, SF, CP
CLO2	**Explain** different technique and theoretical aspect of antenna engineering and satellite communication.	P.01.3	C3	K3			CT, SF
CLO3	**Solve** various mathematical problems to meet specific criteria of antenna engineering and satellite communication issue.	P.03.2	C3		P1 P3 P7		CT, SF
CLO4	**Design** the solution of real-life engineering problems such as antenna design to meet specific criteria, link power budget for satellites	P.03.3	C6	K5			ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3
	ASG	5%	CLO4	C6
Semester Final (70%)	SF	70%	CLO1,2,3	C1, C2, C3
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Introduction to antenna and antenna system.	1,2	CT1 CP SF	L D SDL
	L2	Antenna Classification	1		
	L3	Thevenin Equivalent circuit of antenna.	2		
W2	L4	Radiation mechanism and mandatory condition of radiation.	2		

	L5	Radiation Pattern and Radiation Property.	2		
	L6	E & H plane associated with E & H plane Pattern, Classification of radiation lobes, HPBW, FNBW	2		
W3	L7	Related Math	3		
	L8	Beam area and calculation of beam area, beam efficiency	2		
	L9	Antenna bandwidth, radiation power density	2		
W4	L10	Radiation Intensity, directivity, Solving related math	2,3		
	L11	Different types of polarization	2		
	L12	Explain Friis Transmission Equation.	2		
W5	L13	Matching techniques	2	CP ASG SF	L D SDL
	L14	Antenna Measurements, Balun transformers.	2		
	L15	Radiation resistance, Radiation efficiency, effective aperture	2		
W6	L16	Introduction of microstrip patch antenna	1		
	L17	Different feeding techniques.	2		
	L18	Design of microstrip patch antenna.	4		
W7	L19	Introduction to antenna array, two element array.	1,2		
	L20	N-element linear array, field calculation, radiation pattern of array	2		
	L21	Pattern multiplication.	2		
Mid Break					
W8	L22	Definition, history, need of satellite communication, how satellite communication works.	1,2	CT2 CP SF	L D SDL
	L23	Advantage and disadvantage, application, orbital elements, semi major axis, semi minor axis, mean anomaly, argument of perigee.	1,2		
	L24	Satellite orbits, Posi grade, retrograde, ascending node, descending node, GEO stationary satellite, GEO synchronous satellite.	2		
W9	L25	Orbital mechanics, equation of orbit, Kepler‘s three law of planetary motion.	2		
	L26	Describing the orbit of a satellite, locating the satellite in the orbit.	2		
	L 27	Look angle determination, subsatellite point, elevation angle, azimuth angle.	2		
W10	L 28	Introduction, Basic Transmission Theory.	1,2		
	L 29	Link budget calculation.	3		
	L 30	System availability, mean unavailability, radio-star method.	2		
W11	L 31	DMA, FDM-FM-FDMA, Single Channel per carrier	2	CT3 SF	L D SDL
	L 32	TDMA, TDMA frame structure, reference burst, traffic burst, guard time.	2		
	L 33	TDMA burst structure, carrier and clock recovery sequence, unique word, TDMA frame efficiency	2		
W12	L 34	Types of ALOHA, Throughput calculation	2		
	L 35	Average packet delay vs satellite channel throughput	2,3		
	L 36	Satellite spread spectrum communication	2		
W13	L 37	Characteristics, VSAT network system concept	2	CP SF	L D SDL
	L 38	Satellite channels	1,2		
	L 39	Service of VSAT	2		
W14	L 40	Mobile satellite network	1,2		
	L 41	Review class	1,2		

	L 42	Review class	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Antenna Theory – Analysis and Design, Wiley, C. A. Balanis.
2. Antennas for All Applications, McGraw-Hill Science/Engineering/Math, J. D. Kraus, R. J. Marhefka, and A. S. Khan
3. Digital Satellite Communications, TBS, Tri T. Ha; McGraw-Hill International
4. Satellite Communication Mobile & Fixed Services, Kluwer Aca Publisher, Michael J. Miler.
5. Satellite Communications by T. Pratt, C. Bostian, J. Allnut; John Wiley & Sons Inc
6. Introduction to RADAR systems, McGraw-Hill International ,M. Sholnik.

3.5.8 ICE 3116: Antenna Engineering and Satellite Communication Lab

Course Information

Course Code	: ICE 3116	Credit Hours	: 1.5
Course Title	: Antenna Engineering and Satellite Communication Lab	Contact Hour	: 3.0

Pre-Requisite

Course Code: ICE 2114
Course Title: Analog and Digital Communication Lab

Rationale

Antenna Engineering and Satellite Communication Laboratory course is designed to familiarize the students with characterization of some basic antenna types, to practically understand the electromagnetic radiation mechanism besides analysis of radiation pattern. It is also to make the students practically understand the working principle of satellite communication. In addition to expose them to model and simulate parameters of antennas for satellite communication for real life applications.

Objective

1. To practically understand the mechanism of electromagnetic radiation satellite communication technology.
2. To develop students' technical skills on experimental design and investigating the performance of various type of antenna.
3. To enhance students' skill on design and simulation of various antenna for real life application.
4. To familiarize the students to develop engineering design and report writing skills.

Course Contents

In this course, students will perform experiments to practically verify the theories and concepts learned in ICE 2215: Antenna Engineering and Satellite Communication using different hardware equipment and simulation software.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12

CLO1	**Apply** the concept and fundamental engineering knowledge to practically understand the familiarity of issues in antenna engineering and satellite communication field.	H										
CLO2	**Use** the modern tools to measure and/or simulate the various antenna parameters of testing antenna using antenna trainer kit.					H						
CLO3	**Analyze** the different antenna parameters from measured data of radiation pattern.				H							
CLO4	Design different types of transmitter and receiver antennas to provide satellite Uplink and Down link Frequency for real life applications					M						

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	**Apply** the concept and fundamental engineering knowledge to practically understand the familiarity of issues in antenna engineering and satellite communication field.	P.01.3	C3	K3			Q
CLO2	**Use** the modern tools to measure and/or simulate the various antenna parameters of testing antenna using antenna trainer kit.	P.05.2	P4				LP, LT, Q
CLO3	**Analyze** the different antenna parameters from measured data of radiation pattern.	P.04.2	C4				R, Q
CLO4	**Design** different types of transmitter and receiver antennas to provide satellite Uplink and Down link Frequency for real life applications	P.03.3	C6	K5	P1 P3 P7		PRO

*LP = Lab Performance, LT = Lab Test, Q = Quiz, PRO = Project work, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30
Self-directed learning	21
Preparation for lab reports	5
Preparation for lab test	5
Preparation of quiz	21
Engagement in project/Assignment	
Formal Assessment	
Continuous assessment	-
Final Quiz	1
Lab Test/Project show	1

		Total	90
Assessment Strategy (AS)			
Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO2	P4
Report Writing	20%	CLO3	C4
Project	20%	CLO4	C6
Lab Test	30%	CLO2	P4
Quiz	20%	CLO1,2,3	C1, C2 and C4
Total Marks	100%		

Course Plane

Week	Topic
Week 1	Familiarization with equipment, Plotting the polar graph/ radiation pattern of an antenna manually and using software.
Week 2	Study of Folded Dipole (λ/4) antenna.
Week 3	Study of Simple Dipole λ/2 antenna.
Week 4	Study of Simple Dipole (3λ/2) antenna.
Week 5	Study of Folded Dipole (λ/2) antenna.
Week 6	Review & Practice Lab-1
Week 7	Lab Test-1
Week 8	Study of Yagi -UDA 5 Element simple dipole antenna.
Week 9	Study of Polarization Test and variation in the radiation strength at a given distance from the antenna.
Week 10	Study of reciprocity theorem for antenna.
Week 11	To simulate model and analyze antenna look angles of geostationary communications satellite by MATLAB Simulink Model.
Week 12	Project presentation on antenna design for satellite communication.
Week 13	Review & Practice Lab-2
Week 14	Lab Test-2

Text and Reference Books

1. Antenna Theory – Analysis and Design, Wiley, C. A. Balanis.
2. Antennas for All Applications by J. D. Kraus, R. J. Marhefka, and A. S. Khan
3. Digital Satellite Communications, McGraw-Hill International, Tri T. Ha.
4. Satellite Communication Mobile & Fixed Services, Kluwer Aca Publisher, Michael J. Miler;

3.5.9 HUM 3183: Professional Ethics and Environmental Protection

Course Information

Course Code	: HUM 3183	Credit Hours	: 2.0
Course Title	: Professional Ethics and Environmental Protection	Contact Hour	: 2.0

Pre-Requisite

None

Rationale

It is essential for professionals in any field to have an understanding of the ethical problems and principles in their field. But anyone, no matter what their job, must deal with many other professions as well. Part of professional ethics is the understanding of the ethics of other professions: how they interact and what can be expected from them as correct ethical behavior. In turn, any professional will benefit from a critical scrutiny of their own ethics by those from other professions. The general principles of professional ethics will be examined, as well as the distinctive problems of the different

fields. This course will help the communication engineering students to conceptualize the dynamics of the ethical practice in electrical domain.

Objective

1. To inculcate the sense of social responsibility.
2. To develop a firm ethical base.
3. To make the students realize the significance of ethics in electrical professional environment.

Course Contents

Introduction to Engineering ethics and professionalism; History and development of engineering ethics and ethical theories; Moral Reasoning and Codes of Ethics; Moral Frameworks for Engineering Ethics; Professional Engineering Codes, Codes of Ethics (IEB);

Codes of Ethics (IEEE), Risk, Safety, Accidents, Liability, Trust and reliability Engineer's Responsibilities and Rights; Ethical expectation: Employers and employees, inter-professional relationship, Professional Organization – maintaining a commitment of ethical standards. Human qualities of an engineer. Obligation of an engineer to the clients. Attitude of an engineer to other engineers. Measures to be taken in order to improve the quality of engineering profession. Desired characteristics of a professional code. Institutionalization of ethical conduct.

Environmental Ethics: The Internet and Free Speech, Power Relationships, Property, Privacy, Additional Issues Environmental Ethics: Engineering, ecology, economics, Sustainable development.

Ethical frameworks Global Issues: Multinational corporations, globalization of engineering, Technology transfer, appropriate technology Cautious Optimism and Moral Leadership: Cautious optimism as a technology development attitude, Moral leadership in engineering.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Understand the theoretical aspects of ethics and moral philosophy in professional fields			H									
CLO2	Identify practical and legal problems commonly encountered by engineers in their professional field/industry.						H						
CLO3	Develop foundation knowledge of ethics to be applied in professional fields.								H				
CLO4	Critically assess the codes of professional conduct and their implications in electrical engineering life.												L

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Understand the theoretical aspects of ethics and moral philosophy in professional fields	P.03.1	C2	K5		-	CT, SF,CP
CLO2	Identify practical and legal problems commonly encountered by engineers in their professional field/industry.	P.06.2	C3	K7		-	ASG, SF

CLO3	Develop foundation knowledge of ethics to be applied in professional fields.	P.08.2	C6	K7		-	CT, SF
CLO4	Critically assess the codes of professional conduct and their implications in electrical engineering life.	P.12.3	C5			-	CT,SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	26
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	25
Revision	12
Assessment Preparations	12
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	80

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C2
	CT (1-3)	20%	CLO1,2,4	C2, C3, C5
	ASG	5%	CLO2	C3
Semester Final (70%)	SF	70%	CLO1,2,3,4	C2, C3, C6,C5
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Introduction to Engineering ethics and professionalism	1	CT1 CP SF	L D SDL
	L2	History and development of engineering ethics and ethical theories	2		
W2	L3	History and development of engineering ethics and ethical theories	1,2		
	L4	Moral Reasoning and Codes of Ethics	2		
W3	L5	Moral Frameworks for Engineering Ethics	2		
	L6	Professional Engineering Codes, Codes of Ethics (IEB)	3		
W4	L7	Codes of Ethics (IEEE)	1,2		
	L8	Risk, Safety, Accidents, Liability, Trust and reliability	2,3		
W5	L9	Engineer's Responsibilities and Rights	3	CT2 CP SF	L D SDL
	L10	Ethical expectation: Employers and employees, inter-professional relationship	2,3		
W6	L11	Professional Organization–maintaining a commitment of ethical standards	1		
	L12	Human qualities of an engineer	2		
W7	L13	Ethical Issues in Electrical Engineering Practice: Case studies	2		
	L14	Obligation of an engineer to the clients	2		

Mid Break					
W6	L15	Attitude of an engineer to other engineers	1,2	CT3 CP SF	L D SDL
	L16	Measures to be taken in order to improve the quality of engineering profession	2,4		
W9	L17	Desired characteristics of a professional code	2		
	L18	The Internet and Free Speech, Power Relationships,	3		
W10	L 19	Property, Privacy, Additional Issues Environmental Ethics: Engineering, ecology, economics, Sustainable development.	1,2		
	L 20	Property, Privacy, Additional Issues Environmental Ethics: Engineering, ecology, economics, Sustainable development.	1,2		
W11	L 21	Applied ethics in engineering: Whistle Blowing	2	ASG SF	L D SDL
	L 22	Different Case Studies of ethics	4		
W12	L 23	Multinational corporations, globalization of engineering,	2		
	L 24	Technology transfer, appropriate technology Cautious Optimism and Moral Leadership:	1		
W13	L 25	Cautious optimism as a technology development attitude, Moral leadership in engineering	2	CP SF	L D SDL
	L 26	Cautious optimism as a technology development attitude, Moral leadership in engineering	1,2		
W14	L 27	Cautious optimism as a technology development attitude, Moral leadership in engineering	1		
	L 28	Summary, Review and Open discussion	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Engineering Ethics: Concepts and Cases, Cengage Learning
   Boston, USA: 4th Edition, 2009, Wadsworth Publishing, Charles E. Harris, et el.
2. Engineering Ethics, 4th Edition, Mc-Graw hill, 2012, Charles B. Fleddermann.
3. Engineering Ethics. Farnham, United Kingdom Ashgate Publishing, 2005, Davis, M., ed.

3.6 Course Outline of 3rd Year, 2nd Semester

3.6.1 ICE 3211: Internet and Web Programming

Course Information			
Course Code Course Title	: ICE 3211 : Internet and Web Programming	Credit Hours Contact Hour	: 3.0 : 3.0

Pre-Requisite

None

Rationale

This course motivates to enable internet and web programming technologies in such a way where internet is appearing anytime and everywhere by studying affordances, limitations, necessary protocols, user interfaces, framework design etc. of such internet systems in order to implement them for different applications.

Objective

1. To understand of the range of novel applications based upon web programming as well as its particular requirements.
2. To identify different features that helps to develop a web site personal and commercial.
3. To analyze the different properties and requirements that influences the development of an internet providing system and web programming system.

Course Contents

Introduction to Web Technologies: Introduction to Web servers like Apache 1.1, IIS XAMPP (Bundle Server), WAMP (Bundle Server), Handling HTTP Request and Response, installations of above servers, HTML and CSS: HTML 5.0, XHTML, CSS 3. Internet.
Java Script: An introduction to JavaScript–JavaScript DOM Model-Date and Objects, - Regular Expressions-Exception Handling-Validation-Built-in objects-Event Handling- DHTML with JavaScript.
Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions Session Handling- Understanding Cookies. Installing and Configuring Apache Tomcat Web Server; - DATABASE CONNECTIVITY: JDBC perspectives, JDBC program example - JSP: Understanding Java Server Pages- JSP Standard Tag Library (JSTL)-Creating HTML forms by embedding JSP code.
Introduction to PHP: The problem with other Technologies (Servlets and JSP), Downloading, installing, configuring PHP, Programming in a Web environment and the anatomy of a PHP Page. Overview of PHP Data types and Concepts: Variables and data types, Operators, Expressions and Statements, Strings, Arrays and Functions. PHP Advanced Concepts: Using Cookies, Using HTTP Headers, Using Sessions, authenticating users, Using Environment and Configuration variables, Working with Date and Time.
Creating and Using Forms: Understanding Common Form Issues, GET vs. POST, validating form input, working with multiple forms, and Preventing Multiple Submissions of a form. XML: Basic XML Document Type Definition XML Schema DOM and Presenting XML, XML Parsers and Validation, XSL and XSLT Transformation, News Feed (RSS and ATOM).
AJAX: Ajax Client Server Architecture-XML Http Request Object-Call Back Methods; Web Services: Introduction- Java web services Basics – Creating, Publishing, Testing and Describing a Web services (WSDL)-Consuming a web service, Database Driven web service from an application– SOAP.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Apply the basic concepts of communication technologies over the internet and explain their functioning.	H											
CLO2	Analyze the fundamental trade-offs related to resource limitations and communication needs in communication by using internet.		H										
CLO3	Demonstrate and apply an understanding of the range of novel applications based upon web programming as well as its particular requirements.	H											

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods

CLO1	Apply the basic concepts of communication technologies over the internet and explain their functioning.	P.01.3	C3	K3			CT, SF, CP
CLO2	Analyze the fundamental trade-offs related to resource limitations and communication needs in communication by using internet.	P.02.3	C4	K4	P1, P2, P6		CT, SF, ASG
CLO3	Demonstrate and apply an understanding of the range of novel applications based upon web programming as well as its particular requirements.	P.01.4	C3	K4	P1, P3, P7		CT, SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3
	ASG	5%	CLO2	C3
Semester Final (70%)	SF	70%	CLO1,2,3	C1, C2, C3, C4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Introduction to Web Technologies	1	CT1 CP SF	L D SDL
	L2	Introduction to Web servers like Apache 1.1, IIS XAMPP (Bundle Server), WAMP (Bundle Server)	2		
	L3	Handling HTTP Request and Response	1		
W2	L4	Installations of above servers	1,2		
	L5	HTML and CSS: HTML 5.0, XHTML, CSS 3. Internet	2		
	L6	HTML and CSS: HTML 5.0, XHTML, CSS 3. Internet	2		
W3	L7	HTML and CSS: HTML 5.0, XHTML, CSS 3. Internet	2		
	L8	HTML and CSS: HTML 5.0, XHTML, CSS 3. Internet	3		
	L9	HTML and CSS: HTML 5.0, XHTML, CSS 3. Internet	1		
W4	L10	An introduction to JavaScript	1,2		
	L11	JavaScript DOM Model-Date and Objects	2,3		
	L12	Regular Expressions	3		

W5	L13	Exception Handling-Validation-Built-in objects	3	CT2 CP SF	L D SDL
	L14	Event Handling- DHTML with JavaScript	2,3		
	L15	Servlets: Java Servlet Architecture	2		
W6	L16	Servlet Life Cycle- Form GET and POST actions Session Handling	1		
	L17	Understanding Cookies	2		
	L18	Installing and Configuring Apache Tomcat Web Server	2		
W7	L19	DATABASE CONNECTIVITY: JDBC perspectives, JDBC program example	2		
	L20	JSP: Understanding Java Server Pages- JSP Standard Tag Library (JSTL)	2		
	L21	Creating HTML forms by embedding JSP code	3		
Mid Break					
W8	L22	Introduction to PHP: The problem with other Technologies (Servlets and JSP)	1,2	CT3 CP SF	L D SDL
	L23	Downloading, installing, configuring PHP	2		
	L24	Programming in a Web environment and the anatomy of a PHP Page	3		
W9	L25	Overview of PHP Data types and Concepts: Variables and data types, Operators, Expressions and Statements	2		
	L26	Strings, Arrays and Functions	3		
	L 27	PHP Advanced Concepts: Using Cookies, Using HTTP Headers, Using Sessions, authenticating users	3		
W10	L 28	Using Environment and Configuration variables	1,2		
	L 29	Working with Date and Time	1,2		
	L 30	Creating and Using Forms: Understanding Common Form Issues, GET vs. POST	2		
W11	L 31	Validating form input, working with multiple forms, and Preventing Multiple Submissions of a form	2	ASG SF	L D SDL
	L 32	XML: Basic XML	2		
	L 33	Database Design and E-R model	1		
W12	L 34	Document Type Definition XML Schema DOM and Presenting XML	2		
	L 35	XML Parsers and Validation	1		
	L 36	XSL and XSLT Transformation, News Feed (RSS and ATOM)	3		
W13	L 37	AJAX: Ajax Client Server Architecture	2	CP SF	L D SDL
	L 38	XML Http Request Object-Call Back Methods	1,2		
	L 39	Web Services: Introduction- Java web services Basics	3		
W14	L 40	Creating, Publishing, Testing and Describing a Web services (WSDL), Consuming a web service	1		
	L 41	Database Driven web service from an application– SOAP	1,2		
	L 42	Review class	1-3		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

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

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

3.6.2 ICE 3212: Internet and Web Programming Lab

Course Information

Course Code Course Title	: ICE 3212 : Internet and Web Programming Lab	Credit Hours Contact Hour	: 1.5 : 3.0

Pre-Requisite

None

Rationale

The study of internet and web programming is teaching students fundamental concepts of internet and show them how they are applied in the construction of Web applications. The course will show through technological tools the key issues to address for building useful and usable Web applications, the new trends and open issues.

Objective

1. General Understanding of Internet and Web Programming.
2. Developing Programming Skills for Advanced Web site design.

Course Contents

This course contains web technologies, java script, php, creating and using forms to enable internet and web programming technologies in such a way where internet is appeared anytime and everywhere by studying affordances, limitations, necessary protocols, user interfaces, framework design etc. of such internet systems in order to implement them for different applications.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	**Demonstrate** the fundamental principles, typical characteristics, mechanisms and ethical use internet and web programming.								H				
CLO2	**Apply** ethical principles, responsibility and norms of the engineering practice to write project reports on developing web site or improve existing web programming code.								H				
CLO3	**Perform** effective oral presentation on complex engineering activities.										H		
CLO4	**Create** written engineering reports by applying principle-based approaches and design documentation on website development project for different stake holders.										H		

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy							
No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	**Demonstrate** the fundamental principles, typical characteristics, mechanisms and ethical use internet and web programming.	P.08.1	A5				LP, LT
CLO2	**Apply** ethical principles, responsibility and norms of the engineering practice to write project reports on developing web site or improve existing web programming code.	P.08.2	A4				R, Q
CLO3	**Perform** effective oral presentation on complex engineering activities.	P.10.3	A2			A2, A4	Presentation
CLO4	**Create** written engineering reports by applying principle-based approaches and design documentation on website development project for different stake holders.	P.10.2	P3				R

*LP = Lab Performance, LT = Lab Test, Q = Quiz, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30
Self-directed learning	
Preparation for lab reports	21
Preparation for lab test	5
Preparation of quiz	5
Engagement in project/Assignment	21
Formal Assessment	
Continuous assessment	-
Final Quiz	1
Lab Test/Project show	1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO1, CLO2	A4, A5
Project Report Writing	20%	CLO4	P3
Lab Project	40%	CLO1,2,3,4	P4, C4, C3
Project Presentation	20%	CLO3	A2
Viva	10%	CLO3	A2
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Familiarization with HTML features and development of codes for creating a web page.
Week 2	Develop a web page using HTML and CSS features.

Week 3	Develop a responsive web page using HTML and CSS features.
Week 4	Develop a professional registration form and table using HTML, CSS and JavaScript.
Week 5	Develop and demonstrate basic operation of XHTML file that includes JavaScript.
Week 6	Review & Practice Lab-1
Week 7	Lab Test-1
Week 8	Develop and demonstrate a XHTML document using JavaScript that perform validation of user input and provide alert when errors are detected.
Week 9	Create a web page using table tag to format web page also create the time table of your class using table tag.
Week 10	Create your profile page like educational details, hobbies, achievement, my ideas.
Week 11	Develop a PHP program to store current date-time in a COOKIE and display the 'Last visited on' date-time on the web page upon re-opening of the same page.
Week 12	Develop a simple website including home page, registration form and store the page value in a database table.
Week 13	Review & Practice Lab-2
Week 14	Lab Test-2

Text and Reference Books

1. Web Engineering: The Discipline of Systematic Development of Web Applications, Wiley, G. Kappel, B. Pryyll, S. Reich.
2. Internet and World Wide Web How to Program, Prentice Hall, M. H. Deitel, J. P. Deitel and B. A. Goldberg.
3. Beginning PHP and MySQL, 3rd Edition, Apress Publications (Dream tech.), Jason Gilmore,
4. PHP 5 Recipes A problem Solution Approach by Lee Babin, Nathan A Good, Frank M. Kromann and Jon Stephens.
5. Internet and World Wide Web, Pearson, How to Program Deitel and Deitel and Nieto.

3.6.3 ICE 3213: Microprocessor and Microcontroller

Course Information

Course Code	: ICE 3213	Credit Hours	: 3.0
Course Title	: Microprocessor and Microcontroller	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

To learn and familiarize the basics of how computer works, its language and interfacing between different parts of the memory of the microprocessor. The student also can learn about the microcontroller.

Objective

1. To understand basic architecture of microprocessors and interfacing by programming languages to control the operation of microprocessors.
2. To become skilled at designing embedded systems and simplifying traditional manual process controls with programmable devices.
3. To be able to learn about microcontroller with associated devices.
4. Design and interfacing of microcontroller-based embedded systems

Course Contents

Introduction to Microprocessor: Introduction to Microprocessor and its applications, Microprocessor Evolution Tree, Microprocessor Architecture (Harward & Princeton), General

Architecture of the Microprocessor and its operations, Component of Microprocessor system: Processor, Buses, Memory, Inputs-outputs (I/Os) and other Interfacing devices.

8-bit Microprocessor: Intel 8085 microprocessor: Pin Diagram, Internal architecture: ALU, Registers, Timing and control unit, interrupt,Instruction Set of 8085: Instruction format, op-codes, mnemonics, no. of bytes computation of the instruction, Machine cycles and Tstates and Execution time computation of an instruction. Classification of instruction with their examples. Writing of assembly Language programs.

16-bit Microprocessor: Architecture of Intel 8086: Pin Diagram, Bus Interface Unit, Execution unit, Register organization, Memory addressing, Memory Segmentation, Pipelining, Min & Max operating Modes 8086Instruction set: Format, Addressing Modes, Instruction Set Groups: Data transfer, Arithmetic, Logic, String, Branch control transfer and Processor control. Interrupts: Hardware and software interrupts.

Fundamental of Programming: Program structure for microprocessors, Flowcharts of series, parallel, and controls structures. Assembler Level Programming: Memory space allocation for monitor and user program. Assembly language program using Debug or MASM assembler.

Peripheral Interfacing: Programmed I/O, Memory Mapped I/O, Interrupt Driven I/O, DMA I/O interface, Serial and Parallel communications. Peripheral Devices: DMA controller (Intel 8237), Programmable peripheral interface (Intel 8255), Programmable timer/counter (Intl 8253/8254), Programmable Interrupt Controller (Intel 8259).

Microcontroller: History and features Architecture of 8051 – Special Function Registers (SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming.

Interfacing Microcontroller: 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation - Comparison of Microprocessor, Microcontroller, PIC and ARM processors

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Remember the basic architecture of microprocessors and relation between various internal blocks inside any microprocessor.	H											
CLO2	Solve any mathematical operation to handle with 8086instruction set and ability to utilize it in programming and to interface various I/O or memory devices to the microprocessor.		H										
CLO3	Develop Intel 8086 microprocessor and programming in assembly language to perform machine dependent programming.			H									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods

CLO1	Remember the basic architecture of microprocessors and relation between various internal blocks inside any microprocessor.	P.01.1	C1 C2	K1			CT, SF, CP
CLO2	Solve any mathematical operation to handle with 8086instruction set and ability to utilize it in programming and to interface various I/O or memory devices to the microprocessor.	P.02.1	C4	K1 K2 K3			CT, SF
CLO3	Develop Intel 8086 microprocessor and programming in assembly language to perform machine dependent programming.	P.03.2	C3		P1 P3 P7		CT, SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3, C4
	ASG	5%	CLO4	C3
Semester Final (79%)	SF	70%	CLO1,2,3	C1, C2, C3, C4
Total Marks		100%		

Course Plan

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Introduction to microprocessor and its applications.	1	CT1 CP SF	L D SDL
	L2	Microprocessor evolution tree.	2		
	L3	Microprocessor architecture (Harvard & Princeton).	1		
W2	L4	General architecture of the microprocessor and its operations.	1,2		
	L5	Component of microprocessor system: inputs-outputs (I/Os)	2		
	L6	Processor, buses, memory other interfacing devices.	2		
W3	L7	Intel 8085 microprocessor: pin diagram.	2		
	L8	Internal architecture: ALU, registers, timing and control unit.	3		
	L9	Interrupt, instruction set of 8085: instruction format, op-codes, mnemonics, no. of bytes computation of the instruction.	1		

W4	L10	Machine cycles and Tstates and execution time computation of an instruction.	1,2		
	L11	Classification of instruction with their examples.	2,3		
	L12	Writing of assembly language programs.	3		
W5	L13	Architecture of intel 8086: pin diagram, bus interface unit, execution unit.	3	CT2 CP SF	L D SDL
	L14	Register organization, memory addressing, memory segmentation, pipelining.	2,3		
	L15	Min & max operating modes 8086 instruction set.	2		
W6	L16	Addressing modes, instruction set groups: data transfer, arithmetic, logic.	1		
	L17	String, branch control transfer and processor control.	2		
	L18	Interrupts: hardware and software interrupts.	2		
W7	L19	Program structure for microprocessors, flowcharts of series, parallel.	2		
	L20	Controls structures of microprocessors.	2		
	L21	Assembler level programming.	3		
Mid Break					
W8	L22	Memory space allocation for monitor and user program.	1,2	CT3 CP SF	L D SDL
	L23	Assembly language program using debug or MASM assembler.	2		
	L24	Programmed I/O, memory mapped I/O.	3		
W9	L25	Interrupt driven I/O, DMA I/O interface.	2		
	L26	Serial and parallel communications. peripheral devices.	3		
	L 27	DMA controller (Intel 8237).	3		
W10	L 28	Programmable peripheral interface (Intel 8255),	1,2		
	L 29	programmable timer/counter.	1,2		
	L 30	(Intl 8253/8254), programmable interrupt controller (Intel 8259).	2		
W11	L 31	History and features architecture of 8051 – special function registers (SFRs)	2	ASG SF	L D SDL
	L 32	I/O Pins ports and circuits - instruction set - addressing modes.	2		
	L 33	Assembly language programming.	1		
W12	L 34	8051 timers - serial port programming - interrupts programming.	2		
	L 35	LCD & keyboard interfacing.	1		
	L 36	ADC, DAC & sensor interfacing.	3,4		
W13	L 37	External memory interface- stepper motor.	2	CP SF	L D SDL
	L 38	Waveform generation.	1,2		
	L 39	Comparison of microprocessor.	3,4		
W14	L 40	Microcontroller.	1		
	L 41	PIC of microcontroller.	1,2		
	L 42	ARM processors.	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. The Intel Microprocessors, Pearson, Barry B. Brey.
2. Microprocessor and Interfacing Programming and Hardware, McGraw Hill, Douglas V Hall.
3.Microprocessors and Microcomputer-Based System Design by Mohammed Rafiquzzaman.
4. Microprocessors Architecture, Programming and Applications, Penram International Publishing Pvt., R. Gaonkar.
5 Programming and customizing 8051 microcontrollers by Myke Predka.

3.6.4 ICE 3214: Microprocessor and Microcontroller Lab

Course Information

Course Code Course Title	: ICE 3214 : Microprocessor and Microcontroller Lab	Credit Hours Contact Hour	: 1.50 : 3.0

Pre-Requisite

None

Rationale

To learn and familiarize the basics of how computer works, its language and interfacing between different parts of the memory of the microprocessor. The student also can learn about the microcontroller.

Objective

1. To understand basic architecture of microprocessors and interfacing by programming languages to control the operation of microprocessors.
2. To become skilled at designing embedded systems and simplifying traditional manual process controls with programmable devices.
3. To be able to learn about microcontroller with associated devices.
4. Design and interfacing of microcontroller-based embedded systems.

Course Contents

Practical System orientation on basis of the course ICE 3213: Intel 8086 microprocessor: architecture, addressing modes, instruction sets, assembly language programming, system design and interrupt. Interfacing: programmable peripheral interface, programmable timer, serial communication interface, programmable interrupt controller, direct memory access, keyboard, display device and other I/O device interface. Interfacing of microcontroller with microprocessor.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Design the basic components inside Intel 8086 microprocessor and relation between various internal blocks inside any microprocessor.			H									
CLO2	Select and Apply appropriate techniques to solve complex engineering problems using modern engineering tools considering the limitations using 8086 microprocessor.					H							
CLO3	Demonstrate individual skills in solving multi-disciplinary problems using microcontroller and microprocessor.									M			
CLO4	Apply engineering management principles and economic decision making to solve engineering projects as a team by using microcontroller and microprocessor											H	

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Design the basic components inside Intel 8086 microprocessor and relation between various internal blocks inside any microprocessor.	P.05.2	P4		P1 P4 P5		LP, LT, Q
CLO2	Select and Apply appropriate techniques to solve complex engineering problems using modern engineering tools considering the limitations using 8086 microprocessor.	P.04.2	C4				R, Q
CLO3	Demonstrate individual skills in solving multi-disciplinary problems using microcontroller and microprocessor.	P.09.1	A2				P, Q
CLO4	Apply engineering management principles and economic decision making to solve engineering projects as a team by using microcontroller and microprocessor.	P.11.1	P4				R

*LP = Lab Performance, LT = Lab Test, Q = Quiz, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30
Self-directed learning	
Preparation for lab reports	21
Preparation for lab test	5
Preparation of quiz	5
Engagement in project/Assignment	21
Formal Assessment	
Continuous assessment	-
Final Quiz	1
Lab Test/Project show	1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO1	P4
Report Writing	20%	CLO2	C4
Project	20%	CLO4	A2
Lab Test	30%	CLO1	P4
Quiz	20%	CLO1,2,3	P4, C4, A2
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Study on the familiarization with MDA-8086 microprocessor kit and its operation in "Machine Code" mode
Week 2	Study on the observations of MNEMONIC operations with machine code in MDA-8086 microprocessor kit.
Week 3	Study on how to load the machine codes of a sample program to MDA-8086 then execute it and verify the results.

Week 4	Study on different types of arithmetic and logic operation in assembly language
Week 5	Study on the different jump condition of MDA 8086 microprocessor
Week 6	Review & Practice Lab-1
Week 7	Lab Test-1
Week 8	Study on the bit shifting of seven segment display in MDA 8086 using different conditional instruction**.**
Week 9	Study on row shifting of dot matrix display using MDA 8086 microprocessor.
Week 10	Introduction to Microcontroller.
Week 11	Interfacing with I/O devices (7-segment display).
Week 12	Interfacing with Analog World.
Week 13	Review & Practice Lab-2
Week 14	Lab Test-2

Text and Reference Books

1. Lab Manual
2. The Intel Microprocessors, Pearson Education (US), Barry B. Brey
3. Microprocessor and Interfacing Programming and Hardware, McGraw Hill, Douglas V Hall.
4. Microprocessors and Microcomputer-Based System Design, CRC Press, Mohammed Rafiquzzaman
5. Microprocessors Architecture, Programming and Applications, Pearson College Div, R. Gaonkar.
6. Programming and customizing 8051 microcontroller by Myke Predka,

3.6.5 ICE 3215: Digital Signal Processing

Course Information

Course Code Course Title	: ICE 3215 : Digital Signal Processing	Credit Hours Contact Hour	: 3.0 : 3.0

Pre-Requisite

Course Code: ICE 2113
Course Title: Signals and Systems

Rationale

Digital Signal Processing course is designed to introduce the fundamental concepts of discrete signal processing and their applications in communications, control and instrumentation.

Objective

1. To describe the key theoretical principles underpinning DSP in a design procedure through design examples and case studies.
2. To explain how to use a powerful general-purpose mathematical package such as MATLAB to design and simulate Digital Signal Processing systems.
3. To select and analyze the architecture of a digital signal processor and some programming issues in fixed-point digital signal processor in real-time implementation.
4. To perform real-time signal processing algorithms using the latest fixed -point processor.

Course Contents

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

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

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

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

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

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

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

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Understand the key theoretical principles underpinning DSP in a design procedure through this design examples and case study	H											
CLO2	Evaluate the basic architecture of a digital signal processor and some programming issues in fixed-point digital signal processor in real-time implementation.		H										
CLO3	Analyze and implement signal processing algorithms.			H									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Understand the key theoretical principles underpinning DSP in a design procedure through this design examples and case study.	P.01.1	C2	K3	P1	-	CT, SF,CP
CLO2	Evaluate the basic architecture of a digital signal processor and some	P.02.2	C5	K5	P2	-	CT, SF

	programming issues in fixed-point digital signal processor in real-time implementation.						
CLO3	Analyze and implement signal processing algorithms.	P.03.2	C4	K3	P1	-	CT, SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C2
	CT (1-3)	20%	CLO1,2,3	C2, C5, C4
	ASG	5%	CLO3	C4
Semester Final (70%)	SF	70%	CLO1,2,3	C2, C5, C4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Linearity of System, Classification and properties of signals, Common signals in engineering	1	CT1 CP SF	L D SDL
	L2	Continuous-Time (CT) and Discrete-Time (DT) signal and system	2		
	L3	Quantization, Analog to digital conversion of signal	1		
W2	L4	Impulse Response	1,2		
	L5	Finite Impulse Response (FIR) of Discrete-Time Systems	2		
	L6	Infinite Impulse Response (IIR) of Discrete -Time Systems	2		
W3	L7	Difference Equation	2		
	L8	Convolution	3		
	L9	Correlation, Covariance, Transient and Steady-State Response	1		
W4	L10	Discrete Fourier Transformation (DFT)	1,2		
	L11	Fast Fourier Transformation (FFT)	2,3		
	L12	Fast Fourier Transformation (FFT)	3		
W5	L13	Inverse FFT	3	CT2 CP SF	L D SDL
	L14	Z-Transformation	2,3		
	L15	Z-Transformation	2		
W6	L16	Mathematical Problems of Z-Transformation	1		

	L17	Inverse Z-Transformation	2		
	L18	Mathematical Problems of inverse Z-Transformation	2		
W7	L19	Linear Time-Invariant (LTI) system, Stationarity and Ergodicity	2		
	L20	Frequency and Power Spectrum	2		
	L21	Frequency and Power Spectrum	3		
Mid Break					
W8	L22	Origins, properties and suitable models of popular bio signals	1,2	CT3 CP SF	L D SDL
	L23	Objectives and challenges of Bio signal Analysis	2		
	L24	Steps of Bio signal Processing	3		
W9	L25	Noise Mode	2		
	L26	Averaging filters	3		
	L 27	Averaging filters	3		
W10	L 28	Design and principles of Wiener Filter	1,2		
	L 29	Design and principles of Wiener Filter	1,2		
	L 30	FIR filters	2		
W11	L 31	FIR filters	2	ASG SF	L D SDL
	L 32	Fundamental Design of Window-based FIR filter	2		
	L 33	Fundamental Design of Window-based FIR filter	1		
W12	L 34	IIR Filter design	2		
	L 35	IIR Filter design	1		
	L 36	Applications of IIR Filters in Biosignals	3		
W13	L 37	Spectral analysis of ECG and EEG signals	2	CP SF	L D SDL
	L 38	Spectral analysis of ECG and EEG signals	1,2		
	L 39	Case study on ECG and EMG signals	3		
W14	L 40	Case study on ECG and EMG signals	1		
	L 41	Introduction to Feature Extractions and Classification	1,2		
	L 42	Summary, Review and Open discussion	1-3		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1.Digital Signal Processing, PEARSON INDIA, John G. Proakis & Dimitris Manolakis

2. Discrete-Time Signal processing - Allan Oppenheim & Ronald Schafer

3. Digital Signal Processing-A practical approach, Prentice Hall, Emmanuel C. Ifeachor Barrie W. Jervis

4. Signals and Systems, Pearson, Rodger Ziemer & William Tranter

3.6.6 ICE 3216: Digital Signal Processing Lab

Course Information			
Course Code	: ICE 3216	Credit Hours	: 0.75
Course Title	: Digital Signal Processing Laboratory	Contact Hour	: 1.50

Pre-Requisite

Course Code: 2114
Course Title: Signals and Systems Lab

Rationale

The Digital Signal Processing Sessional course is designed to assist better understanding of dealing with signals and processing signals for getting desired output, removing noise associate with signals.

Objective

1. To design, simulate and implement digital signal processing systems in MATLAB
2. To use practical knowledge to design and implement a real-time signal processing algorithms using the latest fixed-point processor.

Course Contents

Speech, image & data processing algorithms; Sampling continuous time signals; Z-transform, Inverse Z-transform, Frequency domain representation, Fourier series and Fourier Transform; Equivalent noise definition of bandwidth; Convolution, Correlation and method of numerical 281 integration; Computation of the DFT: Goertzel FFT, Chirp Z-transform algorithms. Two-dimensional filter design.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Develop a good understanding of the fundamental issues and challenges of DSP: data, model selection, model complexity, etc.		H										
CLO2	Evaluate the strengths and weaknesses of many popular DSP approaches.					H							
CLO3	Appreciate the underlying mathematical relationships within and across DSP algorithms.				M								
CLO4	Design and implement various DSP algorithms in a range of real-world applications.			H									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Develop a good understanding of the fundamental issues and challenges of DSP: data, model selection, model complexity, etc.	P.02.2	C4		P1 P4 P5		LP, Q
CLO2	Evaluate the strengths and weaknesses of many popular DSP approaches.	P.05.2	P4		P1 P4 P5		LT
CLO3	Appreciate the underlying mathematical relationships within and across DSP algorithms.	P.02.1	C4	K1 K2 K3	P1 P2 P6		P,R, Q
CLO4	Design and implement various DSP algorithms in a range of real-world applications.	P.03.1	C2	K5	P1 P3 P7		LT,Q

*LP = Lab Performance, LT = Lab Test, Q = Quiz, R=Report, P= Project EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	4
Experiment	20
Self-directed learning	
Preparation for lab reports	10
Preparation for lab test	4
Preparation of quiz	4
Engagement in group project	-
Formal Assessment	
Continuous assessment	-
Final Quiz	1
	1
Total	45

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO1	C4
Lab Test	20%	CLO2	P4
Project /Group Presentation	20%	CLO3	C4
Quiz	30%	CLO1	C4
Lab Reprt	20%	CLO1,2,3	C4, P4
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Discrete time signals Sequences
Week 2	
Week 3	Linear Constant Coefficient difference equation, Sampling continuous time signals
Week 4	
Week 5	Two dimensional sequences and systems, Z-transform, Inverse Z-transform, H-transform
Week 6	Review & Practice Lab-1
Week 7	Lab Test-1
Week 8	Frequency domain representation, Discrete time systems and signals, Fourier series and Fourier Transform
Week 9	
Week 10	Parseval's Theorem, Equivalent Bandwidth, Noise Convolution
Week 11	Correlation, Numerical integration, Computation of the DFT
Week 12	Correlation, Numerical integration, Computation of the DFT
Week 13	Review & Practice Lab-2
Week 14	Lab Test-2

Text and Reference Books

1.Digital Signal Processing, PEARSON INDIA, John G. Proakis & Dimitris Manolakis

2. Discrete-Time Signal processing - Allan Oppenheim & Ronald Schafer

3. Digital Signal Processing-A practical approach, Prentice Hall, Emmanuel C. Ifeachor Barrie W. Jervis

4. Signals and Systems, Pearson, Rodger Ziemer & William Tranter

3.6.7 ICE 3217: Computer Networking

Course Information			
Course Code Course Title	: ICE 3217 : Computer Networking	Credit Hours Contact Hour	: 3.0 : 3.0

Pre-Requisite:

None

Rationale

To learn and familiarize the basic data communication model, layer architecture, protocols and fundamentals on computer network. To apply extensive knowledge on principles of computer networks and protocols to solve various engineering problems. Finally, this course is designed to develop a designing capability involving real life practical problems in computer networks.

Objective

1. To know and understand how computer networks are organized with the concept of layered approach.
2. To be able to describe how packets in the Internet are delivered and Internet structure.
3. To design practical, complex data communication system and computer network
4. To apply extensive knowledge on principles of computer networks and protocols to solve various engineering problems.

Course Contents

Introduction: Computer networks, Types of Computer networks, Network Topology, network edge, links, Circuit Switching and Packet Switching, Performance: loss, delay, throughput in networks,
protocol and protocol hierarchies, The OSI reference model, TCP/IP protocol suit, Networks under attack: security.

Application Layer: Principles of network applications, Client-Server Model, Domain Name System (DNS), Electronic mail (SMTP) and File Transfer (FTP), HTTP and WWW, P2P architecture.

Transport layer: Transport-layer services, Multiplexing and demultiplexing, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Congestion control and Quality of service, Performance issues.

Network layer: Two key network-layer functions, Interplay between routing and forwarding, Network layer design issues, Virtual circuit and datagram networks, what's inside a router, IP, IP addresses, Routing algorithms, Congestion control algorithms, Internetworking, Network layer protocols; ARP, IPv4, ICMP, IPv6, Routing protocols; RIP, OSPF and BGP, Broadcast and multicast routing.

Data Link Layer: Data link layer design issues, Error detection and correction, Elementary data link protocols, sliding window protocols, Protocol specification and verification, HDLC. Medium Access Sub-layer: Channel allocation problem, multiple access protocols (MAC), IEEE standards for LANs and MANs, Bridges, and High Speed LANs, ATM and Frame Relay.

Physical Layer: The theoretical basis for data communication, attenuation and distortion, signal types, bandwidth, propagation delay, public carrier circuits, modulation, encoding, multiplexing, physical layer interfacing standards. Transmission media wired and wireless, Narrowband ISDN, Broadband ISDN and ATM. transmission modes, asynchronous and synchronous transmission, bit - character and frame synchronization.

Networks security: DoS attacks, DDoS attacks, IP Spoofing, IP Sniffing etc.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Define, understand and describe how computer networks are organized with the concept of layered approach and how packets in the Internet are delivered and Internet structure.	H											

CLO2	Apply extensive knowledge on principles of computer networks and protocols to solve various engineering problems.	H											
CLO3	**Design** practical, complex data communication system and computer network.			H									
CLO4	**Design solution** for complex engineering problem in accordance with professional practices.						M						

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Define, understand and describe how computer networks are organized with the concept of layered approach and how packets in the Internet are delivered and Internet structure.	P.01.1	C3	K1			CT, SF, CP
CLO2	**Apply** extensive knowledge on principles of computer networks and protocols to solve various engineering problems.	P.01.4	C3	K4			CT, SF
CLO3	**Design** practical, complex data communication system and computer network.	P.03.3	C6	K5			CT, SF
CLO4	**Design solution** for complex engineering problem in accordance with professional practices.	P.06.2	C5	K7	P1 P3 P7		ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
	CP	5%	CLO1	C1, C2
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3, C6

Continuous Assessment (30%)	ASG	5%	CLO4	C6
Semester Final (79%)	SF	70%	CLO1,2,3,4	C1, C2, C3, C6
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Chapter 1:Introduction Define Computer networks, Internet, Types of Computer networks, Network Topology.	1	CT1 CP SF	L D SDL
	L2	Chapter 1:Introduction Define protocol, network edge, links	2		
	L3	Chapter 1:Introduction Network core, Packet switching, circuit switching	1		
W2	L4	Chapter 1:Introduction Performance: loss, delay, throughput in networks	1,2		
	L5	Chapter 1:Introduction Protocol and protocol hierarchies, The OSI reference model, TCP/IP protocol suits.	2		
	L6	Chapter 1:Introduction Networks under attack: security	2		
W3	L7	Chapter 2: Application Layer Principles of network applications	2		
	L8	Chapter 2: Application Layer Web and HTTP	2		
	L9	Chapter 2: Application Layer FTP	1		
W4	L10	Chapter 2: Application Layer Electronic mail (SMTP, POP3, IMAP)	1,2		
	L11	Chapter 2: Application Layer DNS	2		
	L12	Chapter 2: Application Layer P2P applications, Socket programming with UDP and TCP	2,3		
W5	L13	Chapter 3: Transport Layer Transport-layer services	1	CT2 CP SF	L D SDL
	L14	Chapter 3: Transport Layer Multiplexing and demultiplexing	2		
	L15	Chapter 3: Transport Layer Connectionless transport: UDP	2		
W6	L16	Chapter 3: Transport Layer Principles of reliable data transfer	1		
	L17	Chapter 3: Transport Layer Connection-oriented transport: TCP	2		
	L18	Chapter 3: Transport Layer Principles of congestion control, TCP congestion control	2		
W7	L19	Chapter 4: Network layer	2		

		Introduction, Two key network-layer functions, Interplay between routing and forwarding.			
	L20	Chapter 4: Network layer Virtual circuit and datagram networks, what's inside a router.	2		
	L21	Chapter 4: Network layer IP: Internet Protocol, datagram format	1,2		
Mid Break					
W8	L22	Chapter 4: Network layer IPv4 addressing Classful and CIDR	1,2	CT3 CP ASG SF	L D SDL
	L23	Chapter 4: Network layer IPv4 addressing Subnetting	3,4		
	L24	Chapter 4: Network layer DHCP	2		
W9	L25	Chapter 4: Network layer NAT	2		
	L26	Chapter 4: Network layer IPv6	2		
	L 27	Chapter 4: Network layer Routing algorithms link state	2		
W10	L 28	Chapter 4: Network layer Routing algorithms distance vector, hierarchical	1,2		
	L 29	Chapter 4: Network layer Routing in the Internet RIP, OSPF, BGP	1,2		
	L 30	Chapter 4: Network layer Broadcast and multicast routing	2		
W11	L 31	Chapter 5: Link layer Introduction, services, Error detection, correction	2	SF	L D SDL
	L 32	Chapter 5: Link layer	2		
	L 33	Chapter 5: Link layer Multiple access protocols FDMA, TDMA, Slotted Aloha, Pure Aloha.	1		
W12	L 34	Chapter 5: Link layer Multiple access protocols CSMA, CSMA/CD Taking turns MAC protocols	2		
	L 35	Chapter 5: Link layer MAC addresses and ARP	1		
	L 36	Chapter 5: Link layer Ethernet, Switches	3,4		
W13	L 37	Chapter 5: Link layer VLAN, link virtualization: MPLS data center networking	2	CP SF	L D SDL
	L 38	Chapter 5: Link layer A day in the life of a web request	3		
	L 39	Chapter 6: Physical Layer	1,2		

		The theoretical basis for data communication, attenuation and distortion, signal types, bandwidth, propagation delay			
W14	L 40	Chapter 6: Physical Layer Public carrier circuits, modulation, encoding, multiplexing, physical layer interfacing standards	1,2		
	L 41	Chapter 6: Physical Layer Transmission media wired and wireless, Narrowband ISDN, Broadband ISDN and ATM. transmission modes, asynchronous and synchronous transmission, bit - character and frame synchronization.	1,2		
	L 42	Review class	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Introduction to data communication and networking, Tata McGraw Hill, Behrouz Forouzan.
2. Computer Networks, Prentice Hall PTR, A. S. Tanenbaum.
3. Data and Computer Communications, Prentice-Hall, William Stallings.
4. Data Communication, Computer Networks and Open Systems, Pearson, Halsall F. Addison Wesley.
5. Data &Network Communications, Delmar Cengage Learning, Miller.

3.6.8 ICE 3218: Computer Networking Lab

Course Information

Course Code Course Title	: ICE 3218 : Computer Networking Lab	Credit Hours Contact Hour	: 1.5 : 3.0

Pre-Requisite:

None

Rationale

This course is designed to focus of this unit is to design and develop computer networks based on programming different networking protocols, and involves three different stages, including, programming basic network protocols, development of distributed applications based on programming network protocols, and design of specialized network programming strategies for developing computer networks with enhanced security, scalability, and optimal performance.

Objective

1. To **grasp** the elementary idea of computer networks and message transmission over a computer network.
2. To **understand** the working principle of various communication protocols in computer networks.
3. To **analyze** the various routing algorithms in computer networks;
4. **To design** and develop practical, complex data communication system and computer network
5. To **program** different network programming tools, network monitoring, tracking and analyzing in computer networks.

Course Contents

In this course, students will perform experiments to practically verify the theories and concepts that learned about Computer Networks, Network Hardware's and Software's, Network Cabling, understanding use of IP Addressing, Variable Length Subnet Mask (VLSM), Practicing LAN topologies, Basic Configuration of Cisco Packet Tracer, Network Interface Connection/ Router & Switch Configuration, Basic Network Configuration using RIP, EIGRP, BGP, OSPF protocols. Remotely access networking devices using Telnet & SSH. Configure Domain Name System (DNS), Dynamic Host Configuration Protocol (DHCP). Configuration of Network Address Translator (NAT). Configuring a Simple Firewall.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	**Apply** extensive knowledge on principles of computer networks to solve various engineering problems.	H											
CLO2	**Identify and analyze** user requirements so as to utilize them in computer networks.		H										
CLO3	**Design and develop** practical, complex data communication system and networks considering societal issues.			H									
CLO4	**Design** solution for complex engineering problem in accordance with professional practices.						H						

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	**Apply** extensive knowledge on principles of computer networks to solve various engineering problems.	P.01.4	C3	K1			LP, LT, Q
CLO2	**Identify and analyze** user requirements so as to utilize them in computer networks.	P.02.3	C4	K4			R
CLO3	**Design and develop** practical, complex data communication system and networks considering societal issues.	P.03.3	C6	K5			P, Q
CLO4	**Design** solution for complex engineering problem in accordance with professional practices.	P.06.2	C6	K7	P1 P3 P7		LT

*LP = Lab Performance, LT = Lab Test, Q = Quiz, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30

Self-directed learning Preparation for lab reports Preparation for lab test Preparation of quiz Engagement in project/Assignment	21 5 5 21
Formal Assessment Continuous assessment Final Quiz Lab Test/Project show	 - 1 1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	20%	CLO1	P4
Report Writing	20%	CLO2	C4
Lab Test	30%	CLO3,4	C6
Quiz	20%	CLO1,2,3	C6, C4, C1
Viva	10%	CLO1,2	C1,C3,C4
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Familiarize with cisco packet tracer to create a network.
Week 2	Analyze classful IPV4 addressing for creating any computer network in cisco packet tracer.
Week 3	Analyze classless IPV4 addressing for creating any computer network in cisco packet tracer.
Week 4	Create a network using cisco (LAN, MAN, WAN).
Week 5	Configure dynamic routing protocol RIP in a network.
Week 6	Configure dynamic routing protocol OSPF.
Week 7	Access remotely networking devices using Telnet.
Week 8	Access remotely networking devices using SSH.
Week 9	Allocate IP addresses to the devices dynamically using DHCP.
Week 10	Configure Network address translator (NAT).
Week 11	Configure of DNS (Domain Name System) server.
Week 12	Configure a Simple Firewall.
Week 13	Review & Practice Lab
Week 14	Lab Test & Quiz

Text and Reference Books

1. Introduction to data communication and networking, Tata McGraw Hill, Behrouz Forouzan.
2. Computer Networks, Prentice Hall PTR, A. S. Tanenbaum.
3. Data and Computer Communications, Prentice-Hall, William Stallings.
4. Data Communication, Computer Networks and Open Systems, Pearson, Halsall F. Addison Wesley.
5. Data &Network Communications, Delmar Cengage Learning, Miller.

3.6.9 ICE 3220: Mobile Application Development Lab

Course Information

Course Code	: ICE 3220	Credit Hours	: 1.5
Course Title	: Mobile Application Development Lab	Contact Hour	: 3.0

Pre-Requisite

Course Code: ICE 3114
Course Title: Java Programming Lab

Rationale

The mobile application development sessional needs to implement rich android applications for the android mobile platform. Student will build the code, compile, execute, and debug mobile applications using the Java for android programming language and android studio to develop programs using advanced programming concepts.

Objective

1. To develop mobile app for mobile devices, such as personal digital assistants, enterprise digital assistants or mobile phones.
2. To develop programming Skills based on Java programming language with application.
3. To create application software step by step for different platforms and versions.

Course Contents

This course covers introductory mobile application development for the Android Operating System using XML and Java. It also includes developing simple applications that could run on Android phones and tablets. It also covers Android application development phases, terminologies, application design, and coding.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Use engineering tools for modeling of complex engineering problems using android features Understanding anatomy of an Android application.					H							
CLO2	Design solution for complex engineering problem in accordance with professional practices by applying java for android apps.						H						
CLO3	Displays good interpersonal skills as a member/leader in solving real life problem by an android based project work.									H			

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Use engineering tools for modeling of complex engineering problems using android features Understanding anatomy of an Android application	P.05.2	P4		P1, P4, P5		LP, LT, Q
CLO2	Design solution for complex engineering problem in accordance with professional practices by applying java for android apps.	P.06.2	C5	K7	P1, P3, P7		R, Q
CLO3	Displays good interpersonal skills as a member/leader in solving real life	P.09.2	A2				Project work

	problem by an android based project work.						

*LP = Lab Performance, LT = Lab Test, Q = Quiz, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30
Self-directed learning	
Preparation for lab reports	21
Preparation for lab test	5
Preparation of quiz	5
Engagement in project/Assignment	21
Formal Assessment	
Continuous assessment	-
Final Quiz	1
Lab Test/Project show	1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO1	P4
Report Writing	20%	CLO2	C5
Project	20%	CLO3	A2
Lab Test	30%	CLO1	P4
Quiz	20%	CLO1,2,3	P4, C5, A2
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Exploring android studio with necessary setup
Week 2	Designing Layouts with necessary setup
Week 3	Experiment 1: Coding in Java Part 1 – Variables, Decisions and Loops
Week 4	Experiment 2: Coding in Java Part 2 – Methods
Week 5	Experiment 3: Java Classes: exploring the core of Object-Oriented Programming
Week 6	Experiment 4: Handling and Displaying Arrays of Data
Week 7	Experiment 5: Exploring Widgets to utilize it in android apps
Week 8	Lab Practice
Week 9	Lab Exam
Week 10	**Project:** Developing a java program to initiate a Dialogue with the User: Part-1
Week 11	**Project:** Developing a java program to initiate a Dialogue with the User: Part-2
Week 12	**Project:** Developing a java program to initiate a Dialogue with the User: Part-3
Week 13	Project Presentation
Week 14	Quiz and Viva

Text and Reference Books

1. Head First Android Development 2e: A Brain-Friendly Guide by Dawn Griffiths, David Griffiths
2. Android Programming for Beginners, Packt Publishing, John Horton
3. Android Recipes, A Problem Solution approach, Apress, Dave Smith, Erik Hellman

3.6.10 ICE 3200: Industrial Training

Course Information

Course Code Course Title	: ICE 3200 : Industrial Training	Credit Hours Contact Hour	: 1 : 2

Pre-Requisite

None

Rationale

To provide comprehensive learning platform to students where they can enhance their employability skills and become job ready along with real corporate exposure.

Objective

1. To provide students the opportunity to test their interest in a particular career before permanent commitments are made.
2. To develop skills in the application of theory to practical work situations.
3. To develop skills and techniques directly applicable to their careers which will increase a student's sense of responsibility and good work habits.
4. To expose students to real work environment experience, gain knowledge in writing report in technical works/projects.
5. Internship students will have higher levels of academic performance.
6. Internship programs will increase student earning potential upon graduation.
7. To build the strength, teamwork spirit and self-confidence in students' life.
8. To enhance the ability to improve students' creativity skills and sharing ideas.
9. To build a good communication skill with group of workers and learn proper behavior of corporate life in industrial sector.
10. The student will be able instilled with good moral values such as responsibility, commitment and trustworthy during their training.

Course Contents

Four weeks training in an assigned company or industry on any one of the Trending technologies according to the industry standards. This is done by making students work on live projects which equip them with the required skill needed for the corporate world. This is obligatory for the completion of B.Sc. course. An evaluation report is to be submitted at the end of the training.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Apply engineering fundamental knowledge and concepts to adopt with industrial and modern technology.	H											
CLO2	Practice good professional ethics and commitment to professional responsibilities.								H				
CLO3	Perform effective oral presentation on complex engineering activities.										H		

CLO4	Produces written engineering reports by applying principle based approaches and design documentation on complex engineering activities for different stake holders.										H		
CLO5	Recognizing the need for continuing education and participation in the broadest context of technological change.												M

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Apply engineering fundamental knowledge and concepts to adopt with industrial and modern technology.	P.01.3	C3	K3			O
CLO2	Practice good professional ethics and commitment to professional responsibilities.	P.08.1	A5				O
CLO3	Perform effective oral presentation on complex engineering activities.	**P.10.3**	A2				OP
CLO4	Produces written engineering reports by applying principle-based approaches and design documentation on complex engineering activities for different stake holders.	P.10.2	P3			A1, A5	RW
CLO5	Recognizing the need for continuing education and participation in the broadest context of technological change.	P.12.3	A5				RW

*O = Observation, OP = Oral Presentation, RW= Report Writing, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	20
Practical/Tutorial/Studio	20
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	20
Report Writing	10
Preparation for Preparations	7
Formal Assessment	
Continuous Assessment	2
Oral Presentation	1
Total	80

Assessment Strategy (AS)

Assessment Method	Marks in %
Observation	20
Observation	20
Oral Presentation	20
Report Writing	20
Report Writing	20
Total:	**100**

3.7 Course Outline of 4th Year, 1st Semester

3.7.1 ICE 4000: Final Year Design Project/ Thesis

Course Information

Course Code	: ICE 4000	Credit Hours	: 2
Course Title	: Final Year Design Project/ Thesis	Contact Hour	: 4

Pre-Requisite

None

Rationale

To provide comprehensive learning platform to students where they can enhance their complex engineering problem solving skills by research or project works.

Objective

1. To learn more in-depth knowledge of the major subject/field of study, including deeper insight into current research and development work.
2. To contribute to research and development work.
3. To use a holistic view to critically, independently, and creatively identify, formulate and deal with complex issues.
4. To plan and use adequate methods to conduct qualified tasks in given frameworks and to evaluate this work.
5. To create, analyze and critically evaluate different technical/architectural solutions.
6. To critically and systematically integrate knowledge.

Course Contents

Student will be required to undertake a suitable Final Year Design project or Thesis individually or in a group of maximum three students during 4th year (1st and 2nd Semester or Summer & Fall Semester) in consultation with the Head of the Department and the faculty guide (or Supervisor) and submit the project or thesis at the end of 4th year 2nd semester on dates announced by the department.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Research literature and Critically evaluates the limitation of existing solution methods using specialized engineering knowledge.		H										
CLO2	Investigate and gather information on a given engineering issue.												H
CLO3	Demonstrate competency in completing individual engineering research or project based on relevant management and economic principles.											M	
CLO4	Develop solution for different components of complex engineering problem.			M									
CLO5	Analysis and interpretation of collected data to provide valid conclusion acknowledging the limitations.			H									

CLO6	Perform effective oral presentation on complex engineering activities.									H		
CLO7	Practice good professional ethics and commitment to professional responsibilities?								H				

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Research literature and critically evaluates the limitation of existing solution methods using specialized engineering knowledge.	P.02.4	C5	K4			RW
CLO2	Investigate and gather information on a given engineering issue.	P.12.1	A1				RW
CLO3	Demonstrate competency in completing individual engineering research or project based on relevant management and economic principles.	P.11.3	A5				RW
CLO4	Develop solution for different components of complex engineering problem.	P.03.2	C3		P1 P3 P7		RW
CLO5	Analysis and interpretation of collected data to provide valid conclusion acknowledging the limitations.	P.04.2	C4				RW
CLO6	Perform effective oral presentation on complex engineering activities.	P.10.3	A2			A2 A4	FD
CLO7	Practice good professional ethics and commitment to professional responsibilities?	P.08.1	A5				CA

*RW= Report Writing, FD = Final Defense Final, CA = Continuous Assessment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Practical/Tutorial/Studio	48
Self-Directed Learning	
Project design and background research work under the supervision of supervisor	48
Project work/Simulation practice at Lab	48
Preparation of report and presentation and demonstration	11
Formal Assessment	
Demonstration	-
Presentation	3
Total	**160**

Assessment Strategy (AS)

Method	Assessment	CLOs	Percentage
Report Writing (50%)	Research literature	CLO1	10
	Critical analysis of data	CLO2	10

	collected by literature review		
	Investigation on methodology	CLO3	10
	Project/Research management and finance	CLO4	10
	Result and discussion on CEP	CLO5	10
Presentation	Final Defense	CLO6	30
Responsibility & Report Writing Ethics	Continuous Assessment/Pre Defense	CLO7	10
	Turnitin Report		10
	Total:		100

3.7.2 ICE 4111: Artificial Intelligence and Neural Computing

Course Information

Course Code Course Title	: ICE 4111 : Artificial Intelligence and Neural Computing	Credit Hours Contact Hour	: 3.0 : 3.0

Pre-Requisite

None

Rationale

To learn and familiarize the basic concept of artificial intelligence expressed through Knowledge Acquisition and Reasoning processes. and. To teach the students the concepts, principles and working of different learning process of neural networks and other classifiers. Finally, this course is designed to develop a designing capability involving real life practical problems through AI solutions.

Objective

1. To learn the fundamentals of artificial intelligence and network architecture.
2. To study the Knowledge Acquisition and Reasoning techniques.
3. To use the principles of neural networks and learning process.

Course Contents

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

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

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

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

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

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

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

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

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	**Perceive** the basic knowledge as well as Nature and goals of AI with appropriate logic and reasoning.	H											
CLO2	**Analyze** different navigation systems and understand the ins and outs and Formulate solutions.		H										
CLO3	**Understand** the fundamental learning and perception process.	H											
CLO4	**Evaluates** and **Justify** the given **accuracy of existing solution methods** in the domain of analytical reasoning.		H										
CLO5	**Design** probable solutions that meet specified needs using Problem Solving techniques			H									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	**Perceive** the basic knowledge as well as Nature and goals of AI with appropriate logic and reasoning.	P.01.3	C2	K3			CT
CLO2	**Analyze** different navigation systems and understand the ins and outs and Formulate solutions.	P.02.2	C4		P1, P4, P5		ASG
CLO3	**Understand** the fundamental learning and perception process.	P.01.1	C2	K1			CT, SF
CLO4	**Evaluates** and Justify the given accuracy of existing solution methods in the domain of analytical reasoning.	P.02.4	C4	K4			SF
CLO5	**Design** probable solutions that meet specified needs using Problem Solving techniques	P.03.2	C6		P1, P7, P3		CT, SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom‘s Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1
	CT (1-3)	20%	CLO1,3,5	C2, C6
	ASG	5%	CLO2	C4
Semester Final (70%)	SF	70%	CLO4	C5
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Nature and goals of AI, Historical background	1	CT1	L D SDL
	L2	Comparison of conventional and neural computation	3		
	L3	overview of network architectures	1		
W2	L4	learning paradigms	1		
	L5	Knowledge acquisition Fundamentals	1		
	L6	Survey of types of knowledge	1		
W3	L7	Survey of available representation	1		
	L8	Conceptual graph and related problems	1,5		
	L9	Frames, Scripts and related problems	1,5		
W4	L10	cases and particularized knowledge	1,5		
	L11	case-based reasoning and related problems	1,5		
	L12	Derivation of consequences from facts	1,5		
W5	L13	Different characterizations of reasoning	1,5	CT2 CP ASG	L D SDL
	L14	Reasoning with uncertainty	1,5		
	L15	Probabilistic reasoning	1,5		
W6	L16	Use of states and transitions	1,5		
	L17	searching of state spaces	1,5		
	L18	Breath first, Depth-first, and related types of search	2		
W7	L19	Breath first, Depth-first, and related types of search	2		
	L20	Breath first, Depth-first, and related types of search	2		
	L21	Brief revision of propositional and predicate calculus	3		
Mid Break					
W8	L22	Connection of logic with programming,	1	CT3 CP SF	L D SDL
	L23	Forward and backward chaining, Resolution.	1,4		
	L24	Overview of AI Programming Language: Prolog, Visual Prolog, LISP etc.	1		
W9	L25	Game Playing, Natural language processing	2,4		

	L26	Expert system, Genetic algorithm, Robotics and Fuzzy logic	2,4		
	L 27	Definition, Benefit, Human Brain	1		
W10	L 28	Models Of Neuron, Types of Activation Function	1		
	L 29	Network Architectures, Knowledge Representation	1		
	L 30	Artificial Intelligence and Neural Networks	1		
W11	L 31	Error-Correction Learning and related problems	3	ASG SF	L D SDL
	L 32	Memory Based Learning and related problems	3		
	L 33	Hebbian Learning and related problems	3		
W12	L 34	Competitive Learning and related problems	3		
	L 35	Boltzmann Learning and related problems	3		
	L 36	Statistical Learning Theory and related problems	3		
W13	L 37	Perceptron, Perceptron Convergence Theorem	3	CP SF	L D SDL
	L 38	Multilayer Perceptron, Back-Propagation Algorithm	3,5		
	L 39	XOR Problem	3,5		
W14	L 40	Decision Rule, Differentiation, Hessian Matrix	3,5		
	L 41	Generalization, Cross-Validation, Network Prunning Technique, Convolutional Network	3,5		
	L 42	Review class	3,5		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Artificial Intelligence A Modern Approach, Pearson, S. Russel and P. Norving.
2. Neural Networks A Comprehensive Foundation, Prentice Hall, Simon Haykin.
3. Artificial Intelligence, MC GRAW HILL INDIA, E. Ritch and K. Knight.
4. Logical Fundamentals of AI, Morgan Kaufmann, Generserth, Michael R, and Nilsson Nills.

3.7.3 ICE 4112: Artificial Intelligence and Neural Computing Lab

Course Information

Course Code	: ICE 4112	Credit Hours	: 1.5
Course Title	: Artificial Intelligence and Neural Computing Sessional	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

To practically learn and familiarize the basic concept of artificial intelligence in terms of neural networks and other classifiers. After being acquainted with these basic components and parts of classifiers, students will be able to design the necessary models, train the test the performance.

Objective

1. To learn the fundamentals of artificial intelligence and network architecture by using Anaconda IDE with latest Python language.
2. To use the principles of neural networks and learning process.
3. To verify and test the performance of neural networks and other classifiers in solving real life problems.

Course Contents

Artificial intelligence is the most advanced course with a combination of advanced computer algorithms, linear algebra and statistics. This course seeks to incorporate the students with the advanced contents like computer vision, robotics and fuzzy logic. Artificial neural networks and its training and testing methods are also included. In this course, students will perform experiments to practically verify the theories and concepts of basic AI in real life problem solving.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Apply the basic knowledge of learning and reasoning methods with appropriate techniques to solve complex engineering problems					L							
CLO2	Design a neural network to solve real life problems and Recognize the role of engineering in society.						H						
CLO3	Identify the working performance and impact of ANN under training and testing environment and society.							H					
CLO4	Display good interpersonal skills as AI and Data engineer									H			

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Apply the basic knowledge of learning and reasoning methods with appropriate techniques to solve complex engineering problems	P.05.1	C3				Q
CLO2	Design a neural network to solve real life problems and Recognize the role of engineering in society.	P.06.1	A3				Q, R
CLO3	Identify the working performance and impact of ANN under training and testing environment and society.	P.07.2	C5	K7			Q, Project
CLO4	Display good interpersonal skills as AI and Data engineer	P.09.2	A2				LP

*LP = Lab Performance, LT = Lab Test, Q = Quiz, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30

Self-directed learning Preparation for lab reports Preparation for lab test Preparation of quiz Engagement in project/Assignment	21 5 5 21
Formal Assessment Continuous assessment Final Quiz Lab Test/Project show	 - 1 1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO4	A2
Report Writing	20%	CLO2	A3
Project	20%	CLO3	C5
Lab Test	30%	CLO3	C5
Quiz	20%	CLO1,2,3	C3, A3, C5
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Introduction to Virtual Environment and necessary setup
Week 2	Study and Development of python codes to Develop a Simple Neural Network Architecture to Predict An Array of Data
Week 3	Study and Development of python codes to perform Experiments with Dataset: Data Processing and Visualization.
Week 4	Study and Development of python codes to Train neural network from scratch
Week 5	Review & Practice Lab-1
Week 6	Lab Test-1
Week 7	**Project Title:** Predicting Diabetes with Multilayer Perceptrons- Data collection and visualization
Week 8	**Project Title:** Predicting Diabetes with Multilayer Perceptrons- training and testing neural network.
Week 9	**Project Title:** Predicting Lung Cancer with Multilayer Perceptrons- Data collection and visualization
Week 10	**Project Title:** Predicting Lung Cancer with Multilayer Perceptrons- training and testing neural network.
Week 11	**Project Title:** Share price prediction model with Multilayer Perceptrons- Data collection and visualization
Week 12	**Project Title:** Share price prediction model with Multilayer Perceptrons- training and testing neural network.
Week 13	Project Presentation
Week 14	Viva- voce and Quiz Test

Text and Reference Books

1. Artificial Intelligence A Modern Approach, Pearson, S. Russel and P. Norving.
2. Neural Networks A Comprehensive Foundation, Prentice Hall, Simon Haykin.
3. Artificial Intelligence, MC GRAW HILL INDIA, E. Ritch and K. Knight.
4. Logical Fundamentals of AI, Morgan Kaufmann, Generserth, Michael R, and Nilsson Nills.

3.7.4 ICE 4113: Software Engineering

Course Information

Course Code Course Title	: ICE 4113 : Software Engineering	Credit Hours Contact Hour	: 3.0 : 3.0

Pre-Requisite

None

Rationale

The Software Engineering course is designed to provide a general introduction to software engineering and design. This course will introduce the important concepts such as software processes and agile methods, essential software development activities from initial software specification through to system evolution. Apart from these, this course will also introduce the important topics including dependability, security, and project management.

Objective

1. To know the different types software engineering models and approaches with diagram.
1. To understand the process of designing, development, and maintaining software systems.
2. To acquire the skill of software project management.
3. To understand software evolution, testing approaches and quality assurance to ensure high standard/professional software.

Course Contents

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

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

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

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

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

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

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

Software Maintenance and configuration management: Definition; Maintenance Characteristics;

Maintainability; Maintenance tasks; Software configuration management.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Understand and applying the fundamentals of software development process.	H											
CLO2	Analyze the user requirements, and designing different kind of system and architectural models for building software systems.		M										
CLO3	Develop testing mechanisms for assuring software quality including the dependability and availability.			H									
CLO4	Develop the communication skill by presenting topics on software engineering.			M									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Understand and applying the fundamentals of software development process.	P.01.3	C3	K3			CT, SF, CP
CLO2	Analyze the user requirements, and designing different kind of system and architectural models for building software systems.	P.02.2	C4		P1, P4, P5		CT, SF
CLO3	Develop testing mechanisms for assuring software quality including the dependability and availability.	P.03.2	C3	K1	P1 P3		CT, SF
CLO4	Develop the communication skill by presenting topics on software engineering.	P.10.3	C6		P1 P3 P7		ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
	CP	5%	CLO1	**C1, C2,C3**

Continuous Assessment (30%)	CT (1-3)	20%	CLO1,2,3	**C1, C2, C3, C4**
	ASG	5%	CLO4	**C6**
Semester Final (70%)	SF	70%	CLO1,2,3	**C1, C2, C3, C4**
Total Marks		100%		

Course Plan

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Introduction to software engineering	1	CT1 CP SF	L D SDL
	L2	Introduction to software engineering (Contd.)	2		
	L3	Introduction to software engineering (Contd.)	1		
W2	L4	Professional SW development ethics	1,2		
	L5	Professional SW development ethics (Contd.)	2		
	L6	Professional SW development ethics (Contd.)	2		
W3	L7	Software processes	2		
	L8	Software processes (Contd.)	3		
	L9	Software processes (Contd.)	1		
W4	L10	Agile software development	1,2		
	L11	Agile software development (Contd.)	2,3		
	L12	Agile software development (Contd.)	3		
W5	L13	Requirements engineering	3	CT2 CP SF	L D SDL
	L14	Requirements engineering (Contd.)	2,3		
	L15	Requirements engineering (Contd.)	2		
W6	L16	Requirements engineering	1		
	L17	Requirements engineering (Contd.)	2		
	L18	Requirements engineering (Contd.)	2		
W7	L19	System modeling	2		
	L20	System modeling (Contd.)	2		
	L21	System modeling (Contd.)	3		
W8	L22	System modeling	1,2	CT3 CP SF	L D SDL
	L23	System modeling (Contd.)	2		
	L24	System modeling (Contd.)	3		
W9	L25	Architectural design	2		
	L26	Architectural design (Contd.)	3		
	L 27	Architectural design (Contd.)	3		
W10	L 28	Design and implementation	1,2		
	L 29	Design and implementation (Contd.)	1,2		
	L 30	Design and implementation (Contd.)	2		
W11	L 31	Software testing	2	ASG SF	L D SDL
	L 32	Software testing (Contd.)	2		
	L 33	Software testing (Contd.)	1		
W12	L 34	Software quality	2		
	L 35	Software quality (Contd.)	1		
	L 36	Software quality (Contd.)	3,4		
W13	L 37	System dependability and reliability engineering	2	CP SF	L D SDL
	L 38	System dependability and reliability engineering	1,2		
	L 39	(Contd.)	3,4		
W14	L 40	System dependability and reliability engineering	1		
	L 41	(Contd.)	1,2		
	L 42	Introduction to project management	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Software Engineering (10th Edition) by Ian Sommerville
2. Software Engineering – a practitioner ‘s Approach (7th Edition) by Roger S. Pressman
3. Software Engineering: Principles and Practice (3rd Edition) by Hans van Vliet

3.7.5 ICE 4114: Software Engineering Lab

Course Information

Course Code	: ICE 4114	Credit Hours	: 1.5
Course Title	: Software Engineering Lab	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

The Software Engineering Sessional course provides a practical experience on developing innovative solutions for real life problems by applying software engineering fundamentals which involve understanding the applicability of different software process models for different context, performing requirement analysis, designing system architecture as well as system models using unified modelling language, developing prototypes using prototyping tools and evaluating the prototype using test cases.

Objective

1. To learn software engineering fundamentals through a practical approach by having experience on developing software systems for solving real-life problems innovatively.
2. To get familiar with documenting software process model, requirement analysis, system architecture, system models formally for a software system.
3. To get oriented with using prototyping tools to develop prototypes for a software system and evaluating those using test cases.

Course Contents

Concepts of software engineering: different phases of software; Software processes: software process models, process activities; Requirements engineering: functional and non-functional requirements, software requirements document, requirement specification, requirement elicitation and analysis; System modelling: context model, interaction models,; Diagrams: Class diagram, Use case diagram, Activity diagram, Data flow diagram, ER diagram, Object diagram, Prototyping tools: orientation with modern prototyping tools; Architectural design: architectural views and patterns; Design and implementation: object oriented design, design patterns; Software testing an prototype evaluation: development testing, release testing, user testing.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Use modern engineering tools efficiently to design, implement and test software or project.					H							
CLO2	Analysis, design and interpretation of collected data using diagrams to provide valid conclusion acknowledging the limitations.				H								
CLO3	Function as effective team leader/member in solving real life problem by a project work.									H			

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Use modern engineering tools efficiently to design, implement and test software or project.	P.05.2	P4		P1 P4 P5		LP, LT, Q
CLO2	Analysis, design and interpretation of collected data using diagrams to provide valid conclusion acknowledging the limitations.	P.04.2	C4				R, Q
CLO3	Function as effective team leader/member in solving real life problem by a project work.	P.11.1	P4				P, R

*LP = Lab Performance, LT = Lab Test, Q = Quiz, EA = Engineering Activities, WP = Complex Engineering Activities, P=Project, R=Report, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30
Self-directed learning	21
Preparation for lab reports	5
Preparation for lab test	5
Preparation of quiz	21
Engagement in project/Assignment	
Formal Assessment	
Continuous assessment	-
Final Quiz	1
Lab Test/Project show	1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO1	P4
Report Writing	20%	CLO2	C4
Project	20%	CLO3	P4
Lab Test	30%	CLO1	P4
Quiz	20%	CLO1,2,3	P4, C4,
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Familiarize with System Analysis and
Week 2	Software Engineering Sessional equipment.
Week 3	To study requirement analysis and develop
Week 4	Software Requirement Specification Sheet (SRS) for suggested system.
Week 5	To perform the function-oriented diagram:
Week 6	Review & Practice Lab-1
Week 7	Lab Test-1
Week 8	To draw the structural view diagram for the system: Class diagram, object diagram.

Week 9	To draw the behavioral view diagram: State-chart diagram, Activity diagram
Week 10	To draw the behavioral view diagram for the suggested system: Sequence diagram, Collaboration diagram.
Week 11	To perform the relationship diagram: ER Deployment diagram for the system.
Week 12	To perform various testing using the testing tool unit testing, integration testing for a sample code of the suggested system.
Week 13	Review & Practice Lab-2
Week 14	Lab Test-2

Text and Reference Books

1. Software Engineering (10th Edition), Pearson, Ian Sommerville
2. Software Engineering – a practitioner 's Approach (7th Edition), McGraw-Hill Education, Roger S. Pressman
3. Software Engineering: Principles and Practice (3rd Edition), McGraw-Hill Education, Hans van Vliet

3.7.6 ICE 4115: Computer and Cyber Security

Course Information

Course Code	: ICE 4117	Credit Hours	: 3.0
Course Title	: Computer and Cyber Security	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

The Computer Security course is designed to provide a comprehensive understanding to the modern security system in computer science. The course begins with the history and development of security. Then it deals with various security models, cryptography, security attacks and the fundamental security objectives. This course also motivates to gather brief review of computer crimes and causes, internet, strategies, crime prevention, etc.

Objective

1. To understand the development of security, traditional encryption, security attacks and the fundamental security objectives.
2. To determine and analyse the security objectives, attacks, and models, so is able to recognize the security requirements in real-life cases.
3. To protect information from being stolen, compromised or attacked.

Course Contents

Introduction to Security: Security basic, Security approaches, Principles of Security, Types of attack, The Security Environment, Threats, Attackers, Wireless Network Security, Electrical Mail security, IP security and Web security.

Cryptography: Overview, Symmetric cipher, Classical encryption technique, Block cipher and the data encryption standard(DES), Triple DES, Introduction to finite fields, Advanced Encryption Standard, Contemporary Symmetric Ciphers, confidentiality using symmetric encryption public, Key encryption and Hash functions, Public-key Cryptography, RSA algorithm, Key management, Diffie-Hellman key exchange, Other Public Key Cryptosystem, Message Authentication and Hash function, Hash Algorithm, Digital Signatures, Trusted Platform Modules.

Exploiting Software: Buffer Overflow Attacks, Format String Attacks, Dangling Pointers, Null Pointer Dereference Attacks, Integer Overflow Attacks, Command Injection Attacks, Time of Check to Time of Use Attacks.

User Authentication Mechanism: Authentication Basics, Passwords, Authentication tokens, Certificate based & Biometric authentication, Firewall.

Digital Forensics: Digital Data Processing procedure, Digital Evidence Controls, Laws and Ethics, Bangladeshi Evidence Act, Legal Policies, Case Studies.

Cyber Law: Digital Copyrights issues, human rights and data encryption, international cyber law, understanding the Technology of Internet, Scope of Cyber Law.

Law of Digital Contracts: The Essence of Digital Contracts, The system of Digital Signature, The Role and Function of Certifying Authorities, Cyber Space property issues, Information Technology Act, Cyber Crimes and Cyber Laws.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Understand the development of security, traditional encryption, security attacks and the fundamental security objectives.								H				
CLO2	Evaluate the security objectives, attacks, and models, so is able to recognize the security requirements in real-life cases.								H				
CLO3	Analyze the design and implementation issues of a real-life security solution.			H									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Understand the development of security, traditional encryption, security attacks and the fundamental security objectives.	P.08.1	A5				CT, SF, CP
CLO2	Evaluate the security objectives, attacks, and models, so is able to recognize the security requirements in real-life cases.	P.08.2	A4	K7			CT, SF, ASG
CLO3	Analyze the design and implementation issues of a real-life security solution.	P.03.3	C6	K7			CT, SF, ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom ‘s Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	

Revision Assessment Preparations	35 20 20
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	A5
	CT (1-3)	20%	CLO1,2,3	A5, A4, C6
	ASG	5%	CLO2,3	A4, C6
Semester Final (79%)	SF	70%	CLO1,2,3	A5, A4, C6
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	The Security Environment	1	CT1 CP SF	L D SDL
	L2	Types of Attack	2		
	L3	Different Attackers scenarios.	1		
W2	L4	Protection Domains, Access Control Lists	1,2		
	L5	Multilevel Security, Covert Channels	2		
	L6	Security model	2		
W3	L7	Introduction to cipher	2		
	L8	Symmetric cipher	3		
	L9	Classical encryption technique	1		
W4	L10	Block cipher	1,2		
	L11	Data Encryption Standard (DES)	2,3		
	L12	Triple DES	3		
W5	L13	Introduction to finite fields	3	CT2 CP SF	L D SDL
	L14	Advanced Encryption Standard	2,3		
	L15	Contemporary Symmetric Ciphers	2		
W6	L16	Symmetric Encryption	1		
	L17	Key Encryption	2		
	L18	**Hash Functions**	2		
W7	L19	BJT Biasing circuits, BJT as an amplifier, biasing the BJT for discrete circuits	2		
	L20	Public-key Cryptography	2		
	L21	RSA Algorithm	3		
Mid Break					
W8	L22	Key Management	1,2	CT3 CP SF	L D SDL
	L23	Diffie-Hellman key exchange	2		
	L24	Public Key Cryptosystem	3		
W9	L25	Message Authentication and Hash function	2		
	L26	Hash Algorithm	3		
	L 27	Digital Signatures	3		
W10	L 28	Trusted Platform Modules	1,2		
	L 29	Buffer Overflow Attacks	1,2		
	L 30	Trojan Horses, Viruses, Worms, Spyware	2		
W11	L 31	Security Network Security practice	2	ASG SF	
	L 32	Authentication application	2		

	L 33	Wireless Network Security	1		L D SDL
W12	L 34	Electrical Mail security	2		
	L 35	IP security and Web security	1		
	L 36	Research on Security and Case Study	3,4		
W13	L 37	Introduction to Digital Forensic.	2	CP SF	L D SDL
	L 38	Processes of Digital Forensic.	1,2		
	L 39	Digital Data Analysis criteria.	3,4		
W14	L 40	Identification process of cybercriminal.	1		
	L 41	Review class	1,2		
	L 42	Review class	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. The Code Book: The Science of Secrecy from Ancient Egypt to Quantum Cryptography, Anchor, Simon Singh
2. Social Engineering: The Science of Human Hacking, Wiley, Christopher Hadnagy.
3. Practical Malware Analysis, No Starch Press, Michael Sikorski
4. Hacking: The Art Of Exploitation, No Starch Press, Jon Erickson

3.7.7 ICE 41**: Elective-I

Course Information			
Course Code Course Title	: ICE 41** : Elective-I	Credit Hours Contact Hour	: 3.0 : 3.0

3.7.8 ICE 41**: Elective-I Lab

Course Information			
Course Code Course Title	: ICE 41** : Elective-I Lab	Credit Hours Contact Hour	: 1.5 : 3.0

3.7.9 ICE 4100: Seminar

Course Information			
Course Code Course Title	: ICE 4200 : Seminar	Credit Hours Contact Hour	: 1.0 : 2.0

Pre-Requisite

None

Rationale

The mobile application development sessional needs to implement rich android applications for the android mobile platform. Student will build the code, compile, execute, and debug mobile applications using the Java for android programming language and android studio to develop programs using advanced programming concepts.

Objective

1.To study research papers for understanding of a new field, in the absence of a textbook, to summarize and review them.
2.To identify promising new directions of various cutting edge technologies.
3.To impart skills in preparing detailed report describing the project and results.
4.To effectively communicate by making an oral presentation before an evaluation committee.

Course Contents

This course covers the in depth understanding of research and project activities in terms of reviewing different research journals, conference papers, periodicals and providing good feedback in terms of seminar.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	**Develop** skill in preparing detailed report using substantial engineering knowledge in describing the project or thesis.				H								
CLO2	**Communicate** effectively by making an oral presentation before an evaluation committee.										H		
CLO3	**Investigate** and gather information on a given engineering issue.												H

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	**Develop** skill in preparing detailed report using substantial engineering knowledge in describing the project or thesis.	P.04.3	C6		P1, P4, P5		Report writing
CLO2	**Communicate** effectively by making an oral presentation before an evaluation committee.	P.10.3	A2			A2 A4	Oral Presentation
CLO3	Investigate and gather information on a given engineering issue.	P.12.1	A1				Report writing

*EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	-
Self-directed learning Preparation for reports writing Preparation for oral presentation	10 10 30

Engagement **in** Papers review, understanding the context of paper	
Formal Assessment Oral Presentation Report writing	 10 -
Total	60

Assessment Strategy (AS)			
Assessment Tools	**Grading**	**CLO**	**Blooms Taxonomy**
Oral Presentation	50%	CLO2	A2
Report Writing	50%	CLO1,3	C6, A1
Total Marks	100%		

3.8 Course Outline of 4th Year, 2nd Semester

3.8.1 ICE 4000: Final Year Design Project/ Thesis

Course Information			
Course Code Course Title	: ICE 4000 : Final Year Design Project/ Thesis	Credit Hours Contact Hour	: 2 : 4

Pre-Requisite

None

Rationale

To provide comprehensive learning platform to students where they can enhance their complex engineering problem solving skills by research or project works.

Objective

1. To learn more in-depth knowledge of the major subject/field of study, including deeper insight into current research and development work.
2. To contribute to research and development work.
3. To use a holistic view to critically, independently, and creatively identify, formulate and deal with complex issues.
4. To plan and use adequate methods to conduct qualified tasks in given frameworks and to evaluate this work.
5. To create, analyze and critically evaluate different technical/architectural solutions.
6. To critically and systematically integrate knowledge.

Course Contents

Student will be required to undertake a suitable Final Year Design project or Thesis individually or in a group of maximum three students during 4th year (1st and 2nd Semester or Summer & Fall Semester) in consultation with the Head of the Department and the faculty guide (or Supervisor) and submit the project or thesis at the end of 4th year 2nd semester on dates announced by the department.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Research literature and Critically evaluates the limitation of existing solution methods using specialized engineering knowledge.		H										
CLO2	Investigate and gather information on a given engineering issue.												H
CLO3	Demonstrate competency in completing individual engineering research or project based on relevant management and economic principles.											M	
CLO4	Develop solution for different components of complex engineering problem.			M									
CLO5	Analysis and interpretation of collected data to provide valid conclusion acknowledging the limitations.			H									
CLO6	Perform effective oral presentation on complex engineering activities.										H		
CLO7	Practice good professional ethics and commitment to professional responsibilities?								H				

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Research literature and critically evaluates the limitation of existing solution methods using specialized engineering knowledge.	P.02.4	C5	K4			RW
CLO2	Investigate and gather information on a given engineering issue.	P.12.1	A1				RW
CLO3	Demonstrate competency in completing individual engineering research or project based on relevant management and economic principles.	P.11.3	A5				RW
CLO4	Develop solution for different components of complex engineering problem.	P.03.2	C3		P1 P3 P7		RW
CLO5	Analysis and interpretation of collected data to provide valid conclusion acknowledging the limitations.	P.04.2	C4				RW
CLO6	Perform effective oral presentation on complex engineering activities.	P.10.3	A2			A2 A4	FD
CLO7	Practice good professional ethics and commitment to professional responsibilities?	P.08.1	A5				CA

*RW= Report Writing, FD = Final Defense Final, CA = Continuous Assessment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Practical/Tutorial/Studio	48
Self-Directed Learning Project design and background research work under the supervision of supervisor Project work/Simulation practice at Lab Preparation of report and presentation and demonstration	48 48 11
Formal Assessment	

Demonstration Presentation	- 3
Total	**160**

Assessment Strategy (AS)

Method	Assessment	CLOs	Percentage (%)
Report Writing (50%)	Research literature	CLO1	10
	Critical analysis of data collected by literature	CLO2	10
	Investigation on methodology	CLO3	10
	Project/Research management and finance	CLO4	10
	Result and discussion on CEP	CLO5	10
Presentation	Final Defense	CLO6	30
Responsibility & Report Writing Ethics	Continuous Assessment/Pre-Defense	CLO7	10
	Turnitin Report		10
		Total:	100

3.8.2 ICE 4211: VLSI and Nanotechnology

Course Information

Course Code Course Title	: ICE 4211 : VLSI and Nanotechnology	Credit Hours Contact Hour	: 3.0 : 3.0

Pre-Requisite

None

Rationale

To learn about the Nanotechnology and many novel devices and circuit architectures which are totally different from current microelectronics circuits, such as quantum computing, nanowire crossbar circuits, spin electronics, CMOS VLSI technology.

Objective

1. To understand basic of VLSI technology
2. To become skilled at designing of nanotechnology using nano materials
3. To be skilled to differentiate between the two different emerging technologies
4. To learn about the impact in the environment of VLSI and nanotechnology

Course Contents

Introduction to VLSI design: Moore's Law, VLSI Design hierarchy, Different VLSI Design approaches.

MOSFET Logic: Review of MOSFETs: I-V Characteristics of MOS Transistor, NMOS, CMOS, Pass-Transistor Logic, Transmission Gates, Bi-CMOS Logic Circuits, Special CMOS Logics, MOS realization of logic gates and circuits.

Circuit Characterization and Performance Estimation: Switching characteristic (propagation delay and parasitic capacitance estimation), static and dynamic power dissipation estimation.

VLSI Circuit Design Processes: Design rules, stick diagrams, mask layout, Structured design approach, Subsystem Design: Data-path Operations, Addition, Multiplication, Counters, Memory Elements. Scaling of MOS Transistor Dimensions, CMOS Testing principle, Chip level Test

Techniques, VLSI system design using CAD tools and hardware descriptive languages like VHDL, Verilog etc.

Programmable logic Device based Design: Introduction, Architecture, Design Flow of Xilinx; Programmable logic structures: ROM, PLA, PAL, GAL PLD, CPLD, Cell-based, FPGA, and ASIC, Implementation of DSP Algorithms.

Nanotechnology: Introduction to nanotechnology; Potential application; Various aspects of Quantum Dots and Nanoparticles, Nanowires, Carbon Nanotubes, Graphene; Fabrication techniques for nanostructures. Energy at the Nanoscale, Nano thermodynamics, Chemical Interactions at the Nanoscale Natural Nanomaterials Societal Implications of Nanoscience and Nanotechnology

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Apply information and concepts of natural science with the familiarity of issues for learning about VLSI and Nanotechnology	H											
CLO2	Formulate solutions, procedures, and methods to solve complex engineering problems on VLSI technology		H										
CLO3	Design the different components or processes of complex engineering problems for different nanomaterial using nanotechnology			H									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Apply information and concepts of natural science with the familiarity of issues for learning about VLSI and Nanotechnology	P.01.3	C3	K2			CT, SF, CP
CLO2	Formulate solutions, procedures, and methods to solve complex engineering problems on VLSI technology.	P.02.2	C4		P1 P4 P5		CT, SF
CLO3	Design the different components or processes of complex engineering problems for different nanomaterial using nanotechnology	P.03.1	C2		P1 P3 P7		CT, SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom‘s Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	

Revision Assessment Preparations	35 20 20
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C2
	CT (1-3)	20%	CLO1,2,3	C2, C3, C4
	ASG	5%	CLO3	C3
Semester Final (79%)	SF	70%	CLO1,2,3	C2, C3, C4
Total Marks		100%		

Course Plan

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Introduction to VLSI design: Moore's Law.	1	CT1 CP SF	L D SDL
	L2	VLSI Design hierarchy.	2		
	L3	Different VLSI Design approaches.	1		
W2	L4	MOSFET Logic: Review of MOSFETs: I-V.	1,2		
	L5	NMOS, CMOS, Pass-Transistor Logic, Transmission Gates.	2		
	L6	Characteristics of MOS Transistor.	2		
W3	L7	Bi-CMOS Logic Circuits.	2		
	L8	Special CMOS Logics.	3		
	L9	MOS realization of logic gates and circuits.	1		
W4	L10	VLSI Circuit Design Processes: Design rules, stick diagrams.	1,2		
	L11	Mask layout, Structured design approach.	2,3		
	L12	Subsystem Design.	3		
W5	L13	Data-path Operations, Addition, Multiplication.	3	CT2 CP SF	L D SDL
	L14	Counters, Memory Elements.	2,3		
	L15	Scaling of MOS Transistor Dimensions.	2		
W6	L16	CMOS Testing principle.	1		
	L17	Chip level Test Techniques.	2		
	L18	VLSI system design using CAD tools.	2		
W7	L19	Hardware descriptive languages.	2		
	L20	VHDL, Verilog etc.	2		
	L21	Programmable logic Device based Design.	3		
Mid Break					
W8	L22	Introduction, Architecture, Design of PLD.	1,2	CT3 CP	SF L D SDL
	L23	Flow of Xilinx.	2		
	L24	Programmable logic structures.	3		
W9	L25	ROM, PLA, PAL.	2		
	L26	GAL, PLD, CPLD.	3		
	L 27	Cell-based, FPGA.	3		
W10	L 28	ASIC.	1,2		
	L 29	Implementation of DSP Algorithms.	1,2		
	L 30	Nanotechnology: Introduction to nanotechnology.	2		
W11	L 31	Potential application; Various.	2	ASG	SF

	L 32	Aspects of Quantum Dots.	2					
	L 33	Nanoparticles.	1				L	
W12	L 34	Nanowires, Carbon Nanotubes, Graphene.	2				D	
	L 35	Fabrication techniques for nanostructures.	1				SDL	
	L 36		1					
		Energy at the Nanoscale.	2					
W13	L 37	Chemical Interactions at the Nanoscale.	1,2					
	L 38	Natural Nanomaterials.	3,4				L	
	L 39	Societal Implications of Nanoscience.	1		CP	SF	D	
W14	L 40	Nanotechnology.	1,2				SDL	
	L 41	Nano thermodynamics.	1-4					
	L 42							

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. CMOS VLSI Design: A Circuits and Systems Perspective, 4th edition by H.E. Weste, David Harris, Ayan Banerjee.
2. Basic VLSI Design, Prentice Hall, Douglas A. Pucknell, Kamran Eshraghian.
3. VLSI Design, s k kataria, C P Verma.
4. Sustainable Nanotechnology: Strategies, Products, and Application, Wiley, Govindan Parayil, Yashwant V. Pathak, et al.

3.8.3 ICE 4212: VLSI and Nanotechnology Lab

Course Information			
Course Code Course Title	: ICE 4212 : VLSI and Nanotechnology Lab	Credit Hours Contact Hour	: 1.50 : 3.0

Pre-Requisite

None

Rationale

To learn about the Nanotechnology and many novel devices and circuit architectures which are totally different from current microelectronics circuits, such as quantum computing, nanowire crossbar circuits, spin electronics, CMOS VLSI technology by the simulation of Verilog, desch software etc.

Objective

1. To understand basic of VLSI technology by the use of simulation software
2. To become skilled at designing of nanotechnology using nano materials using simulation software
3. To be skilled to differentiate between the two different emerging technologies
4. To learn about the impact in the environment of VLSI and nanotechnology

Course Contents

Practical System orientation on basis of the course ICE 4211 to learn about the overall VLSI and Nanotechnology

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Design components of different CMOS circuit using the simulation software.			H									
CLO2	Select and Apply appropriate techniques to solve complex engineering problems using modern engineering tools considering the limitations by the use of VERILOG, Desch etc					H							
CLO3	Demonstrate individual skills in solving multi-disciplinary problems using microcontroller and microprocessor.									M			
CLO4	Apply engineering management principles and economic decision making to solve engineering projects as a team by using microcontroller and microprocessor											H	

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Design components of different CMOS circuit using the simulation software.	P.03.2	C3		P1 P3 P7		LP, LT, Q
CLO2	Select and Apply appropriate techniques to solve complex engineering problems using modern engineering tools considering the limitations by the use of VERILOG, Desch etc	P.05.1	C3		P1, P2, P6		R, Q
CLO3	Evaluate sustainability of complex engineering problems considering society and environment considering the impact of nano devices on environment.	P.07.1	C5		P1, P2, P6		P, Q

*LP = Lab Performance, LT = Lab Test, Q = Quiz, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30
Self-directed learning	
Preparation for lab reports	21
Preparation for lab test	5
Preparation of quiz	5
Engagement in project/Assignment	21
Formal Assessment	
Continuous assessment	-
Final Quiz	1

Lab Test/Project show	1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO1	P4
Report Writing	20%	CLO2	C4
Project	20%	CLO4	A2
Lab Test	30%	CLO1	P4
Quiz	20%	CLO1,2,3	P4, C4, A2
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Implement one JK flipflop and test it. Using the JK flip flop, design one D flip flop and test it.
Week 2	Design a 2x1 multiplexer using any modeling style in Verilog. Using this multiplexer, design and simulate 2-input NAND gate
Week 3	Design one half subtractor circuit. Use any modeling style. Using the half subtractor, implement one full subtractor and verify its truth table.
Week 4	Implement one D flipflop and test it. Using the D flip flop, design one T flip flop and test it.
Week 5	Using SPICE (TINA-TI), design a CMOS inverter with Wpmos/Wnmos=3:1. Select Vdd=5V. Extract the voltage transfer characteristics curve. Also plot transient response for an input pulse of 100KHz.
Week 6	Review & Practice Lab-1
Week 7	Lab Test-1
Week 8	Using TINA-TI implement one 3 input CMOS NAND gate and plot it's transient response.
Week 9	Using TINA-TI implement one 3 input CMOS NOR gate and plot it's transient response.
Week 10	Design a digital system to detect 000 non overlapping sequence. Use Mealy type FSM for your design.
Week 11	Design a 4 bit full adder using any modeling style in Verilog
Week 12	Design a 4 bit full subtractor using any modeling style in Verilog
Week 13	Review & Practice Lab-2
Week 14	Lab Test-2

Text and Reference Books

1. Lab Manual.
2. CMOS VLSI Design: A Circuits and Systems Perspective, 4th edition by H.E. Weste, David Harris, Ayan Banerjee.
3. Basic VLSI Design, Prentice Hall, Douglas A. Pucknell, Kamran Eshraghian.
4. VLSI Design, s k kataria, C P Verma.
5. Sustainable Nanotechnology: Strategies, Products, and Application, Wiley, Govindan Parayil, Yashwant V. Pathak, et al.

3.8.4 ICE 4214: Ethical Hacking and System Security Lab

Course Information			
Course Code Course Title	: ICE 4213 : Ethical Hacking and System Security Lab	Credit Hours Contact Hour	: 1.5 : 3.0
Pre-Requisite			

None

Rationale

To teach students the practical aspects of security issues relating to various cyber-physical systems including industrial control systems and those considered critical infrastructure systems. They are able to know how data breaches happen in our daily life and DDoS attack activities.

Objective

1. To practice examining the architecture of a complex system
2. To use methods to identify significant vulnerabilities and threats in physical systems.
3. To apply advanced cybersecurity principles to develop a comprehensive cyber defense program.

Course Contents

Concepts and Principles of Ethical Hacking and System security; Security Breaches and Defenses in CPS; Types of attack and attacker, range of systems; Security of payment gateways: Card security, EMV payment systems, GSM and SIM cards; Wired and WiFi network security; Examples of weak cryptosystems: GSM, WEP; Infrastructure attacks: smart grids; Hardware Trojans and Trustworthy IC design; SQL injection, Cross Site Scripting (XSS).

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Demonstrate knowledge and understanding of the range of cyber physical and software systems which present potential security hazards			H									
CLO2	Understand and recognize instances of the principal attacks on such systems.								H				
CLO3	Take appropriate measures to protect systems from security breaches.								H				

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Demonstrate knowledge and understanding of the range of cyber physical and software systems which present potential security hazards.	P.03.3	C6	K5			LP, LT, Q
CLO2	Understand and recognize instances of the principal attacks on such systems.	P.08.2	A4	K7			LT, R, Q
CLO3	Take appropriate measures to protect systems from security breaches.	P.08.1	A5				P, Q

*LP = Lab Performance, LT = Lab Test, Q = Quiz, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom ‘s Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	

Lecture	6
Experiment	30
Self-directed learning	
Preparation for lab reports	30
Preparation for lab test	6
Preparation of quiz	5
Engagement in group project	30
Formal Assessment	
Continuous assessment	12
Final Quiz	1
Total	120

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO1	C6
Report Writing	20%	CLO2	A4
Project	20%	CLO3	A5
Lab Test	30%	CLO1	C6
Quiz	20%	CLO1,2,3	C6,A4,A5
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Introductory Session on familiarization of basic security issues and cryptography.
Week 2	Concepts and Principles of Cyber and Physical security.
Week 3	Implement Security Breaches and Defenses in CPS (Cyber Physical Systems) -1
Week 4	Implement Security Breaches and Defenses in CPS (Cyber Physical Systems) - 2
Week 5	Identify types of attack and attacker, range of systems and action against the attacker-1
Week 6	Identify types of attack and attacker, range of systems and action against the attacker-1
Week 7	Lab Test-1
Week 8	Use SQL injection attack that can result in unauthorized access to sensitive data, such as passwords, credit card details, or personal user information.
Week 9	Use Cross site scripting (XSS) to inject malicious code into a vulnerable web application.
Week 10	Apply a DDoS attack to a website to identify the website's vulnerabilities.
Week 11	Identify malicious activities in your device and take action against the activities.
Week 12	Analyze digital data to identify cybercriminal footprints while collecting data from other devices.
Week 13	Review & Practice Lab-2
Week 14	Lab Test-2

Text and Reference Books

1. Cyber Security for Cyber Physical Systems - 1st ed. 2018, Springer, Saqib Ali.
2. Industrial Network Security, Second Edition: Securing Critical Infrastructure Networks for Smart Grid,
SCADA, and Other Industrial Control Systems (2nd Edition), Syngress, Eric D. Knapp and Joel Thomas Langill.
3. Social Engineering: The Science of Human Hacking, Wiley, Christopher Hadnagy

3.8.5 ICE 4215: Cellular and Wireless Communication

Course Information

Course Code Course Title	: ICE 4215 : Cellular and Wireless Communication	Credit Hours Contact Hour	: 3.0 : 3.0

Pre-Requisite

None

Rationale

To familiarize the students with the evolution of various wireless standards from first-generation cellular standards through emerging fifth-generation cellular standards and fundamental concepts of mobile cellular communication system. It is targeted to provide a strong understanding to the students about the basic concepts of cellular frequency reuse, the land mobile radio propagation environment, spectrum utilization, radio resource management, diversity combining techniques and multiple access techniques.

Objective

1. To familiarize the students with the basic concepts and evolution of cellular mobile communication system.
2. To develop student's skill to analyze frequency reuse systems for co-channel interferences and modelling the land mobile radio propagation environment.
3. To make them capable to understand spectrum utilization through channel assignment techniques and radio resource management through handoffs.
4. To develop the ability to explain different diversity techniques, multi-carrier modulation techniques and multiple access techniques.

Course Contents

Introduction: Concept, evolution and fundamentals. Analog and digital cellular systems. Cellular Radio System: Frequency reuse, co-channel interference, cell splitting and components.

Mobile radio propagation: Propagation characteristics, models for radio propagation, antenna at cell site and mobile antenna.

Frequency Management and Channel Assignment: Fundamentals, spectrum utilization, fundamentals of channel assignment, fixed channel assignment, non-fixed channel assignment, traffic and channel assignment.

Handoffs and Dropped Calls: Reasons and types, forced handoffs, mobile assisted handoffs and dropped call rate.

Diversity Techniques: Concept of diversity branch and signal paths, carrier to noise and carrier to interference ratio performance. Multi-carrier modulation, Orthogonal FDM (OFDM).

Multiple Access Techniques: FDMA, TDMA, CDMA, MC-CDMA and receiver.

Digital cellular systems: Global system for mobile, time division multiple access and code division multiple access. 3G and 4G wireless system, future wireless communication system, Wi-Fi, Wi-max and other IEEE standards of wireless communication system.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Define, understand and explain the the basic fundamental concepts and evolution of analog & digital cellular systems and co-channel	H											

	interference for spectrally efficient cellular frequency reuse systems.												
CLO2	Analyze the modelling of mobile radio propagation for fixed-to-mobile channels and mobile-to-mobile channels statistical by identifying the statistical characterization of Multipath-fading and polarization.		H										
CLO3	Evaluate cellular radio resource management by exploring different kind of handoffs.		H										
CLO4	Developing capability to categorize different diversity techniques, multi-carrier modulation techniques and multiple access techniques for developing the concepts about TDMA, CDMA, 3G and 4G wireless systems.			H									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Define, understand and explain the the basic fundamental concepts and evolution of analog & digital cellular systems and co-channel interference for spectrally efficient cellular frequency reuse systems.	P.01.1	C1 C2 C3	K1			CT, SF, CP
CLO2	Analyze the modelling of mobile radio propagation for fixed-to-mobile channels and mobile-to-mobile channels statistical by identifying the statistical characterization of Multipath-fading and polarization.	P.02.2	C4				CT, SF
CLO3	Evaluate cellular radio resource management by exploring different kind of handoffs.	P.02.1	C4	K1, K2 K3	P1 P2 P6		CT, SF
CLO4	Developing capability to categorize different diversity techniques, multi-carrier modulation techniques and multiple access techniques for developing the concepts about TDMA, CDMA, 3G and 4G wireless systems.	P.03.3	C6	K5	P1 P3 P7		ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	

Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3, C4
	ASG	5%	CLO4	C6
Semester Final (79%)	SF	70%	CLO1,2,3	C1, C2, C3, C4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Brief History of Wireless Systems and Standards	1	CT1 CP SF	L D SDL
	L2	Evolution of mobile cellular communications systems	2		
	L3	Fundamentals of analog and digital cellular systems. (1)	1		
W2	L4	Fundamentals of analog and digital cellular systems. (2)	1,2		
	L5	Propagation Modeling: Fixed-to-Mobile Channels (1)	2		
	L6	propagation Modeling: Fixed-to-Mobile Channels (2)	2		
W3	L7	Propagation Modeling: Mobile-to-Mobile Channels	2		
	L8	Propagation Modeling: Statistical Characterization of Multipath-Fading Channels	3		
	L9	Propagation Modeling: Statistical Characterization of Multipath-Fading Channels	1		
W4	L10	Propagation Modeling: Polarized Channel Modeling	1,2		
	L11	Propagation Modeling: Shadowing and Path-loss models	2,3		
	L12	Cellular Radio System: Frequency reuse, co-channel interference	3		
W5	L13	Cellular Radio System: Co-channel interference (1)	3	CT2 CP SF	L D SDL
	L14	Cellular Radio System: Co-channel interference (2)	2,3		
	L15	Cellular Radio System: Cell splitting and components.	2		
W6	L16	Modulation: QAM,	1		
	L17	Modulation: QAM,	2		
	L18	Modulation: Orthogonal Modulation and Variants	2		
W7	L19	Orthogonal Frequency Division Multiplexing	2		
	L20	Multi-Antenna Techniques: Diversity Combining (1)	2		
	L21	Multi-Antenna Techniques: Diversity Combining (2)	3		
Mid Break					
W8	L22	Multi-Antenna Techniques: Selective Combining	1,2	CT3 CP SF	L D SDL
	L23	Multiple Access Techniques: FDMA	2		
	L24	Multiple Access Techniques: TDMA	3		
W9	L25	Multiple Access Techniques: CDMA	2		
	L26	Multiple Access Techniques: MC-CDMA	3		
	L 27	Multi-Carrier Techniques	3		
W10	L 28	Orthogonal Frequency Division Multiplexing	1,2		
	L 29	Radio Resource Management	1,2		
	L 30	Handoffs and Dropped Calls: Reasons and types	2		

W11	L 31	Handoffs and Dropped Calls: forced handoffs	2	ASG SF	L D SDL
	L 32	Handoffs and Dropped Calls: mobile assisted handoffs	2		
	L 33	Handoffs and Dropped Calls: dropped call rate.	1		
W12	L 34	Channel Assignment Techniques: Fundamentals	2		
	L 35	Channel Assignment Techniques: spectrum utilization, fundamentals of channel, assignment	1		
	L 36	Channel Assignment Techniques: traffic and channel assignment.	3,4		
W13	L 37	Global system for mobile, time division multiple access and code division multiple, access	2	CP SF	L D SDL
	L 38	3G and 4G wireless system, future wireless communication system,	1,2		
	L 39	Wi-Fi, Wi-max and other IEEE standards of wireless communication system.	3,4		
W14	L 40	Fundamental evaluation of mobile technologies: 2G, 3G and 4G in detail	1		
	L 41	Review class (1)	1-4		
	L 42	Review class (2)	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Wireless communications, T.S Pearson Education, 2003, Rappaport.
2. GSM Architecture: Ericson
3. Mobile Cellular Telecommunication Systems, McGraw-Hill Education, William C.Y Lee.
4. Principles of Mobile Communication, Springer, Gordon L. Stuber.

3.8.6 ICE 4216: Software Testing and Quality Assurance Lab

Course Information			
Course Code Course Title	: ICE 4219 : Software Testing and Quality Assurance Lab	Credit Hours Contact Hour	: 1.5 : 3.0

Pre-Requisite

Course Code: ICE 4114
Course Title: Software Engineering Lab

Rationale

This course is the basic activity aimed at detecting and solving technical issues in the software source code and assessing the overall product usability, performance, security, and compatibility. It has a very narrow focus and is performed by the test engineers in parallel with the development process or at the dedicated testing stage. The course will help to learn how to use available resources to develop software, reduce cost of software and how to maintain quality of software.

Objective

1. To understand software quality: how to define it, analyze it, and measure it.
2. To select the proper analytical tool/technique for a given situation and explore how to analyze
   results.
3. To understand the strengths and weaknesses of different quality assurance techniques, such as software testing, static analysis, code review, and demonstration.
4. To learn to collect, manage, and evaluate quality metrics.
5. To analyze and verify a variety of software properties including, but not limited to functionality, security, reliability, and performance.

6. To gain experience with real quality assurance tools including static analysis tools, software testing frameworks, and software quality measurement tools.

Course Contents

This course will introduce various quality assurance tools and techniques. We will build their quality toolbox not only with useful tools and techniques, but with the knowledge of when those tools should be used, how to evaluate their results, and what assurances they can provide. Specific quality assurance and control areas covered include code/artifact review techniques, software testing, static analysis, and demonstration.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Identify the techniques in testing phase for better quality assurance and software reliability to create, select and apply appropriate techniques, modern engineering concepts and IT tools for software testing	H											
CLO2	Design and develop the bug free software systems using basic concepts of software testing mechanism and implement concepts of object-oriented testing, web testing and regression testing using modern tools.					H							
CLO3	Apply verification, validation activities, static, dynamic testing, debugging tools and techniques and importance of working in teams.									H			

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Identify the techniques in testing phase for better quality assurance and software reliability to create, select and apply appropriate techniques, modern engineering concepts and IT tools for software testing	P.01.3.	C3	K3			LP, LT, Q
CLO2	Design and develop the bug free software systems using basic concepts of software testing mechanism and implement concepts of object-oriented testing, web testing and regression testing using modern tools.	P.05.3	P5	K6	P1 P3 P7		R, Q

CLO3	Apply verification, validation activities, static, dynamic testing, debugging tools and techniques and importance of working in teams.	P.9.2	A2				P, R

*LP = Lab Performance, LT = Lab Test, Q = Quiz, EA = Engineering Activities, WP = Complex Engineering Activities, P=Project, R=Report, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30
Self-directed learning	
Preparation for lab reports	21
Preparation for lab test	5
Preparation of quiz	5
Engagement in project/Assignment	21
Formal Assessment	
Continuous assessment	-
Final Quiz	1
Lab Test/Project show	1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO1	C3
Report Writing	20%	CLO2	P5
Project	20%	CLO3	A2
Lab Test	30%	CLO1	C3
Quiz	20%	CLO1,2,3	P5, C3, A2
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	To determine the nature of roots of a quadratic equations, its input is triple of +ve integers (say x,y,z) and values may be from interval[1,100] the program output may have one of the following:- [Not a Quadratic equations, Real roots, Imaginary roots, Equal roots] Perform BVA.
Week 2	To determine the type of triangle. Its input is triple of +ve integers (say x,y,z) and the values may be from interval[1,100].The program output may be one of the following [Scalene, Isosceles, Equilateral, Not a Triangle].Perform BVA.
Week 3	To perform robust case testing on Problem No. 1.
Week 4	To perform robust case testing on Problem No. 2.
Week 5	To create a test plan document for any application (e.g. Library Management System).
Week 6	Review & Practice Lab-1
Week 7	Lab Test-1
Week 8	Experimental study of Any Testing Tool (Win Runner) for any application (e.g. Library Management System).
Week 9	Experimental study of Any Test Management Tool (QA Complete) for any application (e.g. Library Management System).
Week 10	Experimental study of automate the Test cases using Test Automation tool (using QA

	Complete).
Week 11	To learn how to raise and report Bugs using Bug tracking tool (Bugzilla, Jira using QA.
Week 12	To study of any open-source testing tool (Web Performance Analyzer/O STA)
Week 13	Review & Practice Lab-2
Week 14	Lab Test-2

Text and Reference Books

1. Software Testing and Quality Assurance-Theory and Practice, Wiley-Spektrum, Kshirasagar Naik and Priyadarshi Tripathy
2. Software Quality Assurance, Morgan Kaufmann, Ivan Mistrik, Richard M Soley, Nour Ali, John Grundy, Bedir Tekinerdogan

3.8.7 ICE 42**: Elective-II

Course Information			
Course Code Course Title	: ICE 42** : Elective-III	Credit Hours Contact Hour	: 3.0 : 3.0

3.8.8 BBA 4295: Business Strategy Management

Course Information			
Course Code Course Title	: BBA 4295 : Business Strategy Management	Credit Hours Contact Hour	: 3.00 : 3.00

Pre-Requisite

None

Rationale

This course presents the depth looks of strategic management tasks like developing a strategic vision and mission, setting objectives and crafting strategy to produce desire outcome. The course also examines which kind of strategic decisions are made at which level of management and the major factor that shape a company's strategy. The course is discussed about key factors for competitive success. Moreover, the course focuses on how a company can achieve or defend competitive advantages through its employees and its management of value chain.

Objective

1. To develop the understanding about the basic concepts and analytical tools of strategic management and competitive analysis.
2. To understand the process of crafting and executing the strategy.
3. To develop the ability to think critically and strategically.
4. To describe the core competency theory of strategy.
5. To provide assessing strategic performance of a firm.

Course Contents

Introduction and Overview of Strategic Management: Strategy - Strategy & Strategic Plan - Strategy and Competitors - Strategy and Competitive Advantage - Features of Strategy - Factors to be considered in Selecting Strategy - Winning Strategy and Test of Winning Strategy - Understanding a Company's Strategy – Policy - Strategy vs. Policy.

Strategic Management Process and Company's Direction: Strategic Management - Characteristics of Strategic Management - Five-Phase Managerial Process of Crafting and Executing Strategy - Developing the Company's Strategic Vision and Mission - Setting Objectives - Strategy Crafting, and Strategy Implementation and Executions -Key Elements of a Mission Statement - Strategic Vision vs. Mission -Short-Term Objectives vs. Long-Term Objectives - Financial Objectives vs. Strategic Objectives - Phases of Strategy Crafting - Strategy Making Pyramid/ Hierarchy.

Industry and competitive Analysis: Strategy Analysis - Purpose of Competitive Strategy Analysis - The Five Forces Model of Competition - Driving Forces of Industry's Competitive Structure and Business Environment to Change - Key Success Factors (KSFs) for Competitive Success.

Strategy and Competitive Advantage: Competitive Advantage - Five Generic Competitive Strategies - Low-Cost Leadership Strategy - When a Low Cost Strategy Works Best and Worst - Broad Differentiation Strategies - When a Differentiation Strategy Works Best and Worst - Best-Cost Provider Strategies - Focused Low-Cost Strategies - Focused Differentiation Strategies - Merger, Acquisition and Strategic Alliances - Vertical Integration Strategies - Outsourcing Strategy.

Evaluating Company Resources and Competitive Capabilities: Company's Resource Strengths and Weakness and Its External Opportunities and Threats (SWOT Analysis) - Core Competencies Vs. Distinctive Competencies - Value Chain Model - Benchmarking the Costs of Key Value Chain Activities.

Strategy Fit for Specific Industry: Strategic Challenges in Emerging Industries - Strategies Ways for Coping with Barriers of Emerging Industry - Strategies for Competing in Maturing Industries - Strategic Moves in Maturing Industries - Strategies for Firms in Stagnant or Declining Industries - Strategy for Industry Leaders - Strategy for Runner Up Firms - Strategy for Weak and Crisis Ridden Businesses.

Strategies for Competing in Globalizing Markets: World Economy and Globalizing -International vs. Global Competition -How Markets Differ from Country to Country? -Strategy Options for Entering & Competing in Foreign Markets -Multi-Country Strategy - Characteristics of Multi-Country Competition -Global Strategy - Competitive Strategy Principles - Concept of Profit Sanctuaries.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Understand about Strategy and Strategic management process.							M					
CLO2	Analyze business firms' sustainable competitive advantages, uniqueness of culture and distinctive structure.									M			
CLO3	Evaluate how to select the best alternatives corporate strategy.								M				
CLO4	Examine the strategic control process.											M	
CLO5	Demonstrate capability of making their own decisions in dynamic business landscape.										M		

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Understand about Strategy and Strategic management process.	P.07	C1	2			CT, SF, CP
CLO2	Analyze business firms' sustainable competitive advantages, uniqueness of culture and distinctive structure.	P.09	C2 C3	1-3			CT, SF
CLO3	Evaluate how to select the best alternatives corporate strategy.	P.08	C4	1-3			CT, SF
CLO4	Examine the strategic control process.	P.11	C5	2,3			ASG, SF
CLO5	Demonstrate capability of making their own decisions in dynamic business landscape.	P.10	C6	1-3			SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1, CLO2, CLO3	C1, C2, C3, C4
	CT (1-3)	20%	CLO1, CLO2, CLO3	C1, C2, C3, C4
	ASG	5%	CLO4	C5
Semester Final (70%)	SF	70%	CLO1, CLO2, CLO3, CLO 5, CLO6	C1, C2, C3, C4, C5, C6
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Strategy - Strategy & Strategic Plan	1	CT1 CP SF	L D SDL
	L2	Strategy and Competitors - Strategy and Competitive Advantage	2		
	L3	Features of Strategy - Factors to be Considered in Selecting Strategy	1		
W2	L4	Winning Strategy and Test of Winning Strategy	1,2		
	L5	Understanding a Company's Strategy – Policy - Strategy vs. Policy.	2		
	L6	Strategic Management - Characteristics of Strategic Management	2		

W3	L7	Five-Phase Managerial Process of Crafting and Executing Strategy -	2		
	L8	Developing the Company's Strategic Vision and Mission - Setting Objectives	3		
	L9	Strategy Crafting, and Strategy Implementation and Executions -Key Elements of a Mission Statement.	1		
W4	L10	Strategic Vision vs. Mission -Short-Term Objectives vs. Long-Term Objectives	1,2		
	L11	Strategy Analysis - Purpose of Competitive Strategy Analysis, The Five Forces Model of Competition -	2,3		
	L12	Driving Forces of Industry's Competitive Structure and Business Environment to Change -	3		
W5	L13	Competitive Advantage - Five Generic Competitive Strategies - Low-Cost Leadership Strategy	3	CT2 CP SF	L D SDL
	L14	When a Low Cost Strategy Works Best and Worst - Broad Differentiation Strategies - When a Differentiation Strategy Works Best and Worst	2,3		
	L15	Best-Cost Provider Strategies - Focused Low-Cost Strategies	2		
W6	L16	- Focused Differentiation Strategies ,Focused Differentiation Strategies	1		
	L17	Merger, Acquisition	2		
	L18	Strategic Alliances - Vertical Integration Strategies -	2		
W7	L19	Outsourcing Strategy.	2		
	L20	Key Success Factors (KSFs) for Competitive Success.	2		
	L21	Review	3		
Mid Break					
W8	L22	Company's Resource Strengths	1,2	CT3 CP SF	L D SDL
	L23	Weakness and Its External Opportunities	2		
	L24	Threats (SWOT Analysis)	3		
W9	L25	Core Competencies Vs. Distinctive Competencies	2		
	L26	Value Chain Model	3		
	L 27	Benchmarking the Costs of Key Value Chain Activities.	3		
W10	L 28	Strategic Challenges in Emerging Industries	1,2		
	L 29	Strategies Ways for Coping with Barriers of Emerging Industry	1,2		
	L 30	Strategies for Competing in Maturing Industries	2		
W11	L 31	Strategic Moves in Maturing Industries - Strategies for Firms in Stagnant or Declining Industries	2	ASG SF	L D SDL
	L 32	Strategy for Industry Leaders - Strategy for Runner Up Firms	2		
	L 33	Strategy for Weak and Crisis Ridden Businesses.	1		
W12	L 34	World Economy and Globalizing	2		
	L 35	International vs. Global Competition	1		
	L 36	How Markets Differ from Country to Country?	3,4		
W13	L 37	Strategy Options for Entering	2	SF	L D SDL
	L 38	Competing in Foreign Markets	1,2		
	L 39	Multi-Country Strategy, Concept of Profit Sanctuaries	3,4		
W14	L 40	Characteristics of Multi-Country Competition	1		
	L 41	Global Strategy - Competitive Strategy Principles	1,2		
	L 42	Review class	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text Books:

1. Thomson Arthur A., and Strickland A.J., "Strategic Management: Concepts and Cases", McGraw Hill. 10th Edition
2. Colin, W., "Strategic Management", Palgrave Macmillan.

Recommended Books:

1. Hunger J.D., and Wheelen, T.L., "Essentials of Strategic Management", Prentice-Hall, Inc.
2. David, Fred, "Strategic Management: Concepts and Cases", Prentice-Hall, Inc.
3. C.W.L.Hill and G.R. Jones, Strategic Management, South-Western International Edition

Online Resources

CHAPTER 4: COURSE OUTLINE OF ELECTIVE COURSES (PART-C)

4.1 List of Elective Courses in the Field of Information Technology

4.1.1 ICE 4*17: Machine Learning

Course Information			
Course Code Course Title	: ICE 4*17 : Machine Learning	Credit Hours Contact Hour	: 3.0 : 3.0

Pre-Requisite

None

Rationale

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

Objective

1. To acquire theoretical Knowledge on setting hypothesis for pattern recognition.
2. To learn paradigms in different environmental setting and apply the appropriate learning algorithm to best suit the current need.
3. Apply suitable machine learning techniques for data handling and to gain knowledge from it.

Course Contents

Introduction to Machine Learning
Introduction, Components of Learning, Learning Models, Geometric Models, Probabilistic Models, Logic Models, Grouping and Grading, Designing a Learning System, Types of Learning, Supervised, Unsupervised, Reinforcement, Perspectives and Issues, Version Spaces, PAC Learning, VC Dimension.

Supervised and Unsupervised Learning
Decision Trees: ID3, Classification and Regression Trees, Regression: Linear Regression, Multiple Linear Regression, Logistic Regression, Neural Networks: Introduction, Perception, Multilayer Perception, Support Vector Machines: Linear and Non-Linear, Kernel Functions, K Nearest Neighbors, Introduction to clustering, K-means clustering, K-Mode Clustering.

Ensemble and Probabilistic Learning
Model Combination Schemes, Voting, Error-Correcting Output Codes, Bagging: Random Forest Trees, Boosting: Adaboost, Stacking. Gaussian mixture models - The Expectation-Maximization (EM) Algorithm, Information Criteria, Nearest neighbour methods - Nearest Neighbour Smoothing, Efficient Distance Computations: the KD-Tree, Distance Measures.

Reinforcement Learning and Evaluating Hypotheses
Introduction, Learning Task, Q Learning, Nondeterministic Rewards and actions, temporal-difference learning, Relationship to Dynamic Programming, Active reinforcement learning, Generalization in reinforcement learning. Motivation, Basics of Sampling Theory: Error Estimation and Estimating Binomial Proportions, The Binomial Distribution, Estimators, Bias, and Variance.

Genetic Algorithms: Motivation, Genetic Algorithms: Representing Hypotheses, Genetic Operator, Fitness Function and Selection, An Illustrative Example, Hypothesis Space Search, Genetic

Programming, Models of Evolution and Learning: Lamarkian Evolution, Baldwin Effect, Parallelizing Genetic Algorithms.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.	H											
CLO2	Understand a wide variety of learning algorithms.	M	H										
CLO3	Understand how to evaluate models generated from data and enhance the learning parameters to achieve maximum performance.		H	M									
CLO4	Develop a solution for practical problems through learning models from data.			H									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.	P.01.1	C3	K1			CT, SF, CP
CLO2	Understand a wide variety of learning algorithms.	P.02.1	C4	K1 K2 K3	P1 P2 P6		CT, SF
CLO3	Understand how to evaluate models generated from data and enhance the learning parameters to achieve maximum performance.	P.02.4	C5	K4	P1 P3		CT, SF
CLO4	Develop a solution for practical problems through learning models from data.	P.03.2	C3		P1 P3 P7		ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	

Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3, C4
	ASG	5%	CLO4	C6
Semester Final (79%)	SF	70%	CLO1,2,3	C1, C2, C3, C4
Total Marks		100%		

Course Plan

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Introduction	1	CT1 CP SF	L D SDL
	L2	Conventional Models	2		
	L3	Learning Models	1		
W2	L4	Designing a Learning System	1,2		
	L5	Types of Learning	2		
	L6	Perspectives and Issues	2		
W3	L7	Introduction to regression	2		
	L8	Regression Analysis	3		
	L9	Linear Regression	1		
W4	L10	Logistic Regression	1,2		
	L11	Applications of regression	2,3		
	L12	Regression case study	3		
W5	L13	Supervised Learning	3	CT2 CP SF	L D SDL
	L14	Unsupervised Learning	2,3		
	L15	Transfer Learning	2		
W6	L16	Bayesian Learning	1		
	L17	Naïve Bayes (NB) Classifier	2		
	L18	Mathematics examples of NB	2		
W7	L19	Decision Tree (DT)	2		
	L20	Classification and Regression Trees	2		
	L21	Random Forest (RF)	3		
Mid Break					
W8	L22	K-Nearest Neighbors (KNN)	1,2	CT3 CP SF	L D SDL
	L23	Mathematical Problems	2		
	L24	Support Vector Machine (SVM)	3		
W9	L25	Supervised Mathematical Problems	2		
	L26	K-means clustering	3		
	L 27	K-means Clustering	3		
W10	L 28	Boosting, Adaboost	1,2		
	L 29	Neural Networks	1,2		
	L 30	Gaussian mixture models	2		
W11	L 31	Genetic Algorithms	2	ASG SF	L D SDL
	L 32	An Illustrative Example	2		
	L 33	Hypothesis Space Search	1		
W12	L 34	Models of Evolution and Learning	2		
	L 35	Ensemble Learning	1		
	L 36	Hidden Markov Model	3,4		
W13	L 37	Maximum Likelihood Estimates	2	CP	

	L 38	Parameter Estimation	1,2	SF	L D SDL
	L 39	Computational Learning Theory	3,4		
W14	L 40	Reinforcement Learning Learning Task	1		
	L 41	Q Learning	1,2		
	L 42	Review class	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Pattern Recognition and Machine Learning, Springer, Christopher M. Bishop;
2. Pattern Recognition, Elsevier Inc., Sergios Theodoridis and Konstantinos Koutroumbas.
3. MACHINE LEARNING - An Algorithmic Perspective, Second Edition, Chapman and Hall/CRC, Stephen Marsland, 2015.
4. Machine Learning, McGraw Hill (International Edition), Tom Mitchell,

4.1.2 ICE 4*18: Python Laboratory

Course Information

Course Code	: ICE 4*16	Credit Hours	: 1.5
Course Title	: Python Laboratory	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

Python is a general-purpose interpreted, interactive, object-oriented, and high-level programming language. Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. It uses English keywords frequently whereas other languages use punctuation, and it has fewer syntactical constructions than other languages. Python has many useful features, and it has been used in a lot of areas. Nowadays, it is necessary for students to have basic knowledge of python. This course is designed to teach students about practical implementation n and understanding of python through hands on exercises.

Objective

1. Understand principles of Python.
2. To implement Python programs with conditionals and loops.
3. Represent compound data using Python lists, tuples, and dictionaries.
4. Read and write data from/to files in Python.
5. Understand the pros and cons on scripting languages vs. classical programming languages.

Course Contents

In this course, students will perform experiments to practically verify the theories and concepts that learned about data types, conditional statements, loops, classes, objects, tuples, list, dictionaries, exception handling etc.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12

CLO1	Write, test, and debug simple Python programs.	H											
CLO2	Implement Python programs with conditionals and loops.				H								
CLO3	Develop Python programs step-wise by defining functions and calling them.			H									
CLO4	Use Python lists, tuples, dictionaries for representing compound data.		H										

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Write, test, and debug simple Python programs.	P.01.3	C3	K3			LP, LT, Q
CLO2	Implement Python programs with conditionals and loops.	P.04.2	C4	K5			R, Q
CLO3	Develop Python programs stepwise by defining functions and calling them.	P.03.1	C2		P1 P3 P7		
CLO4	Use Python lists, tuples, dictionaries for representing compound data.	P.09.1	A2				P, Q

*LP = Lab Performance, LT = Lab Test, Q = Quiz, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	6
Experiment	30
Self-directed learning	
Preparation for lab reports	21
Preparation for lab test	5
Preparation of quiz	5
Engagement in project/Assignment	21
Formal Assessment	
Continuous assessment	-
Final Quiz	1
Lab Test/Project show	1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab Performance	10%	CLO1	P4
Report Writing	20%	CLO2	C4
Project	20%	CLO3	A2
Lab Test	30%	CLO1	P4
Quiz	20%	CLO1,2,3	P4, C4, A2
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Introduction to python programming and python datatypes.

Week 2	Experimentation with conditional statements and loop.
Week 3	Create and perform various operations on list and dictionary
Week 4	Create and perform various operations on Tuples and file.
Week 5	Performing different arithmetic operations on numbers in python.
Week 6	Review & Practice Lab-1
Week 7	Lab Test-1
Week 8	To find a value using linear search and binary search in python program.
Week 9	Write a program to create class, object, constructor, and destructor.
Week 10	Write a python program to create a package, sub-package, and modules.
Week 11	Implementation of exception handling in python.
Week 12	Write a python code to read a csv file using pandas module and print the first and last five lines of a file.
Week 13	Review & Practice Lab-2
Week 14	Lab Test-2

Text and Reference Books

1. Python Crash Course, No Starch Press, Eric Matthes (No Starch Press, 2016).
2. Head-First Python, 2nd edition, O'Reilly Media, Paul Barry *(O'Reilly, 2016).*
3. Think Python: How to Think Like a Computer Scientist, 2nd edition, O'Reilly Media, Allen B. Downey *(O'Reilly, 2015).*
4. Learn Python 3 the Hard Way, Addison-Wesley Professional, Zed A. Shaw *(Addison-Wesley, 2016).*

4.1.3 ICE 4*19: Natural Language Processing

Course Information			
Course Code Course Title	: ICE 4*19 : Natural Language Processing	Credit Hours Contact Hour	: 3.0 : 3.0

Pre-Requisite

None

Rationale

NLP introduces the basics of statistical natural language processing (NLP) including both linguistics concepts such as morphology and syntax and machine learning techniques relevant for NLP. This course provides a comprehensive introduction to the theory and practice of text-based natural language processing (NLP)—the development of computer programs that can understand, generate, translate, extract information from, and learn natural language in textual form from web pages, books, newspapers, etc.

Objective

1. To understand natural language processing and to learn how to apply basic techniques for text-based processing of natural language.
2. To understanding approaches to syntax and semantics in NLP.
3. To Understand current methods for statistical approaches to machine learning techniques used in NLP.
4. To implement the NLP technique in different application.

Course Contents

Introduction: NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field.

N-gram Language Models: The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models.

Part Of Speech Tagging and Sequence Labeling: Lexical syntax. Hidden Markov Models (Forward and Viterbi algorithms and EM training).

Basic Neural Networks : Any basic introduction to perceptron and backpropagation Machine Learning, Pattern Recognition and Machine Learning.

LSTM Recurrent Neural Networks "Understanding LSTM Networks" blog post, optionally the original paper Long Short Term Memory.

Syntactic parsing Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs.

Semantic Analysis Lexical semantics and word-sense disambiguation. Compositional semantics. Semantic Role Labeling and Semantic Parsing.

Information Extraction (IE) Named entity recognition and relation extraction. IE using sequence labeling.

Machine Translation (MT) Basic issues in MT. Statistical translation, word alignment, phrase-based translation, and synchronous grammars.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Develop the knowledge on natural language processing and to learn how to apply basic techniques for text-based processing of natural language.	H											
CLO2	Familiarize with the current methods for statistical approaches to machine learning techniques used in NLP.		H										
CLO3	Enable to implement the NLP technique in different application.					H							

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Develop the knowledge on natural language processing and to learn how to apply basic techniques for text-based processing of natural language.	P.01.1	C1 C2	K1			CT, SF, CP
CLO2	Familiarize with the current methods for statistical approaches to machine learning techniques used in NLP.	P.02.2	C4		P1 P4 P5		CT, SF, ASG
CLO3	Enable to implement the NLP technique in different application.	P.05.1	C3		P1 P2 P6		CT, SF, ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom ‘s Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3, C4
	ASG	5%	CLO3	C6,C2,C3
Semester Final (79%)	SF	70%	CLO1,2,3	C1, C2, C3, C4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	NLP tasks in syntax.	1	CT1 CP SF	L D SDL
	L2	NLP semantics	2		
	L3	NLP pragmatics	1		
W2	L4	NLP applications such as information extraction.	1,2		
	L5	NLP question answering, and machine translation.	2		
	L6	The problem of ambiguity.	2		
W3	L7	The role of machine learning. Brief history of the field.	2		
	L8	The role of language models.	3		
	L9	Simple N-gram models.	1		
W4	L10	Estimating parameters and smoothing.	1,2		
	L11	Evaluating language models.	2,3		
	L12	Lexical syntax.	3		
W5	L13	Hidden Markov Models (Forward and Viterbi algorithms and EM training).	3	CT2 CP SF	L D SDL
	L14	Any basic introduction to perceptron.	2,3		
	L15	Any basic introduction to backpropagation Machine Learning.	2		
W6	L16	Any basic introduction to backpropagation Machine Learning.	1		
	L17	Any basic introduction to backpropagation Machine Learning.	2		
	L18	Pattern Recognition and Machine Learning basic.	2		
W7	L19	Pattern Recognition and Machine Learning.	2		
	L20	Optionally the original paper Long Short-Term Memory	2		
	L21	"Understanding LSTM Networks" blog post.	3		
Mid Break					
W8	L22	Grammar formalisms and treebanks.	1,2	CT3 CP SF	L D SDL
	L23	Grammar formalisms and treebanks.	2		
	L24	Efficient parsing for context-free grammars (CFGs).	3		

W9	L25	Statistical parsing and probabilistic CFGs (PCFGs).	2		
	L26	Lexicalized PCFGs.	3		
	L 27	Lexical semantics and word-sense disambiguation.	3		
W10	L 28	Compositional semantics.	1,2		
	L 29	Semantic Role Labeling and Semantic Parsing.	1,2		
	L 30	Named entity recognition and relation extraction.	2		
W11	L 31	IE using sequence labeling.	2	ASG SF	L D SDL
	L 32	Basic issues in MT.	2		
	L 33	Statistical translation.	1		
W12	L 34	word alignment.	2		
	L 35	phrase-based translation.	1		
	L 36	synchronous grammars.	3		
W13	L 37	Real life application.	2	CP SF	L D SDL
	L 38	Recent Research topics.	1,2		
	L 39	Recent Research topics.	3		
W14	L 40	Recent Research topics.	1		
	L 41	Revision class	1,2		
	L 42	Revision class	1-3		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. NLP: The Essential Guide to Neuro-Linguistic Programming – NLP Comprehensive, HarperCollins Publishers, Tom Dotz, Tom Hoobyar, Susan Sanders.
2. NLP at Work: The Essence of Excellence, 3rd Edition (People Skills for Professionals), Nicholas Brealey Publishing, Sue Knight.
3. NLP Workbook: A Practical Guide to Achieving the Results You Want, Red Wheel, Joseph O'Connor
4. NLP: The New Technology of Achievement, William Morrow Paperbacks, Steve Andreas, Charles Faulkner

4.1.4 ICE 4*21: Information System Design and Management

Course Information

Course Code	: ICE 4*21	Credit Hours	: 3.0
Course Title	: Information System Design and Management	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

The Information System Design and Management course motivates to perceive information systems planning, analysis, design and implementation; project management, project scheduling and communicationskills; as well as the fundamentals of security, disaster/recovery planning and ethics in system development to solve various real-life problems.

Objective

1. To assist students for developing a comprehensive understanding of how information systems are developed.
2. To conduct the structured analysis and cost/benefit analysis for developing effective information systems.
3. To understand the importance of project management, security and ethics of system development.

Course Contents

System concepts: primary characteristics of a system, importance of system concepts for developing information systems; **Information systems environment:** elements of a system, information system types and features; **The system development lifecycle:** phases of SDLC, components of a feasibility study, factors to consider in a candidate system; **The role of the system analyst:** academic and personal qualification of a system analyst, multifaceted role of a system analyst, the analyst/user interface and behavioral issues; **Systems planning and the initial investigation:** importance and dimensions of planning, determining user's information requirements and prototyping; **Information gathering:** categories of information, sources of information and information gathering tools; **The tools of structured analysis:** data flow diagrams, data dictionary, structured English, decision trees, decision tables and their pros/cons; Cost-benefit analysis: classification of costs and benefits, cost-benefit analysis techniques and its advantages/disadvantages; **Project management techniques:** project attributes, constraints and stakeholders, project management knowledge areas, project management tools – Gantt charts, network diagrams, critical path analysis and estimating cost; **System maintenance:** primary activities of a maintenance procedure, reducing maintenance cost; Security, disaster/recovery, and ethics in system development: threats to system security and control measures, disaster/recovery planning, ethics codes and standards of behavior in system development.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Understand fundamental concepts of information system, information system environment and primary responsibilities of a system analyst.	M											
CLO2	Apply the practical approaches of structured and cost-benefit analysis for developing information systems for industries/ business organizations.			H									
CLO3	Develop and organize a system using project management techniques and as a team lead or a member.							H					
CLO4	Develop the communication skill by presenting topics on information system design and development.										L		

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Understand fundamental concepts of information system, information system environment and primary responsibilities of a system analyst.	P.01.3	C3	K3			CT, SF, CP
CLO2	Apply the practical approaches of structured and cost-benefit analysis for developing information systems for industries/ business organizations.	P.07.2	C5	K7			CT, SF

CLO3	Develop and organize a system using project management techniques and as a team lead or a member.	P.11.2	P3			A1 A5	CT, SF
CLO4	Develop the communication skill by presenting topics on information system design and development.	P.10.2	P4				ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C3
	CT (1-3)	20%	CLO1,2,3	C3, C5, P3, P4
	ASG	5%	CLO4	P4
Semester Final (70%)	SF	70%	CLO1,2,3	C3, C5, P3, P4
Total Marks		100%		

Course Plan

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Introduction to subject: Objectives, Outcomes, reference book	1	CT1 CP SF	L D SDL
	L2	Definition of systems concept; Characteristics of a system.	2		
	L3	Organization, interaction, Interdependence, Integration, central objective	1		
W2	L4	Elements of a system: outputs and inputs, Processor (s), control, feedback, environment, boundaries and interface	1,2		
	L5	Types of systems: physical or abstract systems, open or closed systems	2		
	L6	Man-made information systems; The major information systems.	2		
W3	L7	The system development life cycle;	2		
	L8	Feasibility study; Analysis; Design;	3		
	L9	The system development life cycle; implementation	1		
W4	L10	The system development life cycle; Post-implementation and Maintenance;	1,2		
	L11	Prototyping	2,3		
	L12	Definition of system analyst; The role of system analyst, What does it take to do systems analysis?	3		

W5	L13	Academic and personal qualifications of the analyst	3	CT2 CP SF	L D SDL
	L14	The analyst /user interface:	2,3		
	L15	Behavioral issues, Conflict resolution;	2		
W6	L16	The MIS organization.	1		
	L17	Systems Analysis: Introduction; Bases for Planning in systems analysis:	2		
	L18	Systems Analysis: Introduction; Bases for Planning in systems analysis (cont.)	2		
W7	L19	Dimension of planning; Initial Investigation:	2		
	L20	Needs identification, determining the user' information requirements; Fact-finding.	2		
	L21	Information Gathering: Introduction; what is structured analysis?	3		
W8	L22	Information Gathering: where does information originate?	1,2	CT3 CP SF	L D SDL
	L23	Information gathering tools: Review of Literature, Procedures and forms,	2		
	L24	Information gathering tools: Review of Literature, Procedures and forms (cont.)	3		
W9	L25	On-site observation, Interviews and questionnaires; Types of interviews and questionnaires	2		
	L26	On-site observation, Interviews and questionnaires; Types of interviews and questionnaires (cont.)	3		
	L 27	On-site observation, Interviews and questionnaires; Types of interviews and questionnaires (cont.)	3		
W10	L 28	The tools of structured analysis: Introduction; What is structured analysis?	1,2		
	L 29	The tools of structured analysis: The date flow diagram (DFD), Data Dictionary,	1,2		
	L 30	The tools of structured analysis: The date flow diagram (DFD), Data Dictionary (cont.)	2		
W11	L 31	Decision tree, Pros and cons of it.	2	ASG SF	L D SDL
	L 32	Structured English, Pros and cons of it.	2		
	L 33	Decision tables, Pros and cons of it.	1		
W12	L 34	Feasibility Study: System performance definition; Feasibility Study	2		
	L 35	Feasibility Considerations, steps in feasibility analysis	1		
	L 36	Feasibility Considerations, steps in feasibility analysis(cont.)	3,4		
W13	L 37	Feasibility report, oral presentation	2	CP SF	L D SDL
	L 38	Cost/Benefit Analysis: Data analysis; cost/Benefit analysis:	1,2		
	L 39	Cost and benefit categories,	3,4		
W14	L 40	Cost and benefit categories (cont.)	1		
	L 41	Procedure for cost/benefit determination, The system proposal.	1,2		
	L 42	Procedure for cost/benefit determination, The system proposal (cont.)	1-4		
*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.					
Text and Reference Books					

1. System Analysis and Design, Galgotia Publications Pvt. Ltd, Elias M. Awad;
2. System Analysis and Design, Prentice Hall, Raja Raman;
3. System Analysis and Design Methods (7th Edition), McGraw Hill, Jeffery L. Whitten;
4. System Analysis and Design, Pearson, Kendel & Kedel.

4.1.5 ICE 4*23: Human Machine Interaction

Course Information

Course Code	: ICE 4*23	Credit Hours	: 3.0
Course Title	: Human Machine Interaction	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

In this course, students are introduced to the fundamental theories and concepts of human computer interaction (HCI). HCI is an interdisciplinary field that integrates theories and methodologies across many domains including cognitive psychology, neurocognitive engineering, computer science, human factors, and engineering design. Students will gain theoretical knowledge of and practical experience in the fundamental aspects of human perception, cognition, and learning as relates to the design, implementation, and evaluation of interfaces.

Objective

1. To learn the basic physiological, perceptual, and cognitive components of human learning and memory.
2. To To understand the definitions and foundations of the HCI domain.
3. To learn to analyze interaction problems from a technical, cognitive, and functional perspective.
4. To develop an awareness of the range of general human-computer interaction issues that must be considered when designing information systems.
4. To develop an awareness of the range of general human-computer interaction issues that must be considered when designing information systems.

Course Contents

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

Hypertext, multimedia and the world wide web: Understanding hypertext, Finding things, Web technology and issues, Static web content, Dynamic web content.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Understand and applying the fundamentals of HCI and Interaction design.	H											
CLO2	Analyze the focused users and system requirements, and to design different kind of UIs and Interaction systems for building intuitive usable software solutions.		M	H									
CLO3	Apply (design) evaluation methods for assuring the enhanced usability including effectiveness, efficiency and satisfaction.				H								

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Understand and applying the fundamentals of HCI and Interaction design.	P.01.1	C1 C2	K1			CT, SF, CP
CLO2	Analyze the focused users and system requirements, and to design different kind of UIs and Interaction systems for building intuitive usable software solutions.	P.03.2	C3	K1	P1 P3		CT, SF
CLO3	Apply (design) evaluation methods for assuring the enhanced usability including effectiveness, efficiency and satisfaction.	P.04.2	C4				CT, SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)				
Assessment Tools		**Grading**	**CLO**	**Blooms Taxonomy**
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2
	CT (1-3)	20%	CLO1,2	C1, C2, C3, C4
	ASG	5%	CLO3	C6
Semester Final (79%)	SF	70%	CLO1,2,3	C1, C2, C3, C4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Introduction to HCI and Interaction design: HCI, Interaction design, The process of design	1	CT1 CP SF	L D SDL
	L2	User focus, Scenarios, Navigation design	2		
	L3	Screen design and layout, Iteration, and prototyping.	1		
W2	L4	HCI in the software process: The software life cycle.	1,2		
	L5	Usability engineering	2		
	L6	Iterative design and prototyping, Design rationale.	2		
W3	L7	Design rules: Principles to support usability, Standards	2		
	L8	Guidelines, Golden rules and heuristics	3		
	L9	HCI patterns	1		
W4	L10	Evaluation techniques: What is evaluation? What, why, and when to evaluate, Goals of evaluation	1,2		
	L11	Evaluation through expert analysis	2,3		
	L12	Evaluation through user participation, Choosing an evaluation method.	3		
W5	L13	Evaluation paradigms and techniques.	3	CT2 CP SF	L D SDL
	L14	The DECIDE framework to guide evaluation.	2,3		
	L15	The D E C I D E framework to guide evaluation. (Contd.)	2		
W6	L16	Observing users: Participant observation, ethnography, Data collection	1		
	L17	Analyzing, interpreting and presenting data	2		
	L18	Qualitative analysis, Feeding the findings back into design	2		
W7	L19	Asking users and experts: Interviews	2		
	L20	Asking users and experts: Questionnaires.	2		
	L21	Asking users and experts: Inspections	3		
Mid Break					
W8	L22	Asking users and experts: Inspections (Contd.)	1,2	CT3 CP SF	L D SDL
	L23	Asking users and experts: walkthroughs	2		
	L24	Asking users and experts: walkthroughs (Contd.)	3		
W9	L25	Universal design: Universal design principles	2		
	L26	Multi-modal interaction	3		
	L 27	Designing for diversity	3		
W10	L 28	Task analysis: Differences between task analysis and other techniques, Task decomposition	1,2		
	L 29	Knowledge-based techniques, Entity-relationship-based techniques	1,2		
	L 30	Sources of information and data collection, Uses of task analysis.	2		
W11	L 31	Modeling rich interaction: Status-event analysis, Rich contexts	2	ASG SF	L D SDL
	L 32	Low intention and sensor	2		

	L 33	Low intention and sensor (Contd.)	1		
W12	L 34	Ubiquitous computing and augmented realities: Ubiquitous computing applications research.	2		
	L 35	virtual and augmented reality	1		
	L 36	Information and data visualization	3		
W13	L 37	Hypertext, multimedia and the world wide web: Understanding hypertext.	2	CP SF	L D SDL
	L 38	Understanding hypertext (Contd.)	1,2		
	L 39	Web technology and issues	3		
W14	L 40	Static web content	1		
	L 41	Dynamic web content	1,2		
	L 42	Review class	1		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Designing the User Interface: Strategies for Effective Human-Computer Interaction (5th Edition) Authors: Shneiderman, Plaisant, Cohen, and Jacobs.
2. Human-Computer Interaction (3rd Edition), Pearson, Authors: Dix, Finlay, Abowd and Beale.
3. Human-Computer Interaction Handbook (3rd Edition). CRC Press. ISBN 1-4398-2943-8, Julie A. Jacko (Ed.). (2012).
4. Interaction Design: Beyond Human Computer Interaction (5th Edition), John Wiley & Sons, Yvonne Rogers, Helen Sharp, Jenny Preece (2019)

4.1.6 ICE 4*25: Big Data Analytics

Course Information

Course Code Course Title	: ICE 4*25 : Big Data Analytics	Credit Hours Contact Hour	: 3.0 : 3.0

Pre-Requisite:

Course Code: ICE 4131
Course Title: Database Management System & Machine Learning.

Rationale

This course is designed to familiarize the students with most important information technologies used in manipulating, storing and analyzing big data. Students will gain the ability to initiate and design highly scalable systems that can accept, store and analyze large volumes of unstructured data in batch mode and/or real time.

Objective

a) To **Understand** the Big Data Platform and its Use cases.
b) To **Apply** analytics on Structured, Unstructured Data to analyze Big Data.
c) **Develop** Big Data Solutions using different techniques.

Course Contents

UNIT I : INTRODUCTION TO BIG DATA AND HADOOP

Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.

UNIT II : HDFS(Hadoop Distributed File System)

The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

UNIT III : Map Reduce
Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

Unit IV : Hadoop Eco System Pig :
Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.
Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions.
Hbase: HBasics, Concepts, Clients, Example, Hbase Versus RDBMS.
Big SQL : Introduction

UNIT V : Data Analytics with R Machine Learning :
Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR**.**

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Apply information and concepts to Understand the Big Data Platform and its Use cases	H											
CLO2	Analyze and solves complex engineering problems reaching substantiated conclusion in Big Data		H										
CLO3	Develop solution for different components of complex engineering problem using various techniques in Big data.			M									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Apply information and concepts to understand the Big Data Platform and its Use cases	P.01.3	C1 C2 C3	K3			CT, SF, CP
CLO2	Analyze and solves complex engineering problems reaching substantiated conclusion in Big Data	P.02.3	C4	K4	P1 P2 P6		ASG,CT, SF
CLO3	Develop solution for different components of complex engineering	P.03.3	C6	K5			ASG, SF

	problem using various techniques in Big data.						

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, P = Presentation, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision	21
Assessment Preparations	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2, C3
	CT (1-3)	20%	CLO1,2	C1, C2, C3, C4
	ASG	5%	CLO2,3	C4, C6
Semester Final (79%)	SF	70%	CLO1,2,3	C1, C2, C3, C4, C6
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Types of Digital Data, Introduction to Big Data.	1	CT1 CP SF	L D SDL
	L2	Big Data Analytics.	1		
	L3	History of Hadoop, Apache Hadoop.	1		
W2	L4	Analyzing Data with Unix tools	1,2		
	L5	Analyzing Data with Unix tools continuing.	1,2		
	L6	Analyzing Data with Hadoop.	1,2		
W3	L7	Hadoop Streaming.	2		
	L8	Hadoop Echo System.	1,2		
	L9	IBM Big Data Strategy.	2		
W4	L10	Introduction to Infosphere.	1		
	L11	BigInsights and Big Sheets.	1		
	L12	The Design of HDFS, HDFS Concepts.	1,3		
W5	L13	Command Line Interface, Hadoop file system interfaces.	2	CT2 CP	

	L14	Data flow, Data Ingest with Flume and Scoop, Hadoop archives.	2	SF	L D SDL
	L15	Hadoop I/O: Compression, Serialization.	1,2		
W6	L16	Avro and File-Based Data structures.	1		
	L17	Anatomy of a Map Reduce Job Run, Failures.	1,2		
	L18	Job Scheduling, Shuffle and Sort.	2		
W7	L19	Task Execution.	2		
	L20	Map Reduce Types and Formats.	1,2		
	L21	Map Reduce Features.	1,2		
Mid Break					
W8	L22	Introduction to PIG.	1	CT3 CP ASG SF	L D SDL
	L23	Execution Modes of Pig.	2		
	L24	Comparison of Pig with Databases.	2		
W9	L25	Grunt	2		
	L26	Pig Latin.	1,2		
	L 27	User Defined Functions, Data Processing operators.	1		
W10	L 28	Hive Shell, Hive Services.	1,2		
	L 29	Hive Metastore.	1,2		
	L 30	Comparison with Traditional Databases, HiveQL.	1,2		
W11	L 31	Tables, Querying Data and User Defined Functions.	1,2	SF	L D SDL
	L 32	HBasics, Concepts, Clients, Example.	2		
	L 33	Hbase Versus RDBMS.	2		
W12	L 34	Big SQL: Introduction.	1		
	L 35	Data Analytics with R Machine Learning : Introduction.	1		
	L 36	Supervised Learning.	1,2		
W13	L 37	Unsupervised Learning.	1,2	CP SF	L D SDL
	L 38	Collaborative Filtering.	3		
	L 39	Big Data Analytics with BigR**.**	2,3		
W14	L 40	Big Data Analytics with BigR continuing.	2,3		
	L 41	Review class	1-3		
	L 42	Review class	1-3		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
2. Tom White " Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012
3. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
4. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013)

5. Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013), Oracle press.

4.1.7 ICE 4*27: Data Science

Course Information			
Course Code Course Title	: ICE 4*27 : Data Science	Credit Hours Contact Hour	: 3.0 : 3.0

Pre-Requisite

None

Rationale

Data Science is the highly sought field of the century. Explore the truth about what Data Science is and hear from real practitioners telling real stories about what it means to work in Data Science and use cases for the same. This course is intended to provide an introduction into the field of Data Science. Students will develop skills in appropriate technology and basic statistical methods by completing hands-on projects focused on real-world data and addresses the social consequences of data analysis and application.

Objective

1. To work with different types of data.
2. To gain a foundational understanding of business analytics.
3. To gain fundamental knowledge of what is Data Science and what do Data Science people do.
4. To learn about Data Science in a business context and what is the future of Data Science.
5. To understand Data Science applications and discover some use cases for Data Science.

Course Contents

Introduction to Data Science

Defining Data Science, What Does a Data Science Professional Do, Data Science in Business, Use Cases for Data Science, Data Science People, Importance of Data Science.

Statistics Essentials

Introduction, Sample or population data, fundamentals of descriptive statistics, central tendency, asymmetry, and variability, Practical example: descriptive statistics, Distributions, Practical example: inferential statistics, Hypothesis testing: Introduction, Practical example: hypothesis testing, Fundamentals of regression analysis, Assumptions for linear regression analysis, Dealing with categorical data, Practical example: regression analysis.

Python Programming for Data Science

Python Basics, Data structures, Python programming fundamentals, Working with Data, Strings and Dates, Data Analytics, Statistical Analysis and Business Applications, Mathematical Computing with Python, Scientific computing with Python, Data Manipulation with Pandas, Data Visualization, Web Scraping.

Machine Learning

Introduction to Artificial Intelligence and Machine Learning, Data Wrangling and Manipulation, Supervised Learning, Feature Engineering, Supervised Learning-Classification, Unsupervised learning, Time Series Modelling, Ensemble Learning, Recommender Systems, Text Mining.

Big Data Hadoop

Introduction to Big Data and Hadoop Ecosystem, HDFS and Hadoop Architecture, MapReduce and Sqoop, Basics of Impala and Hive, Type of Data Formats, Advanced HIVE concept and Data File

Partitioning, Basics of Apache Spark, Implementation of Spark Applications, Spark Algorithm, Spark SQL.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.	H											
CLO2	Understand a wide variety of data science problems and solutions.	M	H										
CLO3	Understand how to evaluate models generated from data and enhance the learning parameters to achieve maximum performance.		H	M									
CLO4	Develop a solution for practical problems through data analysis.			H									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.	P.01.1	C3	K1			CT, SF, CP
CLO2	Understand a wide variety of data science problems and solutions.	P.02.1	C4	K1 K2 K3	P1 P2 P6		CT, SF
CLO3	Understand how to evaluate models generated from data and enhance the learning parameters to achieve maximum performance.	P.02.4	C5	K4	P1 P3		CT, SF
CLO4	Develop a solution for practical problems through data analysis.	P.03.2	C3		P1 P3 P7		ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom‘s Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision	21
Assessment Preparations	21

Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C2
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3, C4
	ASG	5%	CLO4	C6
Semester Final (79%)	SF	70%	CLO1,2,3	C1, C2, C3, C4
Total Marks		100%		

Course Plan

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Defining Data Science	1	CT1 CP SF	L D SDL
	L2	What Does a Data Science Professional Do?	2		
	L3	Data Science in Business	1		
W2	L4	Use Cases for Data Science	1,2		
	L5	Introduction to statistics	2		
	L6	Sample or population data	2		
W3	L7	The fundamentals of descriptive statistics	2		
	L8	Measures of central tendency, asymmetry, and variability	3		
	L9	Practical example: descriptive statistics	1		
W4	L10	Distributions	1,2		
	L11	Estimators and estimates	2,3		
	L12	Confidence intervals: advanced topics	3		
W5	L13	Practical example: inferential statistics	3	CT2 CP SF	L D SDL
	L14	Hypothesis testing: Introduction	2,3		
	L15	Practical example: hypothesis testing	2		
W6	L16	The fundamentals of regression analysis	1		
	L17	Assumptions for linear regression analysis	2		
	L18	Dealing with categorical data	2		
W7	L19	Practical example: regression analysis	2		
	L20	Python Basics for data science	2		
	L21	Python Data Structures	3		
Mid Break					
W8	L22	Working with Data in Python	1,2	CT3 CP SF	L D SDL
	L23	Data Analytics Overview	2		
	L24	Statistical Analysis and Business Applications	3		
W9	L25	Mathematical Computing with Python (NumPy)	2		
	L26	Scientific computing with Python (Scipy)	3		
	L 27	Data Manipulation with Pandas	3		
W10	L 28	Natural Language Processing with Scikit Learn	1,2		
	L 29	Data Visualization in Python using matplotlib	1,2		
	L 30	Web Scraping with BeautifulSoup	2		
W11	L 31	Introduction to Artificial Intelligence and Machine Learning	2	ASG SF	L D SDL
	L 32	Data Wrangling and Manipulation	2		
	L 33	Supervised Learning and Unsupervised learning	1		
W12	L 34	Feature Engineering	2		
	L 35	Ensemble Learning	1		
	L 36	Text Mining	3,4		

W13	L 37	Introduction to Big Data and Hadoop Ecosystem	2	CP SF	L D SDL
	L 38	HDFS and Hadoop Architecture, MapReduce and Sqoop	1,2		
	L 39	Working with Hive and Impala	3,4		
W14	L 40	Implementation of Spark Applications	1		
	L 41	Spark Algorithm and SQL	1,2		
	L 42	Review class	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. The Foundations of Data Science By Ani Adhikari and John DeNero.
2. Practical Statistics for Data Scientists by Peter Bruce.
3. Pattern Recognition and Machine Learning (Information Science and Statistics) by Christopher M. Bishop.
4. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data by EMC Education Services.
5. Python for Data: Data Wrangling with Pandas, Numpy, and IPython by Wes Mckinney.

4.2 List of Elective Courses in the Field of Communication Engineering

4.2.1 ICE 4*29: Microwave Engineering and Radar

Course Information

Course Code	: ICE 4*29	Credit Hours	: 3.0
Course Title	: Microwave Engineering and Radar	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

To understand and develop the basics of microwave devices as well as their radiation patterns, beam width, losses etc. along with radar communication system and its operation.

Objective

1. To gain knowledge and understanding of microwave analysis methods in a lossy transmission medium.
2. To use Smith Chart by examining the load where the impedance must be matched.
3. To be able to apply analysis methods to determine circuit properties of passive/active microwave devices.
4. To understand the antenna characteristics, losses, radiation patterns and their applications.
5. To determine the performance characteristics of a radar system using computer aided design methods.

Course Contents

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

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

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

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

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

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	**Develop** basic understanding and in depth knowledge on microwave transmission line, waveguide, microwave tube and solid state microwave devices.			H									
CLO2	**Apply** different microwave theory and analyze different microwave system's parameter like Transmission Co-efficient, Reflection Co-efficient, VSWR etc.	H											
CLO3	**Identify** the characteristics of microwave devices and circuits along with the contemporary issue in the field of microwave engineering.		H										
CLO4	**Analyze** different types of Radar Displays and their application in real time scenario.		H										

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	**Develop** basic understanding and in depth knowledge on microwave transmission line, waveguide, microwave tube and solid state microwave devices.	P.03.2	C3				CT
CLO2	**Apply** different microwave theory and analyze different microwave system's parameter like Transmission Co-efficient, Reflection Co-efficient, VSWR etc.	P.01.3	C3	K3			ASG
CLO3	**Identify** the characteristics of microwave devices and circuits along	P.02.1	C4	K1 K2	P1 P2		CT, SF

	with the contemporary issue in the field of microwave engineering.			K3	P6		
CLO4	**Analyze** different types of Radar Displays and their application in real time scenario.	P.02.3	C4	K4	P1 P2 P6		CT, SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1
	CT (1-3)	20%	CLO1,3,4	C2, C6
	ASG	5%	CLO2	C3
Semester Final (70%)	SF	70%	CLO3,4	C4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Microwave Transmission Lines	1	CT1	L D SDL
	L2	Transmission Line Analogy	1		
	L3	Voltage and current in ideal transmission lines	1		
W2	L4	Reflection	1		
	L5	Transmission, Standing wave	1		
	L6	Impedance Matching Techniques	1		
W3	L7	Smith Chart and Its Applications	1		
	L8	Waves Propagation in Guided Media	1		
	L9	Propagation through Parallel-Plate Wave Guides	2		
W4	L10	Rectangular and Circular Wave Guides	2		
	L11	Dominant and degenerate modes	2		
	L12	Field patterns	2		
W5	L13	Cavity Resonators	2	CT2 ASG	L D SDL
	L14	Microwave systems	2		
	L15	Classification of microwave tubes	2		
W6	L16	Klystron amplifier, Reentrant cavities	2		
	L17	Velocity Modulation	2		
	L18	Space Charge wave	2		
W7	L19	Multicavity Klystron Amplifier, Reflex Klystron Oscillator	2		

	L20	Magnetron	2		
	L21	Travelling Wave Tube (TWT) Amplifier	2		
Mid Break					
W8	L22	Backward Wave Oscillator (BWO),	2	CT3 CP SF	L D SDL
	L23	Waveguide Components.	2		
	L24	Gunn diode	2		
W9	L25	Energy band structure of Gunn diode	3		
	L26	Gunn oscillator	3		
	L 27	Different modes of Gunn diode oscillator, Application of Gunn diode	3		
W10	L 28	PIN diode as modulator, Solid state devices used as microwave amplifier	3		
	L 29	Applications of solid state microwave devices	3		
	L 30	Microwave Industrial applications of Microwaves	3		
W11	L 31	Microwave Heating Radiation Hazards.	3	SF	L D SDL
	L 32	**Introduction** to Radar	4		
	L 33	Radar Equation CZ	4		
W12	L 34	Operating Principle of Radar with Block Diagram	4		
	L 35	CW and FM Radar	4		
	L 36	Tracking Radar	4		
W13	L 37	Antennas for Radar	4	CP SF	L D SDL
	L 38	Radar Receivers	4		
	L 39	Radar Transmitting System, Duplexer	4		
W14	L 40	Usable Frequencies for Radar	4		
	L 41	Radar Applications.	4		
	L 42	Review class	4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1 D. M. Pozar, Microwave Engineering, Second Edition, Scientific Research, John Wiley & Sons, 1998.

2 Microwave Devices and Circuits, Prentice Hall of India, Samuel Y. Liao;

3 Foundations for Microwave Engineering, McGraw-Hill International, E. Colliong.

4 Introduction to Radar systems, McGraw Hill, Tata.

4.2.2 ICE 4*30: Microwave Engineering and Radar Lab

Course Information			
Course Code Course Title	: ICE 4*30 : Microwave Engineering and Radar lab	Credit Hours Contact Hour	: 1.5 : 3.0

Pre-Requisite

None

Rationale

To practically understand and investigate the basics of microwave devices as well as their radiation patterns, beam width, losses etc. along with radar communication system and its operation.

Objective

1. To get practical ideas about microwave theories.
2. To develop skills about different tools regarding microwaves.

Course Contents

In this course students will perform experiments to verify practically the theories and concepts learned in Microwave Engineering and Radar course.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	**Select and Apply appropriate techniques to Demonstrate** the characteristics of Microwave sources, receiver, directional coupler and effect of microwave signal on the environment.					H							
CLO2	**Investigate and analyze** microwave measurement procedures using small scale microwav based systems in individual or group.				H								
CLO3	**Evaluate sustainability of** the characteristics of microwave components analyze the microwave parameters such as VSWR, attenuation, gain etc. of microwave system.							H					

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	**Select and Apply appropriate techniques to Demonstrate** the characteristics of Microwave sources, receiver, directional coupler and effect of microwave signal on the environment.	P.05.1	C3		P1 P2 P6		Q
CLO2	**Investigate and analyze** microwave measurement procedures using small scale microwave based systems in individual or group.	P.04.2	C4				Q, R, LT
CLO3	**Evaluate sustainability of the** characteristics of microwave components analyze the microwave parameters such as VSWR, attenuation, gain etc. of microwave system.	P.07.1	C5	K7	P1 P2 P6		Q, LP

*LP = Lab Performance, LT = Lab Test, Q = Quiz, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)

Face-to-Face Learning Lecture Experiment	 6 30
Self-directed learning Preparation for lab reports Preparation for lab test Preparation of quiz Engagement in project/Assignment	21 5 5 21
Formal Assessment Continuous assessment Final Quiz Lab Test/Project show	 - 1 1
Total	90

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Viva	10%	CLO1,2,3	C3,4,5
Report Writing	20%	CLO2	C4
Lab Performance	20%	CLO3	C5
Lab Test	30%	CLO2	C4
Quiz	20%	CLO1,2,3	C3,4,5
Total Marks	100%		

Lab Schedule

Week	Topic
Week 1	Study of Microwave Components & Instruments.
Week 2	Study and Development of Reflex Klystron.
Week 3	Study and Development of Gunn Oscillator.
Week 4	Study of microwave frequency measurement.
Week 5	Review & Practice Lab-1
Week 6	Lab Test-1
Week 7	Study and measurement of unknown load impedance.
Week 8	Study the characteristics of variable attenuator.
Week 9	Study and measuring of VSWR.
Week 10	Study of Horn antenna characteristics
Week 11	Study of power division in Magic Tee.
Week 12	Review & Practice Lab-2
Week 13	Lab Test-2
Week 14	Viva- voce and Quiz Test

Text and Reference Books

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

4.2.3 ICE 4*31 Telecommunication Engineering

Course Information

Course Code	: ICE 4*31	Credit Hours	: 3.0
Course Title	: Telecommunication Engineering	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

The course Telecommunication Engineering is designed to familiarized students to design and install equipment used for transmitting wired phone, cellular, cable and broadband data as well as working with copper or fiber optic cabling, complex networks and switching systems in order to enable companies to communicate effectively with customers and deliver high standards of customer service.

Objective

1. To perceive knowledge about components and techniques of telecommunication system.
2. To develop knowledge on design and management of various telecommunication system.
3. To develop skill on identification of telecommunication problems solving.
4. To acquire the knowledge and expertise in the field of telecommunication hardware.

Course Contents

Introduction: overview of telecommunication; history, evolution, convergence of telecommunication and data networks, National and International regulatory bodies;
Basic elements of Telecommunication: Telephone apparatus, microphone, speaker, ringer, pulse and tone dialing mechanism, local and central batteries and advanced systems of power supplies;
Transmission media: Characteristics and applications of twisted pairs, coaxial cables and optical fibers, Terrestrial and satellite microwave, radio waves, VSAT;
Telephone operating principles: telephone equipment, description of the modern phone; Telephone switching systems: PSTN, PBX, standards;
Basics of communication systems: modulation, multiplexing;
Switching system: circuit switching, packet switching;
Traffic analysis: Traffic characterization, grades of service, network blocking probabilities, delay system and queuing, Integrated services digital network (ISDN), Digital subscriber loop (DSL);
Data communication equipment: Tele-Traffic analysis;
Cellular telephony: Frequency reuse, frequency management, channel alignment, handoff strategies, FDMA, TDMA, CDMA and GSM, Introduction to satellite communication, Optical fiber communication, Submarine cables, Digital Radio Microwave, etc.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Apply fundamental knowledge to demonstrate telecommunications systems.	H											
CLO2	Learn to design, implement, and manage Telecommunications systems using voice and data.			H									
CLO3	Model telecommunications systems and networks in order to identify and solve problems.				M								
CLO4	Acquire the knowledge and expertise in the field of telecommunication hardware.					M							

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Apply fundamental knowledge to demonstrate telecommunications systems.	P.01.3	C3	K3			CT, SF, CP
CLO2	Learn to design, implement, and manage Telecommunications systems using voice and data.	P.03.1	C2		P1 P3 P7		CT, SF
CLO3	Model telecommunications systems and networks in order to identify and solve problems.	P.04.3	C6		P1 P4 P5		CT, SF
CLO4	Acquire the knowledge and expertise in the field of telecommunication hardware.	P.05.1	C3		P1 P2 P6		ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C3
	CT (1-3)	20%	CLO1,2,3	C3, C4, C6
	ASG	5%	CLO4	C4
Semester Final (70%)	SF	70%	CLO1,2,3	C3, C4, C6
Total Marks		100%		

Course Plan

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Introduction: Overview of Telecommunication	1	CT1 CP SF	L D SDL
	L2	History of Telecommunication	2		
	L3	Evolution of Telecommunication	1		
W2	L4	Convergence of Telecommunication Data	1,2		
	L5	Networks	2		
	L6	Introduction: Regulatory Bodies	2		
W3	L7	National Regulatory Bodies	2		
	L8	International Regulatory Bodies	3		
	L9	International Regulatory Bodies (Contd.)	1		
W4	L10	Basic Elements of Telecommunication,	1,2		
	L11	Telephone Apparatus, Microphone	2,3		

	L12	Speaker and Ringer, Pulse and Tone Dialing Mechanism, Local and Central Batteries	3		
W5	L13	Advanced Systems of Power	3	CT2 CP SF	L D SDL
	L14	Supplies Transmission Media	2,3		
	L15	Characteristics and Applications: Twisted Pairs	2		
W6	L16	Characteristics and Applications: Coaxial Cable	1		
	L17	Characteristics and Applications: Optical Fibers Terrestrial	2		
	L18	Microwave	2		
W7	L19	Satellite	2		
	L20	Radio Waves, Microwave	2		
	L21	VSAT	3		
W8	L22	Telephone Operating	1,2	CT3 CP SF	L D SDL
	L23	Principles Telephone Equipment	2		
	L24	Description of a Modern Phone	3		
W9	L25	PSTN, PBX	2		
	L26	Standards Modulation Multiplexing	3		
	L 27		3		
W10	L 28	Switching System	1,2		
	L 29	Circuit Switching	1,2		
	L 30	Packet Switching	2		
W11	L 31	Traffic Characterization	2	ASG SF	L D SDL
	L 32	Traffic Analysis	2		
	L 33	Grades ofService	1		
W12	L 34	ISDN DSL	2		
	L 35	Cellular Telephony	1		
	L 36	Cellular Telephony	3,4		
W13	L 37	FDMA	2	CP SF	L D SDL
	L 38	CDMA TDMA, GSM	1,2		
	L 39	Introduction to Satellite Communication	3,4		
W14	L 40	Optical Fibre Communication	1		
	L 41	Submarine Cables, Digital radio Microwave	1,2		
	L 42	Review	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1. Introduction to Telecommunication: Voice, Data and the Internet–Marion Cole;Prentice Hall (2010)
2. Essential Guide to Telecommunications (5th Edition)-Annabel Z. Dodd; Prentice Hall (2012)
3. Optical Fiber Communication: Principles and Practice (3rd Edition)–John M Senior; Pearson (2010)
4. Modern Digital and Analog Communication System (4th Edition)–B P Lathi; Oxford (2011)

4.2.4 ICE 4*33: Information Theory and Coding

Course Information			
Course Code Course Title	: ICE 4*33 : Information Theory and Coding	Credit Hours Contact Hour	: 3.0 : 3.0
Pre-Requisite			
None			
Rationale			

The Information System Design and Management course motivates to calculate entropy, joint entropy, relative entropy, conditional entropy, and channel capacity of a system. It develop the knowledge to differentiate between lossy and lossless compression techniques, decide an efficient data compression scheme for a given information source and the impact of feedback and/or many senders or receivers on the communication systems.

Objective

1. To quantify the notion of information in a mathematically sound way
2. To explain what is the significance of this quantitative measure of information in the communications systems
3. To calculate entropy, joint entropy, relative entropy, conditional entropy, and channel capacity of a system
4. To differentiate between lossy and lossless compression techniques
5. To decide an efficient data compression scheme for a given information source
6. To explain the impact of feedback and/or many senders or receivers on the communication systems

Course Contents

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

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

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

Source Coding and Data Compression: Kraft Inequality; McMillan's Theorem; Optimal Codes; Bounds on the Optimal Code Length; Kraft Inequality for Uniquely Decodable Codes; Huffman Codes; Shannon–Fano–Elias Coding; Universal Codes and Channel Capacity, Run-Length Coding; Arithmetic Coding, Higher-Order Modeling, The Lempel-Ziv Algorithm.

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

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Understand the fundamentals of information theory the significance of codes in various applications.	M											
CLO2	Design encoders and decoders for block and cyclic codes and Obtain knowledge in designing various source codes and channel codes			H									
CLO3	Measure information, entropy and errors.		H										

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Understand the fundamentals of information theory the significance of codes in various applications.	P.01.3	C3	K3			CT, SF, CP
CLO2	Develop and design encoders and decoders for block and cyclic codes and Obtain knowledge in designing various source codes and channel codes	P.03.3	C6	K5	P1 P4 P6		CT, SF
CLO3	Formulate and measure information, entropy and errors.	P.2.2	C4				CT, SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C3
	CT (1-3)	20%	CLO1,2,3	C3, C4, C6
	ASG	5%	CLO4	C4
Semester Final (70%)	SF	70%	CLO1,2,3	C3, C4, C6
Total Marks		100%		

Course Plan

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Introduction to subject: Objectives, Outcomes, reference book	1	CT1 CP SF	L D SDL
	L2	History: Shannon, Bell Labs, Overview of Shannon theory; Channels: Source coding and Channel coding,	2		
	L3	General coding problem: Source and channel coding, Motivating Example: Hamming - linear code;	1		
W2	L4	Error probabilities for Hamming code, Information sources	1,2		
	L5	Discrete probability distributions, bivariate distributions, joint probabilities, marginal probabilities, conditional probabilities,	2		
	L6	Weatherman example	2		

W3	L7	Entropy of source, Basic entropy inequalities, Binomial coefficients and entropy	2		
	L8	Entropy properties (cont'd), Binomial coefficients and entropy (cont'd), Shape of binomial distribution, Entropy as an expected value	3		
	L9	Convexity down of entropy function, Source coding: compression	1		
W4	L10	Variable length codes, uniquely decipherable codes, Kraft Inequality Theorem (necessity)	1,2		
	L11	Instantaneous codes, Prefix tree for prefix code, Kraft's theorem (sufficiency)	2,3		
	L12	Entropy lower bound for average length, Jensen's convexity inequality (started)	3		
W5	L13	Jensen's convexity inequality (handout), 8.0b Noiseless codes and trees, Huffman coding (N=2) example, Huffman coding algorithm, proof by trees	3	CT2 CP SF	L D SDL
	L14	Huffman code, base 3 example, Noiseless coding theorem	2,3		
	L15	Extensions of source theorem, Lempel-Ziv encoding	2		
W6	L16	Source coding [Noiseless coding], Discrete memoryless channel, channel matrix	1		
	L17	Channel distribution: conditional entropy, Mutual information I(X; Y); channel capacity, Types of channels.	2		
	L18	Channels and three probability matrices, Conditional entropy-review, Types of channels, symmetric C. lossless, D. noiseless, E. deterministic,	2		
W7	L19	Channel capacity, Lossless capacity, deterministic capacity, Symmetric channel entropy theorem, capacity of binary symmetric channel	2		
	L20	Channel capacity-review Lossless, noiseless channel, Block codes and their rates, Channel transmission and decoding	2		
	L21	Decoder performance, Ideal observer decoder Noisy coding theorem statement	3		
W8	L22	Row Symmetric channel-review Block codes, Decision scheme, error rate, Maximum likelihood decoding	1,2	CT3 CP SF	L D SDL
	L23	Noisy coding theorem statement, Fano's Inequality	2		
	L24	Weak Converse noisy coding theorem	3		
W9	L25	Noisy Coding Theorem proof for BSC, Hamming balls, Reduction max error to average error, Proof of BSC Noisy coding theorem-average error case	2		
	L26	Fano inequality handout, Noisy coding theorem review, Minimum distance decoding	3		
	L 27	Error detection and correction, Packing and covering radii, Nonlinear code parameters.	3		
W10	L 28	General Existence Problems for Codes; Maximal codes, maximal distance decoding	1,2		
	L 29	Perfect codes, Finite fields versus finite rings, Equivalence of codes	1,2		
	L 30	Scalar multiple equivalence of codes, Linear codes, cyclic codes, New codes from old; A. Extending a code, B. Puncturing a code	2		

W11	L 31	C. Expunging a code, D. Augmenting a code, E. Shortening a code, F. Direct sum construction	2	ASG SF	L D SDL
	L 32	New codes from old. E. (u, u+v) construction, Linear codes: generator matrices, Dual of linear code: dual generator matrix	2		
	L 33	Linear Codes, Dual Codes, Parity Check Matrix and Minimal distance,	1		
W12	L 34	Gilbert-Varshamov lower bound, Syndrome decoding of linear code	2		
	L 35	Hamming codes, Simplex Codes, Majority logic decoding, Burst Errors	1		
	L 36	Burst errors, Binary Golay code G{24}, Upper Bounds for nonlinear codes	3,4		
W13	L 37	Singleton Bound, Sphere-Packing Bound, Plotkin Bound, Example [n, d] = [8,5] for q=2.	2	CP SF	L D SDL
	L 38	Homework review, Asymptotic bounds for codes, Weight enumerators, MacWilliams identities (stated)	1,2		
	L 39	Mac Williams Identity I, Krawtchouk Polynomials, Mac Williams Identity II, 25.3 Characters on F q and V(n, F_q),	3,4		
W14	L 40	Weight enumerators of Perfect codes; Binary Golay code G{23], Characters and Linear Codes.	1		
	L 41	Proof of Mac Williams I, identity, Information theory versus coding theory; entropy of source, of channel, of coding and decoding	1,2		
	L 42	MacWilliam's identities: applications, Singleton bound, Minimum distance separable codes	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

5. Elements of Information Theory, Wiley, T. M. Cover, J. A. Thomas.
6. Fundamentals of Information Theory and Coding Design, Taylor and Francis, R. Togneri, C.J.S DeSilva
7. Information Theory Coding and Cryptography, Tata McGraw Hill, R. Bose.
8. The Theory of Information and Coding, Cambridge University Press, R. J. McElwee.

4.2.5 ICE 4*35 Internet of Thing (IoT)

Course Information			
Course Code	: ICE 4*35	Credit Hours	: 3.0
Course Title	: Internet of Thing (IoT)	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

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

Objective

1. To understanding of how IoT systems are developed.
2. To understand how IoT systems contribute in industrial revolution.
3. To understand the challenges and issues (security, safety) of IoT.
4. to teach students to use computer aided tools and techniques for designing IoT devices.

Course Contents

Introduction to Internet of Things: Definition & Characteristics of IoT, Physical Design of IoT, Things in IoT, IoT Protocols, Logical Design of IoT, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies, history and emergence of IoT.

Applications of IoT: case studies on a number of industries - power, water, healthcare, transportation, oil and gas, construction, agriculture, gene sequencers, mining and race cars.

IoT Enabling Technologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, introductory concept of IoT and big data.

Domain Specific IoTs I: Home Automation, Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/Gas Detectors, Cities- Smart Parking, Smart Lighting, Structural Health Monitoring, Surveillance, Environment Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection, River Floods Detection.

Domain Specific IoTs II: Energy- Smart Grids, Renewable Energy Systems, Prognostics, Retail- Inventory Management, Smart Payments, Smart Vending Machines, Logistics- Route Generation &Scheduling, Shipment Monitoring, Remote Vehicle Diagnostics, Agriculture- Smart Irrigation, Green House Control, Industry- Machine Diagnosis & Prognosis, Indoor Air Quality Monitoring, Health & Lifestyle, Wearable Electronics.

IoT Platforms Design Methodology: Process Specification, Domain Model Specification, Information Model Specification, Service Specifications, IoT Year Specification, Functional View Specification, Operational View Specification, Device & Component Integration, Case Study on IoT System for Weather Monitoring, IoT Physical Devices & Endpoints, Basic building blocks of an IoT Device, Exemplary Device: Raspberry Pi, pc Duino, Beagle Bone Black, Cubie board.

IoT Physical Servers & Cloud Offerings: Introduction to Cloud Storage Models & Communication APIs, WAMP - AutoBahn for IoT, Xively Cloud for IoT, Django Architecture, Starting Development with Django, Amazon Web Services for IoT, Amazon EC2, Amazon Auto Scaling, Amazon S3, Amazon RDS, Amazon Dynamo DB, Amazon Kinesis, Amazon SQS, Amazon EMR, Sky Net IoT Messaging Platform.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Understand fundamental concepts and the details of architectural framework of IoT.	H											
CLO2	Design the architecture and network models of IoT technology and apply appropriately to different types of industrial context			H									
CLO3	Analyze the challenges, security and safety issues of an IoT system.		H										

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Understand fundamental concepts and the details of architectural framework of IoT.	P.01.1	C1 C3	K1			CT, SF, CP
CLO2	Design the architecture and network models of IoT technology and apply appropriately to different types of industrial context	P.03.2	C3		P1, P3, P7		CT, SF, ASG
CLO3	Analyse the challenges, security and safety issues of an IoT system.	P.02.3	C4	K4	P1 P2 P6		CT, SF, ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1, C3
	CT (1-3)	20%	CLO1,2,3	C1, C2, C3, C4
	ASG	5%	CLO2,3	C3, C4, C6
Semester Final (79%)	SF	70%	CLO1,2,3	C1, C2, C3, C4, C6
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Definition & Characteristics of IoT.	1	CT1 CP SF	L D SDL
	L2	Physical Design of IoT, Things in IoT, IoT Protocols.	2		
	L3	Logical Design of IoT, IoT Communication Models.	1		
W2	L4	IoT Communication Models.	1,2		
	L5	IoT Communication APIs.	2		
	L6	IoT Enabling Technologies, history and emergence of IoT.	2		
W3	L7	Case studies on a number of industries - power, water.	2		
	L8	Case studies on a number of industries - healthcare, transportation, oil and gas.	3		
	L9	Case studies on a number of industries -construction, agriculture.	1		
W4	L10	Case studies on a number of industries - gene sequencers, mining and race cars.	1,2		

	L11	Wireless Sensor Networks, Cloud Computing.	2,3		
	L12	Big Data Analytics, Communication Protocols.	3		
W5	L13	Embedded Systems.	3	CT2 CP SF	L D SDL
	L14	Introductory concept of IoT and big data.	2,3		
	L15	Home Automation, Smart Lighting.	2		
W6	L16	Smart Appliances, Intrusion Detection.	1		
	L17	Smoke/Gas Detectors	2		
	L18	Structural Health Monitoring,	2		
W7	L19	Cities- Smart Parking	2		
	L20	Surveillance, Environment Weather Monitoring.	2		
	L21	Air Pollution Monitoring, Noise Pollution Monitoring.	3		
Mid Break					
W8	L22	Forest Fire Detection, River Floods Detection.	1,2	CT3 CP SF	L D SDL
	L23	Energy- Smart Grids, Renewable Energy Systems, Prognostics,	2		
	L24	Retail- Inventory Management, Smart Payments, Smart Vending Machines,	3		
W9	L25	Logistics- Route Generation &Scheduling, Shipment Monitoring,	2		
	L26	Remote Vehicle Diagnostics, Agriculture- Smart Irrigation,	3		
	L 27	Green House Control, Industry- Machine Diagnosis & Prognosis,	3		
W10	L 28	Indoor Air Quality Monitoring, Health & Lifestyle, Wearable Electronics.	1,2		
	L 29	Process Specification, Domain Model Specification.	1,2		
	L 30	Information Model Specification, Service Specifications, IoT Year Specification.	2		
W11	L 31	Functional View Specification, Operational View Specification.	2	ASG SF	L D SDL
	L 32	Device & Component Integration, Case Study on IoT System for Weather Monitoring.	2		
	L 33	IoT Physical Devices & Endpoints, Basic building blocks of an IoT Device.	1		
W12	L 34	Exemplary Device: Raspberry Pi, pc Duino, Beagle Bone Black, Cubie board.	2		
	L 35	Introduction to Cloud Storage Models & Communication APIs.	1		
	L 36	WAMP – Auto Bahn for IoT, Xively Cloud for IoT	3,4		
W13	L 37	Django Architecture, Starting Development with Django.	2	CP SF	L D SDL
	L 38	Amazon Web Services for IoT, Amazon EC2.	1,2		
	L 39	Amazon Auto Scaling, Amazon S3, Amazon RDS	3,4		
W14	L 40	Amazon Dynamo DB, Amazon Kinesis.	1		
	L 41	Amazon SQS, Amazon EMR, Sky Net IoT Messaging Platform.	1,2		
	L 42	Review	1-4		
*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.					
Text and Reference Books					

1. Internet of Things, The: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World, Que Pub, Miller Michael.
2. Analytics for the Internet of Things (IoT): Intelligent analytics for your intelligent devices, Packt Publishing, Andrew Minteer.
3. The Amazon Way on IoT: 10 Principles for Every Leader from the World's Leading Internet of Things Strategies, John E. Rossman, John Rossman

4.3 List of Elective Courses for Interdisciplinary

4.3.1 ICE 4*37: Digital Image Processing

Course Information			
Course Code Course Title	: ICE 4*37 : Digital Image Processing	Credit Hours Contact Hour	: 3.0 : 3.0

Pre-Requisite

Course Code: None
Course Title: None

Rationale

Digital Image Processing course is designed to introduce the fundamentals of image processing and manipulation of television, medical imaging modalities such as X-Ray, Ultrasound (US), MRI, photography, security, astronomy and remote sensing.

Objective

1. To describe image formation and the role human visual system plays in perception of gray and color image data.
2. To explain the basic elements and applications of image processing.
3. To select and analyze image sampling and quantization requirements and implications.
4. To perform gray level transformations for Image enhancement.

Course Contents

Digital image fundamentals: visual perception, Light and Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Some basic relationships between 245 pixels, Linear and

Nonlinear operations; image transforms: First Fourier Transform (FFT), Discrete Cosine Transform (DCT), Karhunen and Loeve Transform (KLT).

Wavelet transform and sub -band decomposition; image enhancement in the frequency domain and image restoration techniques, image compression techniques, image compression standards: JPEG,MPEG, H.261, and H.263, Image Filter, Image Segmentation.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Understand image formation and the role of human visual system in perception of gray and color image data	H											
CLO2	Evaluate the basic objectives and		H										

	applications of image processing.												
CLO3	Analyze image sampling and quantization requirements and implications			H									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Understand image formation and the role of human visual system in perception of gray and color image data.	P.01.1	C2	K3	P1	-	CT, SF,CP
CLO2	Evaluate the basic objectives and applications of image processing.	P.02.2	C5	K5	P2	-	CT, SF
CLO3	Analyze image sampling and quantization requirements and implications	P.03.2	C4	K3	P1	-	CT, SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C2
	CT (1-3)	20%	CLO1,2,3	C2, C5, C4
	ASG	5%	CLO3	C4
Semester Final (70%)	SF	70%	CLO1,2,3	C2, C5, C4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Digital image fundamentals, Visual perception Light and Electron genetic Spectrum	1	CT1 CP SF	L D SDL
	L2	Digital image fundamentals, Visual perception Light and Electron genetic Spectrum	2		
	L3	Digital image fundamentals, Visual perception Light and Electron genetic Spectrum	1		

W2	L4	Image Sensing and Acquisition, Image Sampling and Quantization, Basic relationships between pixels	1,2		
	L5	Image Sensing and Acquisition, Image Sampling and Quantization, Basic relationships between pixels	2		
	L6	Image Sensing and Acquisition, Image Sampling and Quantization, Basic relationships between pixels	2		
W3	L7	Linear and Nonlinear operations, Image transforms, First Fourier Transform (FFT)	2		
	L8	Linear and Nonlinear operations, Image transforms, First Fourier Transform (FFT)	3		
	L9	Linear and Nonlinear operations, Image transforms, First Fourier Transform (FFT)	1		
W4	L10	Discrete Cosine Transform (DCT) Karhunen and Loeve Transform (KLT)	1,2		
	L11	Discrete Cosine Transform (DCT) Karhunen and Loeve Transform (KLT)	2,3		
	L12	Discrete Cosine Transform (DCT) Karhunen and Loeve Transform (KLT)	3		
W5	L13	Wavelet Transform	3	CT2 CP SF	L D SDL
	L14	Wavelet Transform	2,3		
	L15	Wavelet Transform	2		
W6	L16	Sub-Band Decomposition	1		
	L17	Sub-Band Decomposition	2		
	L18	Sub-Band Decomposition	2		
W7	L19	Image restoration technique, Properties of Noise Estimation of Noise Parameters	2		
	L20	Image restoration technique, Properties of Noise Estimation of Noise Parameters	2		
	L21	Image restoration technique, Properties of Noise Estimation of Noise Parameters	3		
Mid Break					
W8	L22	Filters, Mean Filter, Bandpass and Band reject Filter, Notch Filter and Inverse Filter	1,2		
	L23	Filters, Mean Filter, Bandpass and Band reject Filter, Notch Filter and Inverse Filter	2		
	L24	Filters, Mean Filter, Bandpass and Band reject Filter, Notch Filter and Inverse Filter	3		
W9	L25	Color Image Processing, Fundamentals, Models Smoothing and Sharpening	2		
	L26	Color Image Processing, Fundamentals, Models Smoothing and Sharpening	3	CT3 CP SF	L D SDL
	L 27	Color Image Processing, Fundamentals, Models Smoothing and Sharpening	3		
W10	L 28	Image compression techniques, Coding Redundancy, Measuring Image Information	1,2		
	L 29	Image compression techniques, Coding Redundancy, Measuring Image Information	1,2		
	L 30	Image compression techniques, Coding Redundancy, Measuring Image Information	2		
W11	L 31	Image compression standards, JPEG, MPEG, H.261, and H.26	2	ASG SF	

	L 32	Image compression standards, JPEG, MPEG, H.261, and H.26	2		L D SDL
	L 33	Image compression standards, JPEG, MPEG, H.261, and H.26	1		
W12	L 34	Image Enhancement in the Frequency Domain	2		
	L 35	Image Enhancement in the Frequency Domain	1		
	L 36	Image Enhancement in the Frequency Domain	3		
W13	L 37	Image Segmentation, Detection of Discontinuities Thresholding	2	CP SF	L D SDL
	L 38	Image Segmentation, Detection of Discontinuities Thresholding	1,2		
	L 39	Image Segmentation, Detection of Discontinuities Thresholding	3		
W14	L 40	Edge Linking, Boundary Detection	1		
	L 41	Edge Linking, Boundary Detection	1,2		
	L 42	Summary, Review and Open discussion	1-3		
*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.					
Text and Reference Books					
1. Digital Image Processing (3rd/2nd Edition) - R. C. Gonzalez and R.E. Woods; Pearson Prentice Hall (2009) 2.A. K. Jain: Fundamentals of Digital Image Processing, Academic Press 3.Bovik, "Handbook of Image & Video Processing", Academic Press, 2000					

4.3.2 ICE 4*38 : Digital Image Processing Lab

Course Information			
Course Code Course Title	: ICE 4*38 : Digital Image Processing Lab	Credit Hours Contact Hour	: 0.75 : 1.50
Pre-Requisite			
None			
Rationale			
This course is designed to cover the basic theory and principles of digital image processing techniques and basic video processing. The course will give emphasis in image processing techniques like basic point processing, image filtering in spatial/frequency domain and the applications in image enhancement or other related applications. The overall knowledge will be used in some high-level image processing approach like segmentation, compression, clustering, and others.			
Objective			
1.To provide an introduction to basic concepts and methodologies for the formation, representation, enhancement, and analysis of digital images and video processing. 2.To gain practical experience in the design and implementation of image processing algorithms. 3.To provide a foundation for using modern tools and for further study in the field.			
Course Contents			
Digital Image Fundamentals, Bilevel Image Processing, Binarization of Grey Level Images, Edge Detection, Image Enhancement, Image Segmentation, Image Compression and fundamental of Video processing			
Course Learning Outcomes (CLOs) and Mapping with the PLOs			

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Learn basic image and video processing theories and their real-world applications	H											
CLO2	Understand the role of human visual system and solve problems in perception of gray and color image data.		H										
CLO3	Learn to use image processing related tools for image acquisition, manipulation, storage, and conversion.					H							
CLO4	Investigate and solve various problems using digital imaging techniques				H								

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Learn basic image and video processing theories and their real-world applications	P.01.1	C3				LP, Q
CLO2	Understand the role of human visual system and solve problems in perception of gray and color image data.	P.02.2	C4				LT
CLO3	Learn to use image processing related tools for image acquisition, manipulation, storage, and conversion.	P.05.1	C2				P, R, Q
CLO4	Investigate and solve various problems using digital imaging techniques	P.04.1	C4, P1				LT, Q

*LP = Lab Performance, LT = Lab Test, Q = Quiz, R=Report, P= Project EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	3
Experiment	15
Self-directed learning	
Preparation for lab reports	15
Preparation for lab test	3
Preparation of quiz	2.5
Engagement in group project	15
Formal Assessment	
Continuous assessment	6
Final Quiz	**0.5**
Total	60

Assessment Strategy (AS)

Assessment Tools	Grading	CLO	Blooms Taxonomy
Lab P**erformance**	10%	CLO1	C1, C2
L**ab Test**	20%	CLO2	C2, C3
Project /Group Presentation	20%	CLO3	C2, C3
Quiz	30%	CLO1	C4, P1
Lab Report	20%	CLO1,2,3	C2-C4, P1
Total Marks	100%		

Lab Schedule

Week	**Topic**
Week 1	Introduction to basic Video processing
Week 2	
Week 3	Introduction to Gray Level Transformation using MATLAB
Week 4	
Week 5	Introduction to Spatial Filtering using MATLAB.
Week 6	Review & Practice Lab-1
Week 7	Lab Test-1
Week 8	Introduction to Color Image Manipulation using MATLAB.
Week 9	
Week 10	Introduction to Image Histogram and Histogram Equalization using MATLAB.
Week 11	
Week 12	Introduction to Morphological Operations on Binary Images using MATLAB.
Week 13	Review & Practice Lab-2
Week 14	Lab Test-2

Text and Reference Books

1. Digital Image Processing (3rd/2nd Edition) - R. C. Gonzalez and R.E. Woods; Pearson Prentice Hall (2009)
2. A. K. Jain: Fundamentals of Digital Image Processing, Academic Press
3. Mark S. Nixon & Albert S. Aguado: Feature Extraction and Image Processing, Academic Press
4. William K. Pratt: Digital Image Processing, Wiley-Interscience

4.3.3 ICE 4*39: Biomedical Engineering

Course Information			
Course Code Course Title	: ICE 4*37 : Biomedical Engineering	Credit Hours Contact Hour	: 3.0 : 3.0

Pre-Requisite

None

Rationale

To give a brief introduction to human physiology and various instrumentations system for the measurement and analysis of physiological parameters. The target of the course is to enable the students to have a firm foundation on the mechanisms of the biomedical instruments in use with an aim to provide the student with a strong base to work in the biomedical industry.

Objective

1. To impart basic knowledge on the canonical structure of biomedical instrumentation systems.
2. To introduce the students with the qualitative functions of the four primary system components (sensors, actuators, electronics interface, computation unit)
3. To impart in depth knowledge on the static and dynamic performance characteristics for instrumentation systems.
4. To develop a student‘s skills on the mechanisms of the existing biomedical instruments in order to enable the student to work in the practical field.

Course Contents

Human body: Cells and physiological systems,

Bioelectricity: Genesis and characteristics.

Measurement of bio-signals: Ethical issues, sensors, actuators, transducers, amplifiers and filters.

Electrocardiogram: Electrocardiography, phono cardiograph, vector cardiograph, analysis and interpretation of cardiac signals, cardiac pacemakers and defibrillator.

Blood pressure: Systolic, diastolic mean pressure, Electronics manometer, detector circuits and

practical problems in pressure monitoring, Blood flow measurement: Plethysmography and electromagnetic flow meter.

Measurement and interpretation: Electroencephalogram, cerebral angiograph and chronical X-ray, brain scans, electromyogram (EMG).

Tomography: Positron emission tomography and computer tomography, magnetic resonance imaging (MRI), ultrasonogram, patient monitoring system and medical telemetry, effect of electromagnetic fields on human body.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Be able to describe the structural evolution of the biomedical instrumentation systems.	M											
CLO2	Be able to distinguish among the functions of the fundamental system			H									

	components												
CLO3	Be able to analyses the efficiency of performance of the existing models in instrumentation systems.	H											
CLO4	Be able to operate the biomedical instruments in use and plan for further improvement.		M										

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Be able to describe the structural evolution of the biomedical instrumentation systems.	P.01.1	C3	K2		-	CT, SF, CP
CLO2	Be able to distinguish among the functions of the fundamental system components	P.03.2	C2	K5		-	CT, SF
CLO3	Be able to analyses the efficiency of performance of the existing models in instrumentation systems.	P.01.2	C3	K4	P1	-	CT, SF
CLO4	Be able to operate the biomedical instruments in use and plan for further improvement.	P.02.3	C4	K4	P2	1	ASG

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C1
	CT (1-3)	20%	CLO1,2,3	C2
	ASG	5%	CLO4	C6
Semester Final (70%)	SF	70%	CLO1,2,3	C1, C2, C4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Cells and physiological systems	1	CT1	

	L2	Cells and physiological systems	2	CP SF	
	L3	Cells and physiological systems	1		
W2	L4	Genesis and characteristics.	1		
	L5	Genesis and characteristics.	2		
	L6	Genesis and characteristics.	2		L D SDL
W3	L7	Ethical issues	2		
	L8	transducers	3		
	L9	amplifiers and filters	1		
W4	L10	Electrocardiography	1,2		
	L11	Electrocardiography	2,3		
	L12	phono cardiograph	3		
W5	L13	vector cardiograph	3		
	L14	vector cardiograph	2,3		
	L15	analysis and interpretation of cardiac signals	2		
W6	L16	analysis and interpretation of cardiac signals	1	CT2 CP SF	L D SDL
	L17	Cardiac pacemakers and defibrillator.	2		
	L18	Cardiac pacemakers and defibrillator.	2		
W7	L19	Systolic, diastolic mean pressure	2		
	L20	Electronics manometer	2		
	L21	Electronics manometer	3		
Mid Break					
W8	L22	detector circuits	1,2		
	L23	practical problems in pressure monitoring	2		
	L24	practical problems in pressure monitoring	3		
W9	L25	Plethysmography	2	CT3 CP SF	L D SDL
	L26	electromagnetic flow meter	3		
	L 27	electromagnetic flow meter	3		
W10	L 28	Electroencephalogram	1,2		
	L 29	cerebral angiograph	1,2		
	L 30	cerebral angiograph	2		
W11	L 31	chronical X-ray	2		
	L 32	brain scans	2		
	L 33	Electromyogram (EMG).	1	ASG SF	L D SDL
W12	L 34	Positron emission tomography	2		
	L 35	computer tomography	1		
	L 36	magnetic resonance imaging (MRI)	3,4		
W13	L 37	ultrasonogram	2		
	L 38	patient monitoring system and medical telemetry	1,2		
	L 39	effect of electromagnetic fields on human body	3,4	CP SF	L D SDL
W14	L 40	Question answer and interactive session	1		
	L 41	Syllabus review	1-4		
	L 42	Scope of research on related field	4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.

Text and Reference Books

1.Biomedical Instrumentation & Measurements, Prentice Hall of India, Cromwell.
2. Biomedical Digital Signal Processing, Prentice Hall of India, Tompkins.
3. Medical Instrumentation, Application and Design, John Wiley and Sons, J. G. Webster.

4.3.4 ICE 4*41: Bioinformatics

Course Information

Course Code	: ICE 4*39	Credit Hours	: 3.0
Course Title	: Bioinformatics	Contact Hour	: 3.0

Pre-Requisite

None

Rationale

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

Objective

1. To familiarize with vast amounts of biomedical and genomic data and the use of computational power of analyze those data.
2. To impart a solid understanding of the field of bioinformatics sequence analysis, phylogenetics, protein structure prediction, different topics of molecular biology and their application in medical science.
3. To familiarize with the application of machine learning in computational biology, security and privacy for genomic data etc.

Course Contents

Introduction to Bioinformatics: The central dogma of biology: DNA, RNA

Sequence alignment: Genomic sequences, Scoring matrices. Pairwise alignment. Online databases: BLAST, Advanced BLAST

Molecular phylogeny: Sequence alignment with dot matrix, Alignment visualization, Optimal alignment using dynamic programming method, Analyzing and sequencing nucleic acids

Structure and hierarchy of proteins: Principles of protein structure, protein secondary structure prediction, Protein tertiary structure prediction, Introduction to phylogenetics: drawing tree diagrams, tree building methods

Constructing phylogenetics tree: Stepwise clustering, Fitch Margoliash method, Maximum parsimony and maximum likelihood method, Ancestral studies using phylogeny, DNA replication: transcription, translation, Multiple sequence alignment

DNA digital data storage: DNA-based Archival Storage System

Human variation and disease: Sequence variation, phenologs, comparative genomics, and Personalized medicine

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Account for and use of biomedical and genomic data as well as the use of computational power to analyze those data.				H								

CLO2	Percept methods in sequence bioinformatics such as sequence alignment, phylogenetic analysis and pattern recognition.	H											
CLO3	Analyze and compile results of bioinformatic analyses, such as protein structure prediction, molecular biology etc.		H										
CLO4	Solve given biological problems by using appropriate bioinformatic methods and databases.			H									

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Analyze, Intercept and Account for and use of biomedical and genomic data as well as the use of computational power to analyze those data.	P.04.2	C4				CT, SF, CP
CLO2	Percept methods in sequence bioinformatics such as sequence alignment, phylogenetic analysis and pattern recognition.	P.01.3	C3	K3			CT, SF
CLO3	Analyze and compile results of bioinformatic analyses, such as protein structure prediction, molecular biology etc.	P.02.3	C4	WK4			CT, SF
CLO4	Solve given biological problems by using appropriate bioinformatic methods and databases.	P.03.3	C4	WK5			CT, SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	40
Practical/Tutorial/Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
	CP	5%	CLO1	C4

Continuous Assessment (30%)	CT (1-3)	20%	CLO1,2,3	C1, C2, C3, C4
	ASG	5%	CLO4	C4
Semester Final (70%)	SF	70%	CLO1,2,3,4	C1, C2, C3, C4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Introduction to Bioinformatics: What and why?	1	CT1 CP SF	L D SDL
	L2	The central dogma of biology: DNA, RNA	2		
	L3		1		
W2	L4	Intro to sequence alignment. Genomic sequences,	1,2		
	L5	Scoring Matrices.	2		
	L6		2		
W3	L7	Online database, database searching, BLAST,	2		
	L8	Advance BLAST, PSI-BLAST	3		
	L9		1		
W4	L10	Molecular phylogeny introduction, molecular	1,2		
	L11	phylogeny and evolution	2,3,4		
	L12		3		
W5	L13	Pairwise alignment, Sequence alignment with dot	3	CT2 CP SF	L D SDL
	L14	matrix, Alignment visualization with dot matrix	2,3,4		
	L15	tools.	2		
W6	L16	Optimal alignment, optimal alignment using	1		
	L17	dynamic programming method	2		
	L18		2		
W7	L19	Analyzing and sequencing nucleic acids, Structure	2		
	L20	and hierarchy of proteins, Proteomics and	2		
	L21	genomics in bioinformatics	3		
Mid Break					
W8	L22	Principles of protein structure, protein secondary	1,2	CT3 CP SF	L D SDL
	L23	structure prediction, protein tertiary structure	2		
	L24	prediction	3		
W9	L25	Introduction to phylogenetics, drawing tree	2		
	L26	diagrams, tree building methods	3		
	L 27		3		
W10	L 28	Constructing phylogenetics tree: Stepwise	1,2		
	L 29	clustering, Fitch Margoliash method	1,2		
	L 30		2		
W11	L 31	Constructing phylogenetics tree: Maximum	2	SF	L D SDL
	L 32	parsimony and maximum likelihood method,	2		
	L 33	Ancestral studies using phylogeny	1		
W12	L 34	DNA replication, transcription, translation,	2		
	L 35	Multiple sequence alignment.	1		
	L 36		3		
W13	L 37	DNA digital data storage, DNA-based Archival	2	CP SF	L D SDL
	L 38	Storage System.	1,2		
	L 39		3		
W14	L 40	Human variation and disease. Sequence variation,	1		
	L 41	phenologs, comparative genomics. Personalized medicine.	1,2		
	L 42	Review class	1-4		

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.
Text and Reference Books
1. Understanding bioinformatics (1st Edition), Garland Science, Zvelebil, Marketa J; Baum, Jeremy O 2. Bioinformatics and Functional Genomics (2nd edition), WB, Jonathan Pevsner

4.3.5 ICE 4*43: Robotics

Course Information			
Course Code Course Title	: ICE 4*43 : Robotics	Credit Hours Contact Hour	: 3.0 : 3.0

Pre-Requisite

None

Rationale

Robotics course is designed to introduces the fundamentals of robotics design and development, the principles of robot kinematics, dynamics, motion planning, trajectory generation and control as well as plan and research complete robots for various industrial applications.

Objective

1. To introduces the basics of robotic systems, robot design, development process and their vast applications.
2. To teach the simulation, modelling and drawbacks of a robotic system for an interactive complex environment

Course Contents

Introduction to robotics: overview of robot mechanisms, dynamics, and intelligent controls, planar and spatial kinematics, and motion planning; mechanism design for manipulators and mobile robots, multi-rigid body dynamics, 3D graphic simulation;

Control design: Micro controllers, actuators, and sensors; wireless networking, task modelling;

Advanced in Robotics: Design models for ground mobile robots, Line Following Algorithms, Feedback Systems, Gears and other mechanical systems.

Human-machine interface: embedded software mechanical design, rigid body velocity, Jacobean, inverse kinematics, redundant and parallel robots, trajectory control, face control and haptics, Micro and

Nano-robotics: mobile robots. Human-robot interaction, Multiagents, fault diagnosis.

Course Learning Outcomes (CLOs) and Mapping with the PLOs

NO (3-5)	CLOs (Upon completion of the course, the students will be able to)	PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLO1	Apply information and concepts of robotic technology in-depth of analysis of a complex engineering problem.	H											
CLO2	Develop solution for different components of complex engineering problem using robotic technology.		H										
CLO3	Develop probable solutions that meet specified needs with appropriate			H									

	consideration for public health and safety, culture, societal and environmental considerations.												

**(H = High, M = Medium, L = Low)

Mapping CLOs with Skills and Teaching-Learning & Assessment Strategy

No	CLO	PLOI	BL	WK	WP	EA	Assessment Methods
CLO1	Apply information and concepts of robotic technology in-depth of analysis of a complex engineering problem.	P.01.4	C3	K4	P1 P7 P3		CT, SF, CP
CLO2	Develop solution for different components of complex engineering problem using robotic technology.	P.03.2	C3		P1 P7 P3		CT, SF
CLO3	Develop probable solutions that meet specified needs with appropriate consideration for public health and safety, culture, societal and environmental considerations.	P.03.3	C6	K5			CT, SF

*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, EA = Engineering Activities, WP = Complex Engineering Activities, WK = Knowledge Profile, BL = Bloom's Taxonomy Level, PLOI = Program Learning Outcome Indicator

Teaching Learning Strategy (TLS)

Teaching and Learning Activities	Engagement (hours)
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Self-Directed Learning	
Non-face-to-face learning	35
Revision	20
Assessment Preparations	20
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	120

Assessment Strategy (AS)

Assessment Tools		Grading	CLO	Blooms Taxonomy
Continuous Assessment (30%)	CP	5%	CLO1	C3
	CT (1-3)	20%	CLO1,2	C1, C2, C3
	ASG	5%	CLO2,3	C3, C6
Semester Final (70%)	SF	70%	CLO1,2,3	C1, C2, C3, C4
Total Marks		100%		

Course Plane

Week	Lec.	Topic	CLO	AS	TLS
W1	L1	Introduction to Robotics	1	CT1 CP SF	L D SDL
	L2	Applications of Robotics	2		
	L3	Evolution of Robotics	1		
W2	L4	Overview of Robot Mechanisms	1,2		
	L5	Overview of Robot Dynamics	2		
	L6	Overview of Robot Intelligent Controls	2		

W3	L7	Spatial Descriptions	2		
	L8	Transformations	3		
	L9	Introduction to Kinematics	1		
W4	L10	Planar Kinematics	1,2		
	L11	Spatial Kinematics	2,3,4		
	L12	Motion Planning	3		
W5	L13	Mechanism Design for Manipulators	3		
	L14	Mechanism Design for Mobile Robots	2,3,4		
	L15	Mechanism Design for Mobile Robots (Contd.)	2		
W6	L16	Manipulator Kinematics	1	CT2 CP SF	L D SDL
	L17	Inverse Manipulator Kinematics	2		
	L18	Introduction to Dynamics	2		
W7	L19	Manipulator Dynamics	2		
	L20	Trajectory Generation	2		
	L21	Multi-rigid body Dynamics	3		
Mid Break					
W8	L22	Linear Control of manipulators	1,2		
	L23	Non-Linear Control Manipulators	2		
	L24	Force Control of Manipulators	3		
W9	L25	3D Graphic Simulation	2	CT3 CP SF	L D SDL
	L26	3D Graphic Simulation (Contd.)	3		
	L 27	3D Graphic Simulation (Contd.)	3		
W10	L 28	Control Design	1,2		
	L 29	Actuators	1,2		
	L 30	Sensors	2		
W11	L 31	Task Modelling, Face Control and Haptics	2		
	L 32	Human-Machine Interface	2		
	L 33	Embedded Software Mechanical Design	1		
W12	L 34	Jacobean Kinematics	2	SF	L D SDL
	L 35	Inverse Kinematics	1		
	L 36	Redundant and Parallel Robots	3		
W13	L 37	Micro Robotics	2		
	L 38	Nano-Robotics	1,2		
	L 39	Mobile Robots	3	CP SF	L D SDL
W14	L 40	Human-robot interaction Multiagents	1		
	L 41	Fault Diagnosis	1,2		
	L 42	Review class	1-4		
*CT = Class Test, SF = Semester Final, CP = Class Participation, ASG = Assignment, L = Lecture, D = Discussion, SDL = Self-Directed Learning.					
Text and Reference Books					

APPENDIX

Appendix A: Grading/Evaluation (Part-D)

As per the approved grading scale of Bangladesh Army University of Engineering & Technology (BAUET), Qadirabad, Natore

Grading Policy:

Numerical Score	Letter Grade		Grade points
80% and above	A+	A (Plus)	4.00
75% to > 80%	A	A	3.75
70% to > 75%	A-	A (Minus)	3.50
65% to > 70%	B+	B (Plus)	3.25
60% to > 65%	B	B	3.00
55% to > 60%	B-	B (Minus)	2.75
50% to > 55%	C+	C (Plus)	2.50
45% to > 50%	C	C	2.25
40% to > 45%	D	D (Pass)	2.00
below 40%	F	Fail	0.00
Assigned courses are	I	-	Incomplete
As per academic	W	-	Withdrawn
Failed to submit	X	-	Projects/Thesis
Due to offence	E	-	Expelled

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

Appendix B: Calculation of GPA CGPA

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

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

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

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

A Numerical Example

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

Course	Credit C_i	Grade Points	G_i	C_i*G_i
ICE1111	3.00	A	3.75	11.25
ICE1112	0.75	A+	4.00	3.00
ICE 1121	3.00	A-	3.50	10.5

ICE 1122	1.50	B+	3.25	4.875
PHY 1131	3.00	A	3.75	11.25
PHY 1132	1.50	A	3.75	5.625
MATH 1141	3.00	A	3.75	11.25
HUM 1151	3.00	A-	3.50	10.50
HUM 1152	1.50	B+	3.25	4.875
Total	20.25			73.125

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

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

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

Grade Conversion (CGPA to percentage of marks)

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

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