DEPARTMENT OF BASIC SCIENCES & HUMANITIES

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	English HU-100
Credits:	2+0
Instructor(s)-in-charge:	TVF Samra
Course type:	Lecture
Required or Elective:	Nil
Course pre-requisites	Nil
Degree and Semester	DE 43, 1st
Month and Year	Fall 21

2. Course Schedule	
Lecture:	2 hrs/week, Meets once weekly
Lab:	-
Discussion:	Multiple discussion sections offered per quarter
Outside study:	7 hrs/week
Office Hours :	8hrs/week by instructor

3. Course Assessment		
Exam:	2 Sessionals and 1 Final	
Home work:	1 Assignments, 1 Presentation	
Lab reports:	-	
Design reports:	-	
Quizzes:	4 Quizzes	
Grading:	Quizzes:	10%
	Assignments:	10%
	2 One Hour Tests (OHTs):	30%
	Final Exam:	50%
	Lab:	-
	Semester Project:	-
Plagiarism Policy	Any work (Assignment, Projects, labs etc) if found copied, will have strict penalties	

4. Course book and Related Course Material	
Textbook:	Wren and Martin, English Grammar and Composition
Reference Books:	**1.** Building English Skills, Yellow Level **2.** Practical English Grammar by A. J. Thomson and A. V. Martinet **3.** High Schools English Grammar by P. C. Wren and H. Martin **4.** Exploring the World of English by Sadat Ali Shah

5. Catalog Descriptions

This course focuses on the important concepts related to English language. The course is designed to improve students' English proficiency. Most important targeted areas include speaking accuracy, fluency, complexity, pragmatics, and pronunciation.

6. Course Objectives

Objectives of this course include

1. **To enable the learner to communicate effectively and appropriately in real life situation**
2. **To use English effectively for study purpose across the curriculum, to develop interest in and appreciation of Literature**
3. **To develop and integrate the use of the four language skills , Reading, Listening, Speaking and Writing.**
4. **To reinforce Language structures already learnt.**

7. Topics covered in the Course and Level of Coverage

• **Introduction to the course** • **Importance of English** • **Factors affecting English language**	2
• **Parts of Speech, verb tense, subject-verb-Agreement, participle.** • **Types of pronoun** **a) demonstrative pronoun** **b) reflexive pronoun** **c) reciprocal pronoun** **d) relative pronoun**	2
• **Phonetics & Phonology** • **Introduction to the speech sounds** • **Consonant, Vowels, Stress Patterns, Intonation, Form Words, Content Words, Rhythm**	2

Grammar Review-I **Phrase, Clause, Sentence, Sentence structures, Types of sentences (Simple, compound, compound-complex), Punctuation marks, Modifiers**	3
Oral Presentation Skills (Power Point Presentations) ▪ **Diction** ▪ **Rhythm, intonation** ▪ **Stress pattern** ▪ **Preparation** ▪ **Choosing Overall Organizational Pattern** ▪ **Building Strong Opening** ▪ **Tips for Creating a Great Introduction and interesting conclusion** ▪ **Checking for Understanding** ▪ **Posture and Gestures** ▪ **Audio-visual Aids** ▪ **Eye Contact** ▪ **Use of the Voice** ▪ **First Impressions** ▪ **Timing** ▪ **Handling Difficult Questions**	2
▪ **Advanced Sentence Structures-I** ▪ **Misplaced modifiers, Dangling modifiers, mixed constructions**	2
▪ **Advanced Sentence Structures-II Parallelism (Parallelize the non-parallel structures)** ▪ **Sentence fragments, Run-on sentences.**	2
Pre-writing Techniques Free-writing, note keeping/making, brain storming, mind mapping, identifying topics words, and developing topic sentences.	2
Paragraph Writing • **Developing thematic ideas and supporting details** • **Invention & inquiry Technique** • **Usage of synonyms/Antonyms** • **Developing unity in ideas**	
Essay Writing **Types of Essays** • **Organization** • **Common methods of beginning, middle, conclusion** • **Use of linkages/discourse markers.**	2
Précis Writing **Definition, Need/Importance, Characteristics, rules of précis writing**	3
Types of writing • **Narrative writing** • **Descriptive writing** • **Expository writing**	2
Reading and Comprehension	3

(a) Ways to cope with and understand complex texts **(b) Practice in understanding complex texts** **(c) Skimming and scanning, speed reading, intensive and extensive reading**	
Punctuation **Comma, Semi colon, Colon** **Articles/determiners**	1
Electronic Communication: ▪ **SMS, Social Media (WhatsApp, Blogs etc.)** ▪ **Emails and Email Etiquettes**	2
Presentations	
Revision	
Final Exams	

8. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		PLOs	Learning Level	Assessments
CLO 1	Locate common errors usually made by the learners of English as second language.	PLO 10	C2	Assignment 1 Quiz 1
CLO 2	Demonstrate coherence and cohesion in paragraph development.	PLO 10	C3	Final Q6 Quiz 3
CLO 3	Write various types of essays, magazine/newspaper articles and develop effective paraphrasing and summarizing skills.	PLO 10	C3	Final Q5 Quiz 4
CLO 4	Present confidently in front of large audience using audio/ visual aids.	PLO 10	A2	Presentation Quiz 2

9. Mapping of Topics	CLO	Chapter(s)
• **Introduction to the course** • **Importance of English** • **Factors affecting English language**	CLO-1	General Introduction of the course BOOK 1 Page 43-62
▪ **Parts of Speech, verb tense, subject-verb-Agreement, participle.** ▪ **Types of pronoun** **a) demonstrative pronoun** **b) reflexive pronoun** **C) reciprocal pronoun** **D) relative pronoun**	CLO-1	IPA PHONETIC CHART
Phonetics & Phonology **Introduction to the speech sounds** **Consonant, Vowels, Stress Patterns,**	CLO-4	Book II Part 1 Pg. 179-185

Intonation, Form Words, Content Words, Rhythm		Pg. 185-193
Grammar Review-I **Phrase, Clause, Sentence, Sentence structures, Types of sentences (Simple, compound, compound-complex), Punctuation marks, Modifiers**	CLO-2	General lecture through multiple academic resources
Oral Presentation Skills (Power Point Presentations) ▪ **Diction** ▪ **Rhythm, intonation** ▪ **Stress pattern** ▪ **Preparation** ▪ **Choosing Overall Organizational Pattern** ▪ **Building Strong Opening** ▪ **Tips for Creating a Great Introduction and interesting conclusion** ▪ **Checking for Understanding** ▪ **Posture and Gestures** ▪ **Audio-visual Aids** ▪ **Eye Contact** ▪ **Use of the Voice** ▪ **First Impressions** ▪ **Timing** ▪ **Handling Difficult Questions**	CLO-4	Book II Chapter 5 Book II Chapter 5 General lecture through multiple academic resources
▪ **Advanced Sentence Structures-I** ▪ **Misplaced modifiers, Dangling modifiers, mixed constructions.**	CLO-3	Chapter 33 Pg. 355-358
▪ **Advanced Sentence Structures-II Parallelism (Parallelize the non-parallel structures)** ▪ **Sentence fragments, Run-on sentences.**	CLO-3	Chapter 40 Pg. 423- 436
Pre-writing Techniques Free-writing, note keeping/making, brain storming, mind mapping, identifying topics words, and developing topic sentences.	CLO-3	General discussion through various academic resources
Paragraph Writing • **Developing thematic ideas and supporting details** • **Invention & inquiry Technique** • **Usage of synonyms/Antonyms** **Developing unity in ideas**	CLO-2	Chapter 38 Pg. 404-420
Essay Writing	CLO-3	General Introduction to the types of writing through various academic

Types of Essay • **Organization** • **Common methods of beginning, middle, conclusion** • **Use of linkages/discourse markers.**		resources
Précis Writing **Definition, Need/Importance, Characteristics, rules of précis writing.**	CLO-3	Chapter 37 Pg. 389-403
Types of writing Narrative writing Descriptive writing Expository writing	CLO-2	Part II Chapter 26 Pg. 312-319
Reading and Comprehension **(a) Ways to cope with and understand complex texts** **(b) Practice in understanding complex texts** **(c) Skimming and scanning, speed reading, intensive and extensive reading**	CLO-2	General discussion through various academic resources
Punctuation **Comma, Semi colon, Colon** **Articles/determiners**	CLO-2	General discussion through various academic resources
Electronic Communication: ▪ **SMS, Social Media (WhatsApp, Blogs etc.)** ▪ **Emails and Email Etiquettes**	CLO-3	General discussion through various academic resources

10. Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**

	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER & SOFTWARE ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	EC-120 Computer Organization
Credits:	3 (2+1)
Instructor(s)-in-charge:	Dr Sajid Gul Khawaja
Course type:	Lecture + Lab
Required or Elective:	Required
Course pre-requisites	None
Degree and Semester	DE-43 (CE), 1st
Month and Year	Nov, Fall 2021

2. Course Schedule	
Lecture:	2 hrs/week, Meets twice weekly
Lab:	3 hrs/week, Meets once in a week
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	4 hrs/week
Office Hours :	3 hrs/week by instructor, 3 hrs/week by teaching assistant/lab engineer

3. Course Assessment		
Exam:	2 Sessional and 1 Final	
Home work:	3 Assignments	
Lab reports:	10-12 reports	
Design reports:	1 Design report based on Semester Project	
Quizzes:	4-5 Quizzes	
Grading:	Quizzes:	15%
	Assignments:	10%
	2 One Hour Tests (OHTs):	30%
	Final Exam:	45%
	Lab:	***33***%
	Semester Project:	***10***%

4. Course book and Related Course Material	
Textbook:	Computer Organization and Design: The Hardware/Software Interface 6th Edition, David A. Patterson, John L. Hennessy
Reference Books:	1. Structured Computer Organization by Andrew S. Tanenbaum (Latest Issue) 2. Computer Organization by Lavadas and Ward 3. Computer Organization by Carl Hamacher, Zvonko Vranesic and Sawat Zaky

5. Catalog Descriptions
This course aims to provide students with Organization and design of physical computational systems, basic building blocks for computations, understanding and exploiting structure details for performance enhancement and their tradeoff. Course delves into the MIPS architecture for understanding of computer organization, hardware design and interface.

6. Course Objectives
This course is designed to introduce the concepts of computer organization, number systems and to grasp knowledge about basic building blocks of a computer system and digital circuits. Interaction of different I/O devices including secondary storage, memory types and buses is explained. The mechanism of microprocessor components and memory hierarchy, compare and contrast of different addressing modes, Instruction Set Architecture, along with hands on experience with logic designing using Scratch, moving towards hardware design using MIPS (MARS Simulator) leading to design of custom hardware using Hardware Descriptive Languages (HDL Verilog).

7. Topics covered in the Course and Level of Coverage	
Fundamentals: Importance of computer organization with respect to hardware and software,/ great ideas	4hrs
Performance Measures: Understanding performance, relative performance, CPU performance and its factors. Real-performance measures (Benchmarking)	4hrs
Instructions (Language of Computers): Understanding basics of Instructions via MIPS architecture and assembly language	2hrs
MIPS Instruction Set Architecture: Registers, ISA Level Case Studies, Data Types, Instruction Formats, Design Criteria of Instruction Formats and design examples	5hrs
Number Representation and Conversion: Number presentation as binary, hexadecimal, octal. Representation of real numbers using IEEE floating point format .	3hrs
MIPS Processor design: Understanding the MIPS processor unpipelined design for R, I and J type instructions	3hrs
MIPS ISA and pipelining: Introduction to pipelining and its conceptual implementation and its subsequent consequences for MIPS Processor	3hrs
ICT and its role in Daily Life: Classification of Networks, Network Topologies, N/W Hardware Components, MoDem, DSL, Firewalls, Intrusion Detection Systems (IDS)	2hrs

8. Lab Experiments	
Lab 01	Introduction to different components and protocols/methodologies used in computer hardware and software
Lab 02	Introduction to programming languages, logic building and MIT Scratch and its simple building blocks (Events, Looks, Sensing, Variables & Operations)
Lab 03	Introduction to control structures and repetition structures (with nesting)
Lab 04	Introduction to operators in Scratch and problem solving involving all Scratch blocks
Lab 05	Open Lab-I (Problem Solving using Scratch)
Lab 06	Introduction to MARS and MIPS and demo of coding in C++

Lab 07	Use of memory structures, control structures and repetition structures with the introduction of Directives and Labels
Lab 08	Introduction to and use of procedure call and syscalls with problems
Lab 09	Introduction to logical Instructions in MIPS and problem solving with memory structures
Lab 10	Practice of MIPS programming using real life problems
Lab 11	Open Lab-II (Problem Solving using MIPS)
Lab 12	Introduction to Verilog and basic design creation using data flow commands
Lab 13	Introduction to behavioral modelling and simulation of ALU and Accumulator
Lab 14	Processor Design using Verilog
Lab 15	Lab Final

9. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**
CLO 1	To comprehend core components of computer organization and their interworking.	PLO 1	C2
CLO 2	To apply knowledge of data/number/information representations and the limitations of such representations	PLO 1	C3
CLO 3	To understand the basic principles of operation of the memory, I/O, CPU and device level of a typical computer	PLO 3	C3
CLO 4	To use the instruction set architecture for mapping onto the MIPS instruction set and simulating on the MIPS simulator	PLO 5	P4

10. Program Learning Outcomes

PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.

PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF BASIC SCIENCES & HUMANITIES

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	HU-107 Pakistan Studies
Credits:	2 (2+0)
Instructor(s)-in-charge:	TVF Madeeha Arif
Course type:	Lecture
Required or Elective:	Required
Course pre-requisites	None
Degree and Semester	DE-43, Semester 2
Month and Year	Spring 2022

2. Course Schedule	
Lecture:	2 hrs/week, Meets once weekly
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	3 hrs/week
Office Hours :	3 hrs/week by instructor, 3 hrs/week by teaching assistant/lab engineer

Course Assessment		
Exam:	2 Sessional and 1 Final	
Home work:	2 graded Assignments	
Quizzes:	4-6 Quizzes	
Grading	2 One Hour Tests (OHTs):	30%
	Quizzes:	10%
	Assignments	10%
	Final Exam	50%
Plagiarism Policy	Any work (Assignments, ReportsAssesments etc) if found copied, will have strict penalties	
3. Course book and Related Course Material		
Textbooks:	1. Qureshi, I. H. 1990. The Struggle for Pakistan. Karachi: University of Karachi. (Multiple Publishers) 2. Saeed, b. Khalid. 1968. Pakistan: The Formative Phase (1857-1947).	

	Oxford University Press
Reference Books:	• Sharif-ul-Mujahid. 1976. Ideological Orientation of Pakistan. Islamabad: Ministry of Education, Government of Pakistan • Wolpert, Stanley. 1993. *Jinnah of Pakistan*. Karachi: Oxford University Press. • Hodson, H. W. 2001. *The Great Divide: Britain – India – Pakistan*. Karachi: Oxford University Press. • Khan, Hamid. 2001. *Constitutional and Political History of Pakistan*. Karachi: Oxford University Press. • Iqbal, Muhammad. 1930. *The Reconstruction of Religious Though in Islam.* • Ullah, Hamid. 1980. *Introduction to Islam*. Paris: Centre CulturelIslamique (Paris). (Multiple Publishers) • Jalal, Ayesha. 1994. *The Sole Spokesman: Jinnah, The Muslim League and The Demand for Pakistan*. Cambridge: Cambridge University Press • Qureshi, I. H. 1990. *The Struggle for Pakistan.* Karachi: University of Karachi. (Multiple Publishers) • Mahmood, Safdar. 2000. Pakistan: *Political Roots & Development 1947-1999*. Oxford University Press. • Rizvi, A. Hassan. 1993. *Pakistan and the Geo-strategic Environment: A Study of Foreign Policy*. New York: Palgrave Macmillan • Samad, Abdus, Governance, *Economic Policy and Reform in Pakistan*. Lahore: Vanguard • Khan, Jameel-ul-Rehman. 1999. *Government and Administration in Pakistan*. Islamabad: Public Administration Research Centre • Sattar, Abdul. 2007. *Pakistan Foreign Policy 1947-2005: A Concise History*. Karachi: Oxford University Press. • Ijaz Hussain "The Dilemma of National Integration in Pakistan: Challenges and Prospects" ISSRA Papers (2009), 43-60. • Barry Buzan, "Rethinking Security after the Cold War" Vol. 32, No. 1 (March 1997), 5-28.

4. Catalog Descriptions

This subject aims at enhancing students' knowledge about history, geography, culture and society of Pakistan. It also aims at inculcating and encouraging patriotism amongst the young generation of Pakistan. As a result, they contribute as a strong and positive human resource of Pakistan.

5. Course Objectives

The main objectives of this course are:

- **To know the historical understanding of the region at first and then the reason behind the creation of Pakistan in the same territory with different state system and government. Course highlight.**
- **To familiarize the students with importance of Islamic-Pakistani culture and significant adherence with the cultural identity for Pakistan is not only necessary but rather mandatory for the young minds who becomes future potential human resource of the country.**
- **To highlight the values and norms of the society in a way that it integrates into the young minds. Not only culture and society but few economic aspects also get highlighted during the course.**
- **To enhance their leadership qualities while discussing politics and international relations and image of Pakistan.**

6. Topics covered in the Course and Level of Coverage

Ideological Foundation, Iqbal's Ideology and History of the Creation of Pakistan • Cultural differences between Hindus & Muslims and Two Nation Theory • Iqbal's Ideology for Muslims in India • Islam as an integrating philosophy for peace • Historical Perspective	4 hrs
Quaid-i-Azam: An Architect of Pakistan • Biography of Quaid-e-Azam • Round Table Conferences (1930-1932) • Pakistan Resolution • Gandhi-Jinnah Talk • Independence Act-1947 • Quaid-e-Azam as Governor General of Pakistan	4 hrs
The Resources of Pakistan—Land & Natural Resources and Human Resource • Location and geo-strategic importance • Social Structure and cultural strengths & weaknesses • Power potentials of Pakistan • Human Resource	4 hrs
Economic Outlook of Pakistan and Hard-Soft Power • Economic Structure • The key resources like water, energy, mineral resources • The industrial and agricultural potential and their share in our economy	4 hrs

The National Security of Pakistan including Economic, Energy, Water and Food Security • National Security Structure and functions • Economic Security • Energy Security • Water Security • Food Security	4 hrs
Pakistan's Geopolitical Context / External Threats and Internal Security • The ethnic, linguistic and sectarian make up of Pakistan • The potential for internal conflict and integration • The relationship between internal conflict and external relations	4 hrs
Perception and Realities of Pakistan • Pakistan's Political Conditions • Pakistan's Economic Conditions • Pakistan's image in the world • Education standards and its impact on the society • Counter terrorism and counter extremism policies	4 hrs
Governance & State System of Pakistan • Governance Structure • Procedure of Governance and their implementation • Application of Technology on governance in line with advance countries	4 hrs

7. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		PLOs	Learning Level	Assessments
CLO 1	**Understand** the ideological and historical struggle in the creation of Pakistan.	PLO 6	C-2	Q1, OHT1, Final
CLO 2	**Analyze** the significance of geopolitical positioning and its implication for both traditional and non-traditional security of Pakistani society.	PLO 6	C-4	Q2 OHT2, Final
CLO 3	**Understand** and realize the importance of good governance, governance structure, economic system political processes, constitutional and legislative processes and political culture of Pakistani society.	PLO 6	C-5	A1, OHT2, Final
CLO 4	**Analyze** the importance of language and religion in society of Pakistan given its socio-cultural diversity and ethno-sectarian makeup in relation to internal and external conflicts.	PLO 6	C-5	.A2, Q4, Final

8. Mapping of Topics	CLO	Chapter(s)
1. Ideological Foundation, Iqbal's Ideology and History of the Creation of Pakistan Cultural differences between Hindus & Muslims and Two Nation Theory Iqbal's Ideology for Muslims in India Islam as an integrating philosophy for peace Historical Perspective	CLO-1	Sharif-ul-Mujahid. (1976). *Ideological Orientation of Pakistan* Chapter 2 Hodson, (2001). *The Great Divide* "introduction"
2. Quaid-i-Azam: An Architect of Pakistan Biography of Quaid-i-Azam Round Table Conferences (1930-1932) Pakistan Resolution Gandhi-Jinnah Talk Independence Act-1947 Quaid-i-Azam as Governor General of Pakistan	CLO-1	Ayesha Jalal, *The Sole Spokesman* Chapter 4 & 7
3. The Resources of Pakistan—Land & Natural Resources and Human Resource Location and geo-strategic importance Social Structure and cultural strengths & weaknesses Power potentials of Pakistan Human Resource	CLO-2	Syed Afzal Moshadi Shah, Dr. Shehla Amjad, "Cultural Diversity In Pakistan: National Vs Provincial" Hassan. (1993). *Pakistan and the Geo-strategic Environment* (Chapter 1)
4. Economic Outlook of Pakistan and Hard-Soft Power Economic Structure The key resources like water, energy, mineral resources The industrial and agricultural potential and their share in our economy	CLO-3	Samad, Abdus, Governance, *Economic Policy and Reform in Pakistan* Introduction & Chapter 2
5. **The National Security of Pakistan including Economic, Energy, Water and Food Security** National Security Structure and functions Economic Security Energy Security Water Security Food Security	CLO-2	Barry Buzan, "Rethinking Security after the Cold War" Vol. 32, No. 1 (March 1997), 5-20.
6. Pakistan's Geopolitical Context / External Threats and Internal Security The ethnic, linguistic and sectarian make up of Pakistan The potential for internal conflict and integration The relationship between internal conflict and external relations	CLO-4	Rizvi, (1993) *Pakistan and the Geo-strategic Environment: A Study of Foreign Policy.* Chapter 2-4.
7. Perception and Realities of Pakistan Pakistan's Political Conditions Pakistan's Economic Conditions	CLO-4	Mahmood, (2000) Pakistan: *Political Roots & Development 1947-1999* (Chapter 3)

Pakistan's image in the world Education standards and its impact on the society Counter terrorism and counter extremism policies		Burki, 2005. *Education Reform in Pakistan.* Chapter 2
8. Governance & State System of Pakistan Governance Structure Procedure of Governance and their implementation Application of Technology on governance in line with advance countries	CLO-2	Khan, (1999). *Government and Administration in Pakistan*. Chapter 1-3

9. Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**

	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF BASIC SCIENCES AND HUMANITIES

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information

Course Number and Title:	MATH-101 Calculus and Analytical Geometry
Credits:	3-0
Instructor(s)-in-charge:	Assis Prof Dr Faizullah
Course type:	Lecture
Required or Elective:	Required
Course pre-requisites	Nil
Degree and Semester	DE 43 Semester 1st
Month and Year	Fall 21

2. Course Schedule

Lecture:	3 Hrs/week, Meets twice weekly
Lab:	
Discussion:	1 Hr/discussion, multiple discussion sections offered per week
Outside study:	3 Hrs/week
Office Hours :	6 Hrs/week by instructor

3. Course Assessment

Exam:	2 Sessional and 1 Final	
Home work:	3 Assignments	
Lab reports:	-	
Design reports:	-	
Quizzes:	6 Quizzes	
Grading:	Quizzes:	10%
	Assignments:	10%
	2 One Hour Tests (OHTs):	30%
	Final Exam:	50%
	Lab:	-
	Semester Project:	-
Plagiarism Policy	Any work (Assignment, Projects/Quizes, etc) if found copied, will have strict penalties	

4. Course book and Related Course Material

Textbooks:	Swokowski, Onlinick & Pence: Calculus (6th Edition)
Reference Books:	Robert T. Smith & Roland B. Minton: Calculus (3rd Edition)

5. Catalog Descriptions

An Introduction to Analytic Geometry and Calculus covers the basic concepts of analytic geometry and the elementary operations of calculus. This course gives an overview of the fundamental relations of the coordinate system., the fundamentals of straight line, nonlinear equations and graphs, functions and limits, and derivatives. These topics are followed by a discussion of some applications of previously covered mathematical subjects. The fundamentals of the integrals, trigonometric functions, exponential and logarithm functions, and methods of integration, the concepts of parametric equations, polar coordinates, and infinite series will be taught in this course.

6. Course Objectives

a. Understanding the basic concepts of analytical geometry
b. To be able to use the concepts of limits and continuity
c. Applying techniques of differentiation and integration to real world problems
d. Evaluate and carryout the convergence analysis of sequences and series.

7. Topics covered in the Course and Level of Coverage

a. Introduction to Analytical Geometry a. Introduction to course – course outline, education needs b. Review of vectors, scalars, and vector products. Three-dimensional coordinate system and equation of straight line and plane.	3 hrs
b. Limits and Continuity a. Techniques of finding Limits of functions	4hrs
3. Differentiation a. Techniques of differentiation b. Tangent lines and rates of change c. Extrema of functions d. Rolle's and Mean value theorems e. Concavity	7 hrs

4. Integration and its Applications a. Riemann sum, definite integrals and properties of integrals b. Solids of revolution, volume of solids of revolution by Cylindrical shell & Cross section methods c. Arc length, surface of revolution, Center of mass d. Indeterminate forms and L Hospital rule, trigonometric integrals. e.	15 hrs
5. Sequence and Series a. Convergence and divergence of sequences and series, positive term series, integral test b. Basic comparison test, limit comparison test, the ratio and root tests, alternating series, absolute and conditional convergence c. Power series, Maclaurin and Taylor series b.	17 hrs
6. Review a. Review of important concepts before OHT-1 b. Review of important concepts before OHT-2 c. Review of important concepts after OHT-2 d. Addressing student's queries	2 hrs

8. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		PLOs	Learning Level	Assessments
CLO 1	**Understanding the basic concepts of analytical geometry**	PLO 1	C 2	Q1, Q2, OHT-1,Assign1
CLO 2	**To be able to use the concepts of limits and continuity.**	PLO 1	C 3	Q3, Q4, OHT2,Assign 2, OHT2
CLO 3	**Applying techniques of differentiation and integration to real world problems**	PLO 2	C 3	Assign3, Q6-Final
CLO 4	**Evaluate and carryout the convergence analysis of sequences and series**	PLO 2	C 5	Q5, Q7 Final

9.Mapping of Topics	CLO	Chapter(s)
1.Introduction to Analytical Geometry a. Introduction to course – course outline, education needs Review of vectors, scalars, and vector products. Three-dimensional coordinate system and equation of straight line and plane.	CLO-1	Swokowski, Onlinick & Pence: Calculus (6th Edition)Chapter-10
2. Limits and Continuity Techniques of finding Limits of functions	CLO-1	Swokowski, Onlinick & Pence: Calculus (6th Edition)Chapter-1

2 Differentiation a. Techniques of differentiation **b.** Tangent lines and rates of change c. Extrema of functions d. Rolle's and Mean value theorems Concavity	CLO-2	Swokowski, Onlinick & Pence: Calculus (6th Edition)Chapter-2,3
3 Integration and its Applications f. Riemann sum, definite integrals and properties of integrals g. Solids of revolution, volume of solids of revolution by Cylindrical shell & Cross section methods h. Arc length, surface of revolution, Center of mass **i.** Indeterminate forms and L Hospital rule, trigonometric integrals.	CLO-3	Swokowski, Onlinick & Pence: Calculus (6th Edition)Chapter-4,5, Sec.6.9, Sec.7.2,7.3
5. Sequence and Series a. Convergence and divergence of sequences and series, positive term series, integral test b. Basic comparison test, limit comparison test, the ratio and root tests, alternating series, absolute and conditional convergence c. Power series, Maclaurin and Taylor series	CLO-4	Swokowski, Onlinick & Pence: Calculus (6th Edition)Chapter-8

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	ME-105 Workshop Practice
Credits:	0-1
Instructor(s)-in-charge:	Asst Prof Dr Faisal Ahmed
Course type:	03 (Practical) per week
Required or Elective:	Required
Course pre-requisites	None
Degree and Semester	DE-43 Semester 1
Month and Year	Fall 2021

2. Course Schedule	
Practical:	3 hrs/week, Meets once weekly
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Office Hours :	3 hrs/week by instructor

3. Course Assessment	
Lab report	10%
Quizzes/Assignments:	30%
Viva	60%
4. Course book and Related Course Material	
Textbooks:	1. Workshop Technology, Part I& II by W.A. Chapman, Arnold Pub, Latest Edition
Reference Books:	1. Comprehensive Workshop Technology (Manufacturing Processes) by S. K. Garg.

5. Course Objectives

Objective of the course is to make students familiar with the practical aspects of key workshop technologies such as casting, welding and machining. At the culmination of this course, students will be able to identify and implement the key manufacturing processes and steps that can be employed to create various parts and assemblies. Fundamentally, a considerable enhancement in level of engineering knowledge of the students is envisaged upon successful completion of this course.

6.Course outcomes

- Recall the fundamental knowledge of various workshop technologies such as welding, machining and casting etc.
- Show understanding about the implementation of the various manufacturing technologies by

fabricating parts and assemblies.
• Fabricate physical parts and assemblies through a combination of different workshop technologies.

7. Topics covered in the Course and Level of Coverage	
Introduction to welding technology	3 hrs
Practical welding technology	3 hrs
Introduction to casting	3 hrs
Practical demonstration and implementation of sand casting	3 hrs
Introduction to machining	3 hrs
Demonstration and implementation of lathe machining	3 hrs
Introduction to gear making	3 hrs
Spur gear manufacturing fundamentals and demonstration	3 hrs
Introduction to forging	3 hrs
Part fabrication through manual hammer forging	3 hrs
Introduction to fitting and assembly techniques	3 hrs
Create a mechanical assembly through fitting techniques	3 hrs
Introduction to electric fitting	3 hrs
Assembling an electric circuit	3 hrs
Introduction to wood working	3 hrs
Create a wood part by applying various wood working techniques	3

8. Course Learning Outcome (CLOs)		PLOs	Learning Level
CLO 1	**Understand and reproduce the methods of performing workshop practical**	PLO 4	P3
CLO 2	**Comprehending and discussing the overall learning achieved in the lab.**	PLO 4	A2

9. Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF BASIC SCIENCES & HUMANITIES

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	PHY-102 Applied Physics
Credits:	3 (2+1)
Instructor(s)-in-charge:	TVF Dr Layiq Zia
Course type:	Lecture + Lab
Required or Elective:	Required
Course pre-requisites	None
Degree and Semester	DE-43 Semester 1
Month and Year	Fall 2021

2. Course Schedule	
Lecture:	2 hrs/week, Meets once weekly
Lab:	3 hrs/week, Meets once in a week
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	3 hrs/week
Office Hours :	3 hrs/week by instructor, 3 hrs/week by teaching assistant/lab engineer

Course Assessment				
Exam:	2 Sessional and 1 Final			
Home work:	2 graded Assignments			
Lab reports:	12-13 reports, 01 Lab Mid, 01 Lab viva, 01 Lab Final			
Quizzes:	4 Quizzes			
Grading:	Theory (66.6%)		Lab (33.3%)	
	2 One Hour Tests (OHTs):	35%	Lab reports	20%
	Quizzes:	10%	Lab Final	25%
	Assignments	5%	Lab Mid	25%
	Final Exam	50%	Final	30%
Plagiarism Policy	Any work (Assignment, Projects, labs etc) if found copied, will have strict penalties			

3. Course book and Related Course Material	
Textbooks:	1. Physics for Scientists and Engineers 8th Ed Raymond A. Serway 2. Physics by Halliday, Resnick, Krane, 5th edition, Vol-I & Vol-II
Reference Books:	1. Physics By Halliday, Resnick& Walker (7th Edition) 2. University Physics, 12th Edition by Hugh D.Young, Roqer A. Freedman and Lewis Ford 3. Physics for Scientists & Engineers, 6th edition (extended version) by Paul A.Tipler and Gene Mosca

4. Catalog Descriptions

This course consists of topics related to mechanics and electromagnetism. In the first part, students learn about Newton's laws of motion, and its application to many types of forces. Then rotational motion, work and simple harmonic motion. In the second part students study Coulomb's law, Gauss' law and then the basic concepts of magnetism.

5. Course Objectives

The main objectives of this course are

a) To provide a comprehensive presentation of the Newton's laws of motion.
b) To familiarize the students with the techniques problem solving related to forces.
c) To introduce the students to the concept of work and energy.
d) To familiarize students with the concepts of rotational motion.
e) To provide broader understanding of simple harmonic motion.
f) To provide the concept of Electrostatics
g) To provide the basic concepts of Magnetism

6. Topics covered in the Course and Level of Coverage

1. Force and Motion **a. Without friction** **b. With friction** **c. Uniform circular motion**	6 hrs
2. Work and energy **a. Kinetic energy** **b. work energy principle** **c. work done by a variable force**	4 hrs
3. Rotational motion	4 hrs
4. Simple harmonic motion	2 hrs
5. Electrostatics	6 hrs
6. Gauss' law	4 hrs
7. Electric potential	2 hrs

8. Magnetostatics	4 hrs

7. Lab Experiments

Lab 01	Introduction to Lab Equipment: DMM & Power Supply
Lab 02	Analysis of Series and Parallel Resistive Circuits.
Lab 03	Determination of Resistivity of unknown Material (Wire) using Wheatstone Bridge.
Lab 04	Determination of e/m ratio of electron Using Deflection method.
Lab 05	Verification of inverse square law by studying variation of photoelectric current with intensity of light.
Lab 06	Determination of The Planck's Constant using a Photo Cell.
Lab 07	Hook's Law: Determination of Spring constant and effective mass of a spring by static and Dynamic methods.
Lab 08	Compound Pendulum: Determination of radius of gyration K and acceleration due to gravity g.
Lab 09	Introduction to Function generator and Oscilloscope
Lab 10	Determination of RC time constant of RC circuit
Lab 11	Investigation of frequency response (VC, XC) of capacitor in RC circuit.
Lab 12	Determination of Thermal Coefficient of Linear expansion for different metals.
Lab 13	Study of forward and reversed biased I_V characteristics of a Diode.
Lab 14	Hall Effect: Study the Hall voltage relationship with magnetic field and current.

8. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		PLOs	Learning Level	Assessments
CLO 1	**Understand and apply the concepts of mechanics**	PLO 1	C3	Q1, Q2, Q3, A1, OHT-1
CLO 2	**Understand and apply the concepts of electrostatics and magnetostatics**	PLO 1	C3	Q4, A2, OHT2
CLO 3	Validate the theoretical concepts through relevant lab experiments	PLO 2	C3	Lab work, Lab final

9. Mapping of Topics	CLO	Chapter(s)
1. Force and Motion **a. Without friction** **b. With friction** **c. Uniform circular motion**	CLO-1	Physics for Scientists and Engineers 8th Ed Raymond A. Serway Chapter 5 and 6

2. Work and energy **a. Kinetic energy** **b. work energy principle** **c. work done by a variable force**	CLO-1	Physics for Scientists and Engineers 8th Ed Raymond A. Serway Chapter 7
3. Rotational motion	CLO-1	Physics for Scientists and Engineers 8th Ed Raymond A. Serway Chapter 10
4. Simple harmonic motion	CLO-1	Physics for Scientists and Engineers 8th Ed Raymond A. Serway Chapter 15
5. Electrostatics	CLO-2	Physics for Scientists and Engineers 8th Ed Raymond A. Serway Chapter 23
6. Gauss' law	CLO-2	Physics for Scientists and Engineers 8th Ed Raymond A. Serway Chapter 24
7. Electric potential	CLO-2	Physics for Scientists and Engineers 8th Ed Raymond A. Serway Chapter 25
8. Magnetostatics	CLO-2	Physics for Scientists and Engineers 8th Ed Raymond A. Serway, Chapter 29

10. Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF ELECTRICAL ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information

Course Number and Title:	EE-111, Linear Circuit Analysis
Credits:	4 (3+1)
Instructor(s)-in-charge:	Lec Aamir Javed, Lab Engr Mudassir
Course type:	Lecture + Lab
Required or Elective:	Required
Course pre-requisites	Basic electricity and magnetism, Calculus and analytic geometry, solution of systems of linear algebraic equations
Degree and Semester	DE-43 CE Syn B, Semester 1
Month and Year	Fall 2021

2. Course Schedule

Lecture:	3 hrs/week, Meets twice weekly
Lab:	3 hrs/week, Meets once in a week
Office Hours :	3 hrs/week by instructor, 3 hrs/week by teaching assistant/lab engineer

3. Course Assessment

Exam:	2 One Hour Tests (OHTs) and 1 Final	
Home work:	4 Assignments	
Lab reports:	14 Lab reports	
Quizzes:	6 Quizzes	
Grading:	Quizzes:	7.5%
	Assignments:	7.5%
	Two OHT Exams:	22.5%
	Final Exam:	37.5%
	Lab/Semester Project:	25%

4. Course book and Related Course Material

Textbooks:	Electric Circuits Fundamentals, 1st Edition, by Sergio Franco, Oxford English Press 1995.
Reference Books:	Fundamentals of Electric Circuits, 3rd Edition, by Charles K. Alexander & Matthew N.O.Sadiku, McGraw Hill 2003.

5. Catalog Descriptions

The course is designed to acquaint students with basic electronic circuits and their working. The operation of each element comprising the circuit is analyzed. Different techniques used to solve the circuits are discussed in detail along with circuit reduction techniques. The response of first order RC and RL circuits is also analyzed along with step response. In addition to class lectures, comprehensive laboratory exercises are also designed so that theoretical knowledge may be coincided with practical.

6. Course Objectives

a. Present fundamental circuit analysis techniques.
b. Introduce circuit equivalent and modeling.
c. Develop physical insight and intuition for problem solving.
d. Use of PSpice simulation as a verification tool.

7. Topics covered in the Course and Level of Coverage	
• Basic Circuit Elements, KCL , KVL.	9hrs
• Series Parallel circuits, voltage and current dividers.	3hrs
• Nodal and Loop Analysis.	3hrs
• Linearity, Superposition, Source Transformation.	3hrs
• Thevenin and Norton Theorems.	6hrs
• Power and Maximum Power Transfer.	3hrs
• Circuit Analysis with dependent sources.	6hrs
• Operational Amplifiers	6hrs
• Basic RC and RL Circuits, Transients in First-Order Networks.	3hrs

8. Lab Experiments	
Lab 01	Introduction, Basic concepts and lab equipment.
Lab 02	Experimental verification of OHM's law.
Lab 03	Verification of current and voltage divider rule.
Lab 04	Experimental verification of nodal analysis.
Lab 05	Experimental verification of mesh analysis.
Lab 06	Experimental verification of superposition theorem.
Lab 07	Study of state and delta connections of resistances. Experimental verification of star delta transformation.
Lab 08	Experimental verification of Thevenin's theorem.
Lab 09	Study of maximum power transfer theorem and its experimental verification for a network.
Lab 10	Verification of reciprocity theorem.
Lab 11	Implementation of Inverting Amplifier & Non-Inverting Amplifier (OP AMP Applications).
Lab 12	Implementation of Unity Gain Follower & Summing Amplifier (OP AMP Applications).
Lab 13	Transient analysis and time constant determination of an RC circuit.
Lab 14	Experimental Verification of Norton's Theorem.

9. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		PLOs	Learning Level
CLO 1	Understanding and applying the fundamental concepts and response of linear circuit elements in time domain.	PLO 1	C3
CLO 2	Applying different circuit analysis techniques and circuit theorems to solve complex circuits for unknown quantities. Circuit reduction techniques are also utilized.	PLO 2	C3
CLO 3	Identify and model first order electric systems involving capacitors and inductors and analyze their natural and transient response	PLO 2	C4
CLO 4	Creating, selecting and applying different techniques to solve problems in lab along with observing the functionality of circuits in MultiSim.	PLO 5	P2
CLO 5	Demonstrate ability to work effectively as an individual or in a team	PLO 9	A3

10. Program Learning Outcomes

PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**

	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering(CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	CS-114 Fundamentals of Programming
Credits:	3 (2-1)
Instructor(s)-in-charge:	Asst Professor Jahan Zeb
Course type:	Lecture + Lab
Required or Elective:	Required
Course pre-requisites	Nil
Degree and Semester	DE-43(CE), Semester 2
Month and Year	Spring 2022

2. Course Schedule	
Lecture:	2 hrs/week, Meets once weekly
Lab:	3 hrs/week, Meets once in a week
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	7 hrs/week
Office Hours :	3 hrs/week by instructor, 3 hrs/week by teaching assistant/lab engineer

3. Course Assessments		
Exam:	2 Sessional and 1 Final	
Home work:	3 Assignments	
Lab reports:	12 reports	
Design reports:	1 Design report based on Semester Project	
	Assignments:	5%
	Quiz:	10%
	2x Sessional Exams:	35%
	Final Exam:	50%
	Lab Work + Lab Exams:	80% of Lab
	Semester Project:	20% of Lab

4. Course book and Related Course Material	
Textbooks:	1. Deitel and Deitel: C++ How to Program, 7th Edition, Prentice Hall Publications
Reference Books:	1. Robert Lafore: Object-Oriented Programming in C++, Fourth Edition, December 2001,Sams Publishing .

5. Catalog Descriptions

The purpose of this course is to teach fundamentals of programming to the students starting from the basic. The course is software-oriented as students will be trained to create piece of code that are capable of performing one of more tasks. The course includes comprehensive laboratory exercises.

6. Course Objectives

a) The students will have a thorough understanding of the basic concepts of programming.
b) The students will gain an in-depth knowledge of a modern IDE such as Microsoft Visual Studio.
c) The students will have good knowledge of C++ including its advantages and disadvantages.
d) Thus, having acquired a knowledge of Visual Studio and C++, the students will be able to design and implement an algorithm from scratch.

7. Topics covered in the Course and Level of Coverage	
1. Overview a. What is programming? b. Computer configuration c. Algorithms and flowcharts d. Computer languages; generations and levels of programming languages e. data and results f. Introduction to a typical IDE (Microsoft Visual C++ 6.0).	3hrs
2. Input and Output a. Stream I/O b. Cin and Cout c. Assignment Statement d. Implicit and explicit type casting	3hrs
3. Operators a. Arithmetic Operators b. Operator precedence c. Associativity	2hrs
4. Selection (Decisions) a. Relational and logical operators b. AND, OR, and NOT operators c. Truth Tables for conditional operators d. Single, double and multiway selection structure e. If, if/else, nested ifs f. Conditional operator g. Conditional expressions h. Switch statement	8hrs
5. Repetition (Loops) a. Entrance closed and exit controlled loops b. While, do/while, for(; ;), break and continue statements	3hrs
6. Function s a. Programmer defined functions b. Library functions c. Storage classes d. Scope and lifetime of variables e. Parameter pass f. Call by copy and call by reference g. Recursion h. Comparison of iteration and recursion	3hrs
7. Arrays a. Declaring arrays b. Input and output of data in arrays c. Accessing individual elements d. Passing arrays to functions e. Searching and sorting f. Sequential search and binary search g. Bubble sort, selection sort, insertion sort h. Array of characters i. String library functions	6hrs

8. Structures a. Structure declaration b. Accessing structure members c. Arrays of structures d. Passing structures as function arguments e. Structure with structured elements	3hrs
9. Files a. Opening and closing files b. Files pointer c. Binary and text files d. Sequential and random access files e. Reading and writing text files f. Library functions for file manipulation	3hrs

8. Lab Experiments	
Lab 01	C++ program structure
Lab 02	Introduction to arithmetic operations, data types and variables
Lab 03	Introduction to increment/ decrement, logical and relational operators, casting and constants
Lab 04	Selection structures (if, if-else, if-else-if, nested if)
Lab 05	Switch structure, while, do while and infinite loops
Lab 06	Introduction to *for* loop
Lab 07	Introduction to nested loops, break and continue
Lab 08	Arrays and two-dimensional arrays
Lab 09	Functions and function overloading. Variable scope and storage
Lab 10	Introduction to c-style character strings and string class
Lab 11	Structures
Lab 12	Call by reference, pointers and recursion
Lab 13	Introduction to filing
Lab 14	Open lab
Lab 15	Open lab

9.	Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)		
Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**
CLO 1	**Understanding** fundamental concepts of computer programming to solve a problem	1	C2
CLO 2	**Implementing** and **applying** the concepts of functions and Structures in C++	1	C3
CLO 3	**Analyze** real life problems and **relate** their knowledge of programming and algorithms to solve those complex problems using arrays, functions, and pointers	3	C4
CLO 4	To **implement** a well-structured, robust computer program in Visual Studio using C++ programming language	5	P2

10. Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**

	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF BASIC SCIENCES & HUMANITIES

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	HU-101 Islamic Studies
Credits:	2 (2+0)
Instructor(s)-in-charge:	TVF Sidra Qamar
Course type:	Lecture
Required or Elective:	Required
Course pre-requisites	None
Degree and Semester	DE 43, 2ND
Month and Year	Spring 22

2. Course Schedule	
Lecture:	2 hrs/week, Meets once weekly
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	1 hrs/week
Office Hours :	2 hrs/week by instructor

3. Course Assessment		
Exam:	2 Sessional and 1 Final	
Home work:	2 graded Assignments	
Quizzes:	4-6 Quizzes	
Grading	2 One Hour Tests (OHTs):	30%
	Quizzes:	10%
	Assignments	10%
	Final Exam	50%
Plagiarism Policy	Any work (Assignments, Reports, Assesments etc) if found copied, will have strict penalties	

4. Course book and Related Course Material	
Textbooks:	1. Salaymeh, L. (2016). Beginnings of Islamic law: late antique Islamic ate legal traditions - (law)

	2. Bhatia, H. S. (1989). Studies in Islamic Law, Religion and Society. Deep & Deep Publications New Delhi 3. Hasan A.1993. Principles of Islamic Jurisprudence. Islamic Research Institute, International Islamic University, Islamabad. 4. MAILK, M. (2017). Foundations of Islamic governance: a Southeast Asian perspective -(MUSLIM WORLD). 5. PASHA, M.P. (2017). ISLAM AND INTERNATIONAL RELATIONS: FRACTURED WORLDS - (INT'L AFFAIRS). 6. Ulumul Quran by Muhammad Taqi Usmani 7. Islam and Modernism by Mufti Taqi Usmani 8. Rise and decline of Muslim ummah by Dr. Israr Ahmed 9. Understanding the Principles of Islamic World-View by M. Junaid Nadvi 10. Marmaduke Picthall, The Holy Quran English Translation 11. Hussain Hamid Hassan, An Introduction to the study of Islamic Law
Reference Books:	• Quran and its commentary (Tafheem ul quran , tibyan ul quran , tafseer-e-jlalain) • Ahadith and its commentary(Sehah e sitta) • Islamic Jurisprudence by Islam Ehsan Khan, Iqbal Qelani • Perplex for human kind by Syed Hassan Nasr • World religions by Ninian Smart

5.Catalog Descriptions

The course aims to provide the students with the right foundations of knowledge, ethics and behavior to make them aware of their appropriate role and responsibility as a Muslim. Students would be given the opportunity to participate more actively in class discussion and are encouraged to voice their own point of view.

6. Course Objectives

The main objectives of this course are:

- **To cover the fundamentals of Islam**
- **To enable the students to implement ethical, moral values in their life**
- **To give the students, analytical approach towards Islam and modernism**

7.Topics covered in the Course and Level of Coverage

Introduction of Course and its objectives **Introduction to Quran** **Reason to study Quran**	2 hrs

Basic Ethics in Quran and Hadith (Part 1)	2 hrs
Basic Ethics in Quran and Hadith (Part 2)	2 hrs
Basic Ethics in Quran and Hadith (Part 3)	2 hrs
Islam and state **(Khilafa, Communism, Marxism, Dictatorship, Democracy, Monarchy)**	2 hrs
Historical Journey of Islam **(Chronological order of Prophets , Pre-islamic Era and Life of the Prophet PBUH)**	2 hrs
Historical Journey of Islam **(Khulafa e Rashideen, , Ummayid)**	2 hrs
Historical Journey of Islam **(Abbasids, Ottoman Empire, Islam in Contemporary World)**	2 hrs
Assignments and presentations	2 hrs
Assignments and presentations	2 hrs
Assignments and presentations	2 hrs
Five Pillars of Islam **(Kalma Tyeeba, Nmaz, Roza)**	2 hrs
Five Pillars of Islam **(Zakat , Haj)**	2 hrs
Islamic World View	2 hrs
World Religions	2 hrs

8.Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**	**Assessments**
CLO 1	**To cover the fundamentals of Islam**	PLO 6	C-1	Q1, Q 2, A1, OHT-1, Final
CLO 2	**To enable the students to implement ethical, moral values in their life**	PLO 8	C-2	Q 3, A 2, OHT-2, Final
CLO 3	**To give the students, analytical approach towards Islam and modernism**	PLO 6	C-3	Q4, Final

9.Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF BASIC SCIENCES & HUMANITIES

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information

Course Number and Title:	MATH-121 Linear Algebra and Ordinary Differential Equations
Credits:	3-0
Instructor(s)-in-charge:	Asst Prof Dr M Zubair Ali Moughal
Course type:	Lecture
Required or Elective:	Required
Course pre-requisites	Nil
Degree and Semester	DE 43 Semester 2nd
Month and Year	Spring 22

2. Course Schedule

Lecture:	3 Hrs/week, Meets twice weekly
Lab:	-
Discussion:	1 Hr/discussion, multiple discussion sections offered per week
Outside study:	3 Hrs/week
Office Hours :	6 Hrs/week by instructor

3. Course Assessment

Exam:	2 Sessional and 1 Final	
Homework:	3 Assignments	
Lab reports:	-	
Design reports:	-	
Quizzes:	6 Quizzes	
Grading:	Quizzes:	10%
	Assignments:	10%
	2 One Hour Tests (OHTs):	30%
	Final Exam:	50%
	Lab:	-

	Semester Project:	-

4. Course book and Related Course Material

Textbooks:	1. Dennis G. Zill and Michael Cullen, Differential Equations (3rd Edition) 2. E. Kreyszig, Advanced Engineering Mathematics, 9th ed.
Reference Books:	1. Glyn James, Modern Engineering Mathematics,

5. Catalog Descriptions

An Introduction to linear algebra and ordinary differential equations covers the basic concepts of linear algebra and solutions of the differential equations. These courses consist of two parts, linear algebra (e.g., vector spaces and solutions to algebraic linear equations, dimension, eigenvalues, and eigenvectors of a matrix) and differential equations (e.g., solutions to separable and linear first-order equations and to higher-order linear equations with constant coefficients, systems of linear differential equations, solving differential equation by using Laplace, the properties of solutions to differential equations). If you are curious about how we model a phenomenon from nature and how we understand its behavior from past to future mathematically, this is the course that will give you the answers.

6. Course Objectives

To teach techniques for solving ordinary differential equations and impart different concepts of linear algebra.

7. Topics covered in the Course and Level of Coverage

Linear Algebra: Basic Concepts. Matrix Addition. Scalar Multiplication, Matrix Multiplication	1 hr.
Linear Systems of Equations. Gauss Elimination.	1 hr.
Solution of Linear Systems: Existence, Uniqueness, General Form	1 hr.
Inverse of a Matrix. Gauss-Jordan Elimination.	3 hrs.
Vector Spaces, Sub Spaces and Linear Transformations	3 hrs.
Linear dependence, linear independence, spanning set, basis	4 hrs.
Eigenvalues and Eigenvectors	3 hrs.

First Order Ordinary Differential Equations: Separable Variables.	2 hrs.
Homogeneous Equations.	2 hrs.
Exact Equations and Integrating Factors.	2 hrs.
Linear Equations.	1 hr.
Equations of Bernoulli, Ricatti and Clairaut.	2 hrs.
Applications of Linear and Non-Linear First Order ODEs.	2 hrs.
Linear Differential Equations of Higher Order: Preliminary Theory. Initial and Boundary Value Problems. Linear Dependence and Linear Independence. Constructing a second solution from a known solution.	2 hrs.
Homogeneous Linear Equations with constant coefficients.	1 hr.
Non-Homogeneous Linear Equations with constant coefficients Differential Operators. Undetermined Coefficients.	5 hrs.
Variation of Parameters.	2 hrs.
Non-Homogeneous Linear Equations with Variable Coefficients Cauchy-Euler Equation.	2 hrs.
Laplace Transform Laplace Transform and Inverse Transform.	3 hrs.
Unit step function, Dirac delta function	2 hrs.
Solution of 1st and higher order initial value problem using Laplace Transform.	4 hrs.

8. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**	**Assessments**
1.	**CLO 1**: Solving system of linear equation using matrices	PLO 1	C3	Q1, Final 1-question
2.	**CLO 2:** Evaluating Eigen values, Eigen vector and related problems	PLO 1	C3	Q2, Final 1-question
3.	**CLO 3:** Evaluating first order and higher order differential equations.	PLO 2	C5	Q4, A2
4.	**CLO 4:** Carry out Laplace Transform and Inverse Laplace transforms including solution of Initial value problems involving piece-wise continuous functions	PLO 2	C5	Q6, A3, Final 1-question

9. Topics covered in the Course and Level of Coverage	CLO	Chapter(s)
Linear Algebra: a. Basic Concepts. Matrix Addition. Scalar Multiplication, Matrix Multiplication b. Linear Systems of Equations. Gauss Elimination.	CLO-1	Advance Engineering Mathematics, Chapter-7
Solution of Linear Systems: **a.** Existence, Uniqueness, General Form **b.** Inverse of a Matrix, Gauss-Jordan Elimination **c.** Vector Spaces, Sub Spaces and Linear Transformations **d.** Linear dependence, linear independence, spanning set, basis	CLO-1	Advance Engineering Mathematics, Chapter-7
Eigenvalues and Eigenvectors	CLO-2	Advance Engineering Mathematics, Chapter-8
First Order Ordinary Differential Equations: **a.** Separable Variables**,** Homogeneous Equations. **b.** Exact Equations, Linear Equations. **c.** Equations of Bernoulli, Ricatti and Clairaut. **d.** Applications of Linear and Non-Linear First Order ODEs.	CLO-3	Differential equation by D G Zill, Chapter-2-3
Linear Differential Equations of Higher Order: a. Preliminary Theory, Initial and Boundary Value Problems. b. Linear Dependence and Linear Independence. c. Constructing a second solution from a known solution. d. Homogeneous Linear Equations with constant coefficients e. Non-Homogeneous Linear Equations with constant and Undetermined Coefficients. Variation of Parameters. Non-Homogeneous Linear Equations with Variable Coefficients f. Cauchy-Euler Equation.	CLO-3	Differential equation by D G Zill, Chapter-4-5
Laplace Transform a. Laplace Transform and Inverse Transform. b. Unit step function, Dirac delta function **c.** Solution of 1st and higher order initial value problem using Laplace Transform.	CLO-4	Differential equation by D G Zill, Chapter-7

10. Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**

	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	ME-109: Engineering Drawing
Credits:	0-1
Instructor(s)-in-charge:	Asst Prof Dr Faisal Ahmed
Course type:	03 (Practical) per week
Required or Elective:	Required
Course pre-requisites	Basics of Geometrical Drawing
Degree and Semester	
Month and Year	Fall 2021

2. Course Schedule	
Practical:	3 hrs/week, Meets once weekly
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Office Hours :	3 hrs/week by instructor

3. Course Assessment	
Manual Drawing Mid Exam	40%
Quizzes/Assignments:	20%
Autocad Final Exam	40%
4. Course book and Related Course Material	
Textbooks:	• First Year Engineering Drawing by A. C. Parkinson • .Geometrical Drawing by N. D. Bhatt. • B. McFarlane, Beginning AUTOCAD 2004, 1st edition, Elsevier M.A. Drum, Wildfire 2.0 fundamentals
Reference Books:	• Engineering Drawing and Design by Cecil Jensen And Jay D. Helsel • Engineering Graphics by Craft Meyer and Boyer • G.R. Bertoline, E.M. Weibe, Fundamentals of Graphics Communication, 5th edition, McGraw-Hill, New York

5. Course Objectives

This course begins with the study of basic concepts of Engineering Drawing. Students are then practised about technical drawing which includes sectional drawing, isometric drawing, orthographic projection, first and third angle and standard part drawing. They are given assignment per week which has to be completed in their practical period regarding orthographic projections, sectional drawing and isometric drawing. After completing the Engineering Drawing section of the course, they are then taught about drafting tools in AutoCAD. Students learn powerful tools and techniques necessary for professional 2D drawing and dimensioning using the software AutoCAD.

6. Course outcomes

- **Understand the fundamental aspects of drawing**
- **Distinguish between first and third angle of projection drawings**
- **Apply standard dimensions to an engineering drawing in manual drawing and using AutoCAD software**
- **Use the drafting tools and AutoCAD to prepare accurate technical drawings in first and third angle of projection**
- **Use the drafting tools to prepare accurate technical sectioning and isometric drawings**

7. Syllabus Details:

Part-1 Engineering Drawing

- **Types of lines and usage**
- **Drawing Instruments and usage**
- **Sheet Planning and Dimensioning**
- **Orthographic projection, First and Third Angle**
- **Sectional Drawing**
- **Isometric Drawing**

Part-2 Introduction to CAD

- **DRAW commands**
- **SELECTION SETS options**
- **VIEW commands**
- **MODIFY commands**
- **DIMENSION commands**
- **LAYERS commands**

8. Course Learning Outcome (CLOs)		PLOs	Learning Level
CLO 1	Use the basic knowledge of drawing skills.	PLO 1	P2
CLO 2	Apply the concepts of basic drawing techniques.	PLO 2	P3
CLO 3	Demonstrate individually the drawings of plan, elevation and cross sections of machine parts	PLO 3	P3
CLO 4	Apply the precision drafting tools and standard dimensions in AutoCAD to prepare accurate technical drawings	PLO 2	P3

9. Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF BASIC SCIENCES & HUMANITIES

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	HU 109 Communication skills
Credits:	2
Instructor(s)-in-charge:	Lec Zara Rizwan
Course type:	Lecture
Required or Elective:	Required
Course pre-requisites	None
Degree and Semester	DE 43 2ND
Month and Year	Spring 22

2. Course Schedule	
Lecture:	2 hrs/week, Meets once weekly
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	2 hrs/week
Office Hours :	4 hrs /week by instructor

3.Course Assessment		
Exam:	2 sessionals and 1 Final	
Home work:	2 Assignments	
Lab reports:	-	
Design reports:	-	
Quizzes:	4 Quizzes	
Grading:	Quizzes:	15%
	Assignments:	5%
	2 One Hour Tests (OHTs):	30%
	Final Exam:	50%
	Lab:	-
	Semester Project:	-

4. Course book and Related Course Material	
Textbooks:	Effective business communication, Herta A. Murphy Published by McGraw-Hill Companies
Reference Books:	Wren and Martin, English Grammar and Composition Building English Skills, Yellow Level Practical English Grammar by A. J. Thomson and A. V. Martinet High Schools English Grammar by P. C. Wren and H. Martin Exploring the World of English by Sadat Ali Shah

	Business Communication & Technologies (Beck, Harvey, Mylonas, Rasmussen) Business Communication Today (Lesikar & Flatley) Business Communication Today –ll (Bovee & Thill) Business Communication (Mary Ellen Guffey) Business Communication, Building Critical Skills (Locker & Kaczmarek)

5. Catalog Descriptions

This course focuses on Communication Skills and how to be well versed in English communication.

6. Course Objectives

Objectives of this course include

- Write summary of lengthy as well as complex texts without losing the gist and important details of the original written piece
- Practice writing official letters, memorandums and reports in a professional manner
- Perform extensive reading activities in a bid to improve reading skills, learn to aptly place punctuation marks and use question tags in an appropriate manner
- Identify presentation blind spots for sound presentation skills through presentation software such as Prezi etc.

7. Topics covered in the Course and Level of Coverage

Week	Lecture Topic	Reading/Activities
1	Introduction to Communication skills • Definition • Theories in communication • The Communication processes. • Communication in the workplace Verbal and Non-verbal Communication • What is non-verbal communication? • Barriers in both verbal and nonverbal communication • A comparison • Categories of non-verbal communication	• General Course introduction will be given, and its importance will be highlighted in their(students) field • Each student will be asked to introduce themselves; they can talk about their hobbies, their interests, reason for choosing NUST or any other interesting experiences • Interactive session is held to take the opinion and create interest among students for this course.
2	**Effective Listening Skills** • The process of listening • Identifying four different listening responses • Overcoming listening barriers • Practicing active listening skills	**Activity:** (a) Class activities to demonstrate the importance of effective listening (drawing with step-by-step instructions; giving directions and creating maps etc) (b) Students to hold discussions in English language on a variety of topics; they are required to listen to the arguments carefully and provide counterarguments

3	**Paragraph and Essay Writing** • Parts of an essay • Ways to develop a proper beginning, middle, and ending of an essay • Kinds of an essay	**Activity:** • Students are given description of each component of essay • Its different kinds like expository essay, argumentative essay, analytical essay…. etc. • Students are showed different models of essay and asked to analyze its different features pertaining to different kinds of essay • Finally, they are given topic to write argumentative essay
4	**Oral Presentation Skills** • Rhythm, intonation • Stress pattern • Preparation • Choosing Overall Organizational Pattern • Building Strong Opening • Tips for Creating a Great Introduction and interesting conclusion • Checking for Understanding • Posture and Gestures • Audio-visual Aids • Eye Contact • Use of the Voice • First Impressions • Timing • Handling Difficult Questions	**Activity** • Each student will be asked to present a topic of their choice for 3-5 minutes. They will be assessed on their confidence, body language, engaging audience, intonation, time management etc
5	**PowerPoint Presentations** • Instructions on how to create concise and useful slides from large amounts of text • Use of smart art feature in Microsoft PowerPoint • Use of images and figures	**Activity** • Class activity for students to convert text into simple, easy to understand figure or smart art
6	**Message Composition-I** • Positive & Informative Messages • Negative Messages	**Activity:** Read the given good and Bad News letter and answer the critical thinking based questions: 1. Identify the objectives and purpose of the letter? What outcomes should the sender want to achieve? 2. How does the letter need to be organized for stating good messages and bad messages? 3. How could the bad news be

		deemphasized? 4. How could the good news be emphasized? 5. What techniques are used to state good messages and bad messages like • Dependent & independent clause • Active passive voice • Dangling modifiers • Practice different (good & bad) messages from relevant chapters provided in books
7	**Message Composition-II** • Persuasive messages • Sales Messages	**Activity:** • Students are instructed with general rules of writing persuasive messages and sales messages • They are asked to critically analyze given(templates) messages • Finally, students write sales messages on given situation.
8	**Employment Related Skills:** • Job Market Search Skills • Job Planning & Organization Skills • Interviewing for a job • Salary Negotiations	**Activity:** students are given orientation on job market demands and situation https://www.youtube.com/watch?v=CCse XLOXuMg • They will also give briefing on "how to prepare themselves for interview like maintaining portfolio, searching for targeted organization searching for applied designation • students are asked to work in pairs and present mock interview in front of class by giving different situations • Study relevant material from the given Books.
9	**Midterm Examination/OHTs**	
10	**Preparing formal Letters** • Solicited and unsolicited messages • How to write resignation letters • Organization of persuasive, sales or commercial letters-AIDA formula	**Activity** • Students are provided with different formats of letter Block format, Un block format ,Semi block format and AMS stratified format • They are given templates for each letter format • They are given situation and

		asked to write letter on any specific format. • Practice different letter writings from relevant chapters of referred Books.
11	**Electronic Communication:** • SMS, Social Media (WhatsApp, Blogs etc.) • Emails and Email Etiquettes	**Activity:** Students will be showed videos on an effective usage of social media (WATS App…) https://www.youtube.com/watch?v=NU1mptRcELg They are also given professional emails used in workplace. • They are asked to write a letter of inquiry to corporate sector about its products/services… etc. • Students are also encouraged to watch more videos on effective use of social media and its dangers
12	**Applying For a Job** 1. Covering Letter: Searching for a position, evaluating yourself, writing a good job application **2. CV/ Resume Writing:** • Types of résumé, characteristics of CV writing, • organization / formats, common problems in CV writing	Activity: Students will be given general instruction on how to write cover letter and resume • They will be provided with model template to analyze the features of covering letter and resume. • They will be asked to look for job advertisement for applying job and ask to write cover letter and resume accordingly. • Students are assigned to write professional cover letter and resume for internship in coming summer vacations on their current status
13	**Presentations**	Activity: • Students are asked to present their self as tourist guide and give entertaining presentation on any country they like about its culture, famous places. their developments …..etc • Students are also encouraged to make interesting slides for presentation.
14	• Summarizing Industry-related Literature and writing to difference target audiences for specific purposes • Define audience, message, purpose,	**Activity:** • Students will be asked to choose any industry relevant to their discipline

	tone, style, jargon, wordiness and redundancy • Recognize that the anticipated audience determines the manner in which the message should be written • State the purpose of a message quickly and clearly • Eliminate inappropriate jargon, pretension, and wordiness	and select literature with complex language; they will be required to identify the potential target market and rewrite the message to suit the needs of the target audience
15	**Critical Reading Skills** • Ways to cope with and understand complex texts • Practice in understanding complex texts and instructions • Recognize the purpose and function of previewing, scanning, skimming and critical reading	**Activity:** Students are told different techniques used in reading text like • How to skim • How to scan • How to infer an idea • How to critique (positive and negative) in the text Students are given text and its related exercises Which gives practice to all these techniques.
16	Revision/Recapitulation	
17	Make-ups [if any]	
18	Final Term Exams	

8. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**	**Assessments**
CLO 1	Locate common errors usually made by the learners of English as second language.	PLO 10	C2	Q1, OHT-1, Final - question 1 Quiz 1
CLO 2	Demonstrate coherence and cohesion in paragraph development	PLO 10	C3	Assignment 1 Quiz 2
CLO 3	Write various types of essays, magazine/newspaper articles and develop effective paraphrasing and summarizing skills	PLO 10	C3	Final question 3 Quiz 3
CLO 4	Present confidently in front of large audience using audio/ visual aids.	PLO 10	A4	Discussion/ (Assgn) Role play Presentation (quiz 4)

9. Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF ELECTRICAL ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information

Course Number and Title:	EE-211, Electrical Network Analysis
Credits:	4 (3+1)
Instructor(s)-in-charge:	A/P Dr Ahmad Rauf Subhani (e-mail: rauf.subhani@ceme.nust.edu.pk), Lec Kamran Bodla
Course type:	Lecture + Lab
Required or Elective:	Required
Course pre-requisites	EE-111 Linear Circuit Analysis
Degree and Semester	DE-43 CE (A, B) , Semester 2
Month and Year	Spring 2022

2. Course Schedule

Lecture:	3 hrs/week, Meets twice weekly
Lab:	3 hrs/week, Meets once in a week
Office Hours :	3 hrs/week by instructor, 3 hrs/week by teaching assistant/lab engineer

3. Course Assessment

Exam:	One Final Exam	
Home work:	Assignments	
Lab reports:	Reports	
Quizzes:	Quizzes	
Grading:	Quizzes:	11.25%
	Assignments:	7.5%
	Two Sessional Exams:	30%
	Final Exam:	30%
	Lab/Semester Project:	25%

4. Course book and Related Course Material

Textbooks:	Electric Circuits Fundamentals, 1st Edition, by Sergio Franco, Oxford English Press 1995.
Reference Books:	Fundamentals of Electric Circuits, 3rd Edition, by Charles K. Alexander & Matthew N.O.Sadiku, McGraw Hill 2003.

5. Catalog Descriptions

The course is designed to analyze the natural and complete response of first and second order circuits to constant/ non constant forcing functions in time, frequency and s domain. Concepts like frequency/AC response of RLC circuits, phasors, complex impedance, power transfer, resonance and Laplace transform as circuit analysis tools are discussed in detail. In addition to class lectures, comprehensive laboratory exercises are also designed so that theoretical knowledge may be coincided with practical.

6. Course Objectives

b. Students would have a good understanding of the response of AC circuits in time and frequency domain. The concepts of EE 111 Linear Circuit Analysis are utilized.
c. The student would have a good grasp of AC circuit analysis techniques.
d. Students would be able to apply concepts in algebra, complex numbers, simultaneous equation and phasors to calculate accurate solutions to AC circuits.

7. Topics covered in the Course and Level of Coverage	
• Transient response of second order circuits	9hrs
• AC Response of First and Second Order Circuits	3hrs
• AC Resonance in series and parallel circuits	6hrs
• AC Circuit Analysis	6hrs
• AC Power and Three phase systems	6hrs
• Network Functions in s domain and frequency response using Bode plots	6hrs
• Mutual Inductance and Magnetically Coupled Circuits, Ideal Transformer	3hrs
• Laplace Transforms and its applications to circuit analysis	9hrs

8. Lab Experiments	
Lab 01	Learning first order RC circuit with Time Constant, Differentiation and Passive LPF/HPF
Lab 02	Learning Damping Ratio and Resonance in series RLC circuit
Lab 03	Maximum Power Transfer Theorem and Thevenin Equivalent
Lab 04	Designing Band Pass Filter
Lab 05	Designing Band Stop Filter
Lab 06	Determination of complex impedance and power factor of network
Lab 07	Learning operational amplifiers in inverting configuration
Lab 08	Learning operational amplifiers in non-inverting configuration
Lab 09	Understanding the working of operational amplifiers as comparators
Lab 10	Understanding the working of summation amplifiers and designing circuits to control gain
Lab 11	Determination of two port network Z parameters
Lab 12	Determination of two port network Y parameters
Lab 13	Tutorial on circuit designing in proteus
Lab 14	Design Project

9. Course Outcomes and their Relation to Program Outcomes

(Mapping CLO to PLO)

Course Learning Outcome (CLOs)		PLOs	Learning Level
CLO 1	Learning and interpreting frequency response of networks using frequency and s domain techniques and be able to plot frequency response using Bode plot.	PLO1	C 2
CLO 2	Analyzing the circuits for constant/non constant forcing functions in time, frequency and s domain.	PLO2	C4
CLO 3	Learning advanced circuit analysis tools such as the Laplace transform	PLO2	C 3
CLO 4	Observing the working of different circuits in lab.	PLO4	P3
CLO 5	Demonstrate ability to work effectively as an individual or in a team.	PLO9	A3

10. Program Learning Outcomes

PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.

PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF BASIC SCIENCES & HUMANITIES

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information

Course Number and Title:	MATH-161 Discrete Mathematics
Credits:	3+0
Instructor(s)-in-charge:	Assoc Prof Dr. M. Umar Farooq
Course type:	Lecture
Required or Elective:	Required
Course pre-requisites	Nil
Degree and Semester	DE-42 Semester 3
Month and Year	Fall 2021

2. Course Schedule

Lecture:	3 hrs/week, Meets twice weekly
Lab:	-
Discussion:	multiple discussion sections offered per quarter
Outside study:	7 hrs/week
Office Hours :	6 hrs/week by instructor

3. Course Assessment

Exam:	2 Sessionals and 1 Final	
Home work:	3 Assignments	
Lab reports:	-	
Design reports:	-	
Quizzes:	6 Quizzes	
Grading:	Quizzes:	10%
	Assignments:	10%
	2 One Hour Tests (OHTs):	30%
	Final Exam:	50%
	Lab:	-
	Semester Project:	-

4. Course book and Related Course Material

Textbooks:	a) K.H. Rosen, Discrete Mathematics and its Applications, (4th Edition) (b) Susanna S. Epp, Discrete Mathematics with Application (3rd Edition)
Reference Books:	B Kolman, R.C. Busby & S.C. Ross, Discrete Mathematical Structures, (5th Edition) Pearson Education.

5. Catalog Descriptions

This course introduces the basic concepts and techniques of counting, reasoning, graph theory, algorithms and mathematical modeling.

6. Course Objectives

The objective of this course is to provide strong foundation for the upcoming courses in the Computer and Software engineering program.

7. Topics covered in the Course and Level of Coverage

Article	Topics	Estimated Contact Hours
1.1, 1.2, 1.3	Introduction, Logic, Propositional Equivalences, predicates and Quantifiers	3
1.4, 1.5, 1.6, 1.7	Basic Set Theory, Functions, Sequences and Summation	3
2.3, 3.1, 3.2	The Integers and Division, Methods of Proof; Mathematical Induction	3
3.3, 3.4	Recursive Definition and Algorithms	3
4.1, 4.2	Basic counting, Pigeon hole principles	3
6.1, 6.2	Relations and their Properties	3
6.3	Relation Representation	3
6.5, 6.6	Equivalence Relations, Partial Ordering	3
7.1, 7.2	Intro to Graphs	3
7.3, 7.4	Graph Isomorphism, Connectivity	3
7.5, 8.1	Euler and Hamilton Path, Intro to Trees	3
7.6	Shortest Path Problem	3
8.4, 8.5	Tree Sorting, Spanning Trees	3
8.6	Minimum Spanning Trees	3
9.1-9.4	Boolean function, Logic gates, minimization of circuits	3

8.Course Outcomes and their Relation to Program Outcomes

(Mapping CLO to PLO)

Course Learning Outcome (CLOs)		PLOs	Learning Level	Assessments
CLO 1	Use of mathematical reasoning to comprehend and construct mathematical argument	PLO 1	C3	Q1, Q2, A1, OHT-1, Final 2-questions
CLO 2	Solve counting problems with combinatorial analysis	PLO 2	C3	Q3, Q4, A2, OHT2, Final 2-questions
CLO 3	Applied Graphs to real world problem	PLO 1	C3	Q5, OHT2, Final 2-questions
CLO 4	Analyze various algorithms	PLO 2	C4	Q6, A3, Final 2-questions

9.Mapping of Topics	CLO	Chapter(s)
Introduction, Logic, Propositional Equivalences, predicates and Quantifiers	CLO-1	Discrete Mathematics and its Applications, Chapter-1, **1.1, 1.2, 1.3**
Basic Set Theory, Functions, Sequences and Summation	CLO-1	Discrete Mathematics and its Applications, Chapter-1, **1.4, 1.5, 1.6, 1.7**
The Integers and Division, Methods of Proof; Mathematical Induction	CLO-1	Discrete Mathematics and its Applications, Chapter-2 & 3, **2.3, 3.1, 3.2**
Recursive Definition and Algorithms	CLO-1	Discrete Mathematics and its Applications, Chapter- 3, **3.3, 3.4**
Basic counting, Pigeon hole principles	CLO-2	Discrete Mathematics and its Applications, Chapter- 4, 4.1, 4.2
Relations and their Properties	CLO-2	Discrete Mathematics and its Applications, Chapter-6, 6.1, 6.2
Relation Representation	CLO-2	Discrete Mathematics and its Applications, Chapter-6, 6.3
Equivalence Relations, Partial Ordering	CLO-2	Discrete Mathematics and its Applications, Chapter-6, 6.5, 6.6
Intro to Graphs	CLO-3	Discrete Mathematics and its Applications, Chapter-7, 7.1, 7.2
Graph Isomorphism, Connectivity	CLO-3	Discrete Mathematics and its Applications, Chapter-7, 7.3, 7.4

Euler and Hamilton Path, Intro to Trees	CLO-3	Discrete Mathematics and its Applications, Chapter-7, 7.5, 8.1
Shortest Path Problem	CLO-3	Discrete Mathematics and its Applications, Chapter-7, 7.6
Tree Sorting, Spanning Trees	CLO-3	Discrete Mathematics and its Applications, Chapter-8, 8.4, 8.5
Minimum Spanning Trees	CLO-3	Discrete Mathematics and its Applications, Chapter-8, 8.6
Boolean function, Logic gates, minimization of circuits	CLO-4	Discrete Mathematics and its Applications, Chapter-9, 9.1---9.4

10.Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.

PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	CS-212 Object Oriented Programming
Credits:	4 (3+1)
Instructor(s)-in-charge:	Lecturer Anum Abdul Salam – LE Sundas Ashraf/ TA Saba
Course type:	Lecture + Lab
Required or Elective:	Required
Course pre-requisites	CS-114 Fundamentals of Programming
Degree and Semester	DCE -43 A/B, Semester 3
Month and Year	Fall 2022

2. Course Schedule	
Lecture:	3 hrs/week, Meets once weekly
Lab:	3 hrs/week, Meets once weekly
Office Hours:	Monday – 1215 – 1400 hrs. Tuesday – 1215 – 1500 hrs. Friday – 1115 – 1400 hrs.
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	6 hrs/week

3. Course Assessment

Exam:	Mid Term Exam and Final Exam
Homework:	3 Assignments
Lab report:	13
Design Project (CEP):	1
Quiz	6-8
Open Lab	2

4. Grading:

Course	Quizzes, Assignments:	20%	75%
	Mid Semester Exam:	30%	
	Final Exam:	50%	
Lab	Lab Work: (Lab Tasks, Open Lab, Lab Exam)	70%	25%
	Semester Project (Complex Engineering Problem):	30%	

5. Course book and Related Course Material

Textbooks:	1. Robert Lafore, **"Object Oriented Programming with C++,"** 2. **An Introduction to Object-Oriented Programming with Java**, 5th Edition by C. Thomas Wu
Reference Books:	1. Object-oriented Programming in Java: A Graphical Approach by Kathryn E. Sanders

6. Catalog Description

This course introduces advanced programming skills and focuses on the core concepts of object-oriented programming and design using Java. Object-oriented programming represents the integration of software components into a large-scale software architecture. Software development in this way represents the next logical step after learning coding fundamentals, allowing for the creation of sprawling programs. The course focuses on the understanding and practical mastery of object-oriented concepts such as classes, objects, data abstraction, encapsulation, methods, method overloading, inheritance, and polymorphism.

7. Course Objectives

a. The main objective of the course is to familiarize the students with **Object Oriented Programming (OOP) paradigm**.
b. The students will gain an in-depth knowledge of **OOP concepts such as Abstraction, Data Encapsulation, Inheritance, Polymorphism etc.**
c. Analyze a problem statement to develop a model of the scenario necessary to create an application
d. Gain skills in designing, and programming software for reuse of code.

8. Topics Covered:

1. Introduction to object-oriented programming and its fundamentals a. Programming Paradigms b. Need of OO Paradigm c. Abstract Data Types d. Data Abstraction and Encapsulation	2 hrs.
2. Classes and objects a. Designing Programmer Defined datatypes b. Structures vs. Classes c. Classes in C++ d. Data Abstraction using Access Specifiers e. Constructors and Object Instantiation f. Accessing attributes via setters/ getters and input validation	4 hrs.
3. Introduction to JAVA a. Introduction to JAVA b. Java Code Compilation and Execution c. Learning Datatypes, Operators, Conditional Blocks, and Iterations in JAVA d. Packages in JAVA e. Writing a Basic JAVA Program f. Writing Classes and Object Declaration in JAVA	3 hrs.
4. More on Classes a. 'Static' and 'final' keywords in JAVA b. Need to declare class members as 'static' and 'final' c. Deep vs. Shallow Copying in JAVA d. Copy Constructors e. Use of = = vs equals function for Object comparison f. Declaring Arrays of non-Primitive datatypes	6 hrs.
5. Inheritance a. Reusability in OOP b. Need of Inheritance and understanding 'is-a' relationship c. 'extend' key word in JAVA d. 'super' keyword and sequence of constructor call	3 hrs.

e. Function overwriting and binding f. 'final' member functions in hierarchy g. Protected and default access Specifiers	
6. Polymorphism a. Need of Dynamic Binding b. Abstract Classes and Abstract Functions c. Significance of having an Abstract Class d. Polymorphic Arguments e. Association	3 hrs.
7. Composition and Aggregation a. Need of Composing Classes and Reusability b. 'has-a' phrase to understand inter-class relationship c. Composition vs. Aggregation d. Deep and Shallow instantiation of objects in Composition	3 hrs.
8. Interfaces a. Need of Multiple Inheritance b. Elaborate Diamond Death Scenario c. Significance of Interfaces d. Inheritance vs. Interfaces e. Declaring and using Interfaces	2 hrs.
9. Object Oriented Design and UML a. Introduction to OOD and OOA b. Introduction to UML Class Diagram c. Representing Objects, Inter-class relationships in UML d. Static, Constant and access specifier notations in UML	2 hrs.
10. Exception Handling a. Introduction to Exceptions b. How to Handle exceptions c. 'try-catch', 'throw' and 'finally' keyword d. Types of Exceptions e. Multiple catch blocks f. Programmer Defined exceptions g. Propagator vs. Catcher, 'throws' keyword	3 hrs.
11. Data Serialization a. Introduction to File Handling b. IO Exception c. Types of File Handling d. Low level I/O, High Level I/O, Object I/O and Text file I/O e. Exploring various built-in functions of file class f. Adding GUI using JFile Chooser	4 hrs.
12. Graphical User Interface a. Components of Window Builder Application b. Layouts in SWT c. Event Handling of components d. Adding class files in GUI based Project	2 hrs.
13. Patterns and Data Holders in JAVA a. Introduction to Patterns b. Various Symbols to generate a generalized pattern. c. 'StringBuffer' and 'StringBuilder' Classes d. Reusing data holders from JAVA Built-in APIs e. 2D Dynamic Arrays f. Homogenous and Heterogenous Lists in JAVA	5 hrs.

14. Threading in JAVA a. Creating Threads using Thread Class and Runnable Interface b. Synchronizing threads c. Multithreading in JAVA	3 hrs.

9. Lab Experiments:

Lab 1	Introduction to Classes
Lab 2	Default and Parameterized Constructors in C++
Lab 3	Introduction to Classes in JAVA
Lab 4	Static Data Members of a Class
Lab 5	Array of Objects, Constant Attributes and Copy Constructor
Lab 6	Implement Inheritance and learn it's use case
Lab 7	Practice Polymorphism, Learn static and dynamic binding and Abstract Classes
Lab 8	Practicing Composition and learn where to use it
Lab 9a	Design and Implement Interfaces
Lab 9b	Exception Handling in JAVA
Lab 10	Data Serialization in JAVA
Lab 11	Text File Handling in JAVA
Lab 12	Open Lab-I
Lab 13	Graphical User Interface in JAVA
Lab 14	Patterns and Data Holders in JAVA
Lab 15	Threads in JAVA
Lab 16	Open Lab-II

10. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**
CLO 1	To **apply** fundamental concepts of object-oriented programming for their mapping to real life scenarios.	1	C3
CLO 2	To **design** solutions for implementing given problem in terms of objects and classes with their relationships, attributes and properties using specific tool(s).	3	P3

CLO 3	Apply the major object-oriented concepts i.e., data abstraction, encapsulation, inheritance, and polymorphism to **construct**/ implement a solution for the given problem in an open lab/assignment.	3	P3
CLO 4	Design and **develop** a complete solution for the given scenario/ complex Engineering problem using learned techniques and tools.	2	P4

11. Grading Policy:

Assignment Policy:	To develop comprehensive understanding of the subject, assignments will be given. Late assignments will not be accepted / graded. All assignments will count towards the total (No 'best-of' policy). The students are advised to do the assignment themselves. Copying of assignments is highly discouraged and violations will be dealt with severely by referring any occurrences to the disciplinary committee. The questions in the assignment are meant to be challenging to give students confidence and extensive knowledge about the subject matter and enable them to prepare for the exams.
Plagiarism:	NUST CEME maintains a **zero-tolerance** policy towards plagiarism. While collaboration in this course is highly encouraged, you must ensure that you do not claim other people's work/ ideas as your own. Plagiarism occurs when the words, ideas, assertions, theories, figures, images, programming codes of others are presented as your own work. You must cite and acknowledge all sources of information in your assignments. Failing to comply with the NUST CEME plagiarism policy will lead to strict penalties including zero marks in assignments and referral to the academic coordination office for disciplinary action.

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information

Course Number and Title:	EC-210 Logic and Sequential Circuit Design
Credits:	4 (3+1)
Instructor(s)-in-charge:	Lt Col Hammad Tanveer Butt / LE Abubakar
Course type:	Lecture + Lab
Required or Elective:	Required
Course pre-requisites	EC-120 Computer Organization
Degree and Semester	DE 42 Semester 3
Month and Year	Fall 2021

2. Course Schedule

Lecture:	3 hrs/week, Meets twice weekly
Lab:	3 hrs/week, Meets once in a week
Outside study:	8 hrs/week
Office Hours :	6 hrs/week by instructor, 3 hrs/week by lab engineer

3. Course Assessment

Exam:	2 OHTs and 1 Final	
Home work:	6 Assignments	
Lab reports:	12 reports	
Design reports:	1 Design report based on Semester Project	
Quizzes:	6 Quizzes	
Grading:	Quizzes:	10%
	Assignments:	10%
	2 One Hour Tests (OHTs):	20%
	Final Exam:	50%
	Semester Project:	10%
	Lab Work:	70%
	Lab Final:	15%
	Lab Mid/ Open Lab:	15%

4. Course book and Related Course Material

Textbooks:	**10.** "Digital Design", 5th Ed. Prentice Hall , by Mano and Ciletti..
Reference Books:	"Logic & Computer Design Fundamentals", 5th Ed. Prentice Hall by Mano and Kime,. Class Notes and Lecture material/Slides (Each Student to take own Class Notes)

5. Catalog Descriptions

This course will teach undergraduate students about the basic knowledge of Boolean algebra and digital data representation and manipulation in digital systems. It would focus on gate level design of digital circuits from truth table, and subsequently introduce analysis and simplification of gate level design. The TTL and CMOS implementation of digital gates will be discussed in the context of SSI and an overview of CMOS VLSI shall also be provided towards digital IC design. The later part of the course would teach the design and analysis of Combinational Logic Circuits using MSI and LSI and introduce decoders/encoders, multiplexer, adders and ALU. Towards end of this course, the design and analysis of synchronous Sequential Logic Circuits using state table/diagrams, FSM, Flip Flops, Registers, Shift Registers, Counters, Memory will be discussed and programmable logic devices (PLDs) and FPGAs will be introduced.

6. Course Objectives

To teach students about the fundamental concepts covering overview of Digital systems, Boolean algebra, Combinational and Sequential Logic, which stresses the underlying design principles and the impact of these principles on digital and computer system implementation. General topics include Boolean algebra, Binary representation and Codes, Truth Table, Boolean functions, Logic minimization, Combinational and Sequential MSI, State Diagrams, various types of RAM/ROM memory and Programmable logic.

7.Topics covered in the Course and Level of Coverage	
Concept of Computation, Numbers, Set Theory & Logic.	3hrs
Digital signals, Discrete & Binary Systems, Boolean gates	3hrs
Binary Representations, Codes, Signed, Unsigned numbers binary representation, Arithmetic operations, Overflow	3hrs
Floating point numbers binary representation, ASCII and Gray Code	3hrs
Error Checking and Correction	3hrs
Boolean Algebra, De Morgan's Laws and Gate level Minimization	3hrs
Karnaugh Maps for Logic Minimization	3hrs
Combinatorial Logic-I , MSI, Half Adder / Adder	3hrs
Combinatorial Logic-II, Decoder/Encoder, Multiplexer	3hrs
Combinatorial Logic-III, ALU	3hrs
Sequential Logic-I, Asynchronous vs. Synchronous design, State Table /Diagram, Flips Flops, FSM.	3hrs
Sequential Logic-II, Latches, Registers, Shift Registers/Counters.	3hrs
Sequential Logic-III, Digital Addressable Memory, RAM/ROM, PLD/FPGA.	3hrs
TTL and CMOS Circuits, Digital IC Design.	3hrs

8. Lab Experiments	
Lab 01	STUDY OF BASIC GATES
Lab 02	UNIVERSAL GATES
Lab 03	Boolean Algebra Rules and Logic Circuits
Lab 04	Canonical SOP/POS Form and Logic Designing
Lab 05	Half and Full Adders
Lab 06	Open Lab 1
Lab 07	Fan-In and Fan-Out of TTL logic Family
Lab 08	Measuring Propagation Delay of TTL LOGIC Gates
Lab 09	Multiplexers, Demultiplexers
Lab 10	IC to 7-segment display
Lab 11	Verilog

Lab 12	Test benches in Verilog
Lab 13	Flip Flops (Sequential Circuit)
Lab 14	Shift Registers
Lab 15	Open Lab 2

9.Course Outcomes and their Relation to Program Outcomes

(Mapping CLO to PLO)

Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**
CLO 1	Identify and explain fundamental concepts of digital logic design including basic and universal gates, number systems, binary coded systems, basic components of combinational and sequential circuits.	PLO 1	C2
CLO 2	Demonstrate the acquired knowledge to apply techniques related to the design and analysis of digital electronic circuits including Boolean algebra and multi-variable Karnaugh map methods.	PLO 1	C2
CLO 3	Analyze small- and medium-scale combinational and sequential digital circuits	PLO 2	C4
CLO 4	Design small-scale combinational and synchronous sequential digital circuit using Boolean algebra and K-maps through experimentation	PLO 3	P4

10.Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF ELECTRICAL ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	EE-215, Electronic Devices and Circuits
Credits:	4 (3+1)
Instructor(s)-in-charge:	Asst Prof M Anis Ch, LE Azmat
Course type:	Lecture + Lab
Required or Elective:	Required
Course pre-requisites	EE-111 Linear Circuit Analysis
Degree and Semester	DE-42-CE-A, Semester 3
Month and Year	Fall 2021

2. Course Schedule	
Lecture:	3 hrs/week, Meets twice weekly
Lab:	3 hrs/week, Meets once in a week
Office Hours :	3 hrs/week by instructor, 3 hrs/week by teaching assistant/lab engineer

3. Course Assessment		
Exam:	Final Exam	
Home work:	Assignments	
Lab reports:	Reports	
Quizzes:	Quizzes	
Grading:	Quizzes:	7%~12%
	Assignments:	4%~8%
	Two Sessional Exams:	22% ~30%
	Final Exam:	30% ~38%
	Lab/Semester Project:	25%

4. Course book and Related Course Material	
Textbooks:	Microelectronic Circuits, 6th Edition, by Adel S. Sedra and Kenneth C. Smith, Oxford University Press 2009.
Reference Books:	Fundamentals of Microelectronics, 2nd Edition, by B. Razavi, Wiley 2013.

5. Catalog Descriptions
The course is designed to acquaint students with physical operation and terminal characteristics of diodes, modeling of forward and reverse characteristics of diodes, zener diodes, rectifiers and limiting circuits. Physical structure

and principle of operation of BJTs and MOSFETs. Analysis of dc circuits and biasing of transistors, small/large signal models of BJTs and MOSFETs. Small signal model, design and analysis of various amplifier configurations. In addition to class lectures, comprehensive laboratory exercises are also designed so that theoretical knowledge may be consolidated with practical examples.

6. Course Objectives

a) Learn principle of operation and characteristics of electronic devices namely diodes, BJTs and MOSFETs.
b) Design and analysis of electronic circuits based on diodes, BJTs and MOSFETs.
c) Develop hands-on skills through Lab and project work.
d) Develop physical insight and intuition for problem solving.
e) Use of SPICE simulation as a verification tool.

7. Topics covered in the Course and Level of Coverage

Diodes	
1. The Ideal Diode	2hrs
2. Terminal Characteristics of PN Junction Diodes	1hrs
3. Modeling the Diode Forward Characteristic	3hrs
4. Operation in the Reverse Breakdown Region (Zener Diodes)	1.5hrs
5. Rectifier Circuits	3.5hrs
6. Limiter Circuits	1hrs
BJTs	
7. Device Structure and Physical Operation	4hrs
8. Current-Voltage Characteristics	2hrs
9. BJT Circuits at DC	3hrs
10. Applying the BJT in Amplifier Design	3hrs
11. Small-Signal Operation and Models	3hrs
12. Basic BJT Amplifier Configurations and Discrete-Circuit BJT Amplifiers	3hrs
MOSFETs	
13. Device Structure and Physical Operation	3hrs
14. Current Voltage Characteristics	1hrs
15. MOSFET Circuits at DC	2hrs
16. Applying the MOSFETs in Amplifier Design	3hrs
17. Small-Signal Operation and Models	2hrs
18. Basic MOSFET Amplifier Configurations	2hrs
19. Biasing in MOS Amplifier Circuits and Discrete-Circuit MOS Amplifiers	5hrs

8. Lab Experiments	
Lab 01	Introduction: Basic Concepts and Lab Equipment
Lab 02	Diode Characteristics
Lab 03	Construction of a Half Wave Rectifier Circuit and Checking its Output Waveform on Oscilloscope
Lab 04	Construction of a Full Wave Rectifier Circuit and Checking its Output Waveform on Oscilloscope
Lab 05	To Check the Effects of Filter Capacitance on DC Output Voltage and Ripples on Oscilloscope
Lab 06	Study of Diode Clippers (Application of Diodes)
Lab 07	Study of Diode Clampers (Application of Diodes)
Lab 08	Study of Zener Diode Characteristics and Voltage Regulator
Lab 09	Study of Characteristics of Bipolar Junction Transistor (BJT)
Lab 10	Fixed and Voltage Divider Bias of BJTs
Lab 11	Emitter and Collector Feedback Bias of BJT
Lab 12	Common Emitter Transistor Amplifier
Lab 13	Common Base and Emitter Follower(Common Collector) Amplifier

9. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		PLOs	Learning Level
CLO 1	Learning and understanding the fundamental electronic devices namely diodes, BJTs, MOSFETs and analyzing the response of circuits comprising of these devices.	PLO 1	C4
CLO 2	Applying different techniques to solve complex circuits for unknown quantities.	PLO 2	C3
CLO 3	Observing the working of different circuits in the lab.	PLO 4	P2
CLO 4	Demonstrate ability to work effectively as an individual or in a team	PLO 9	A3

10. Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**

	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information

Course Number and Title:	EC-301 Computer Graphics
Credits:	(2+1)
Instructor(s)-in-charge:	Dr. Farhan Riaz
Course type:	Lecture + Lab
Required or Elective:	Elective
Course pre-requisites	Intro to programming
Degree and Semester	DE 42 CE Semester 3
Month and Year	Fall 2021

2. Course Schedule

Lecture:	3 hrs/week, Meets twice weekly
Lab:	3 hrs/week, Meets once in a week
Outside study:	8 hrs/week
Office Hours :	6 hrs/week by instructor, 3 hrs/week by lab engineer

3. Course Assessment

Exam:	2 OHTs and 1 Final	
Home work:	2 Assignments	
Lab reports:	12 reports	
Design reports:	1 Design report based on Semester Project	
Quizzes:	4 Quizzes	
Grading:	Quizzes:	10%
	Assignments:	10%
	2 One Hour Tests (OHTs):	20%
	Final Exam:	50%
	Semester Project:	10%
	Lab Work:	70%
	Lab Final:	15%
	Lab Mid/ Open Lab:	15%

4. Course book and Related Course Material

Reference :	• Blender Manual • Class notes • Unity / Unreal engine documentation

5. Course Outcome

- The students will have good understanding of graphics standards & APIs, Graphics I/O Devices and elements of pictures.
- The student knows how to create valid and complete 3D meshes for use in visualization, games design, and 3D printing.
- The student knows how to effectively use different materials, textures and texture mapping.
- The student knows how to rig different models and use it for animation.
- The students will complete a game development / AR project which will enable them to independently start publishing low complexity games / AR applications for various platforms

6. Course Objectives

The Computer Graphics course is directed towards providing students the ability to use computer technology to create realistic images and animations. The course gives students an introduction to the Computer Graphics concepts and discusses graphics algorithms working behind the scene. The course provides a basic understanding of the skills and techniques employed by 3D modeling, animation and game development professionals. In this online course, we will explore basic mesh modeling, texturing, lighting, animation, rendering and game development in 3D environment. This course should provide a good basis for further independent study in architectural, engineering, game, theatrical and character modeling.

7. Topics covered in the Course and Level of Coverage	
• **Introduction to computer graphics, computer graphics in different areas of life, graphics standards & APIs.**	2hrs
• **Basic block Modelling**	2hrs
• **Modelling natural objects**	2hrs
• **Particle systems**	2hrs
• **Material & Shaders**	2hrs
• **Surface Texturing**	2hrs
• **Lighting**	2hrs
• **Rendering**	2hrs
• **Rigging**	2hrs
• **Animation**	2hrs
• **Basic elements of a game**	2hrs
• **Level design**	2hrs
• **Characters and their animations**	2hrs
• **UI elements**	2hrs
• **Developing AR applications using game engines.**	2hrs

8. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		PLOs	Learning Level
CLO 1	Identify and explain fundamental concepts of graphics standards & APIs, Graphics I/O Devices and elements of pictures.	PLO 1	C2
CLO 2	Demonstrate the acquired knowledge to create valid and complete 3D meshes for use in visualization, games design, and 3D printing.	PLO 5	P3
CLO 3	Know how to effectively use different materials, textures and texture mapping.	PLO 1	C2
CLO 4	Create rigged 3D models for use in game engines and animations	PLO 5	C5
CLO 5	Create a single level 3D animated game / AR application	PLO 5	P5

9. Program Learning Outcomes

PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**

	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	EC435 Introduction to IoTs
Credits:	3 (2+1)
Instructor(s)-in-charge:	Dr Ali Hassan / LE Hamza
Course type:	Lecture + Lab
Required or Elective:	Elective
Course pre-requisites	None
Degree and Semester	DCE-43
Month and Year	Fall 2022

2. Course Schedule	
Lecture:	2 hrs/week, Meet once weekly
Lab:	3 hrs/week, Meets once in a week
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	4 hrs/week
Office Hours :	3 hrs/week by instructor, 3 hrs/week by teaching assistant/lab engineer

3. Course Assessment			
Exam:	1 Mid Term and 1 Final		
Lab reports:	12 reports		
Design reports:	1 Design report based on Semester Project		
Quizzes:	4-6 Quizzes		
Assignments:	4-6 Assignments		
Grading Tentative:	**Lecture 75%**	Quizzes:	10%
		Assignments:	10%
		1 Mid Term:	30%
		Final Exam:	40%
		Semester Project:	10%
	Lab 25%	Lab Work:	50%
		Lab Mid:	25%
		Lab Final:	25%

4. Course book and Related Course Material

Textbooks:	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry IoTFundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press; 1st edition (June 13, 2017)
Reference Books:	a. Marco Shwartz, "internet of things with ESP8266", https://ur.b-ok.global/book/5285368/0e392f b. Mr. Magesh Jayakumar, The internet of things with esp8266 Hands on approach: Get started with Arduino IDE and ESP8266, Feb 13 2017

5. Catalog Descriptions

6. Course Objectives

a) To answer why, when and how to use IoT components to form a functional integrated IoT system.

b) Teach the fundamentals of IoT architecture and relevant models.

c) Teach different IoT Protocols.

d) Teach different types of sensors, MCUs, and actuators commonly used in IoT use cases.

e) Teach the programming of IoT devices with solid examples

f) Teach fundamental concepts in IoT security

g) Discuss several use cases of IoT devices in smart industry, health, homes, agriculture etc.

7. Topics covered in the Course and Level of Coverage

1. Introduction to IOT	2 hrs
2. Overview of IoT Hardware Components	2 hrs
3. Overview OSI Model for IoTs and IoT Architecture	2 hrs
4. ESP8266 WiFi Serial Module	2 hrs
5. Programming a Microcontroller for IoT Device	2 hrs
6. Working with Communication Modules	6 hrs
7. Using a Mobile App and HTTP to Control a microcontroller	4 hrs
8. Creating an IoT Temperature & Humidity Sensor System with Data Analytics	4 hrs
9. Building an IoT System with multiple nodes and gateway and usage of MQTT protocol etc	4 hrs
10. Safety and security of IoT systems	2 hrs
11. Safety and security of IoT systems	2 hrs
12. Design/Case studies of IoT systems.	2 hrs

8. Lab Experiments

Lab 01	Installation of Arduino IDE along with libraries to implement firmware on a microcontroller for sensors and actuators
Lab 02	Programming of Lora modules for transmission and reception of messages.
Lab 03	Programming of Bluetooth module and RFID along with Display such as OLED
Lab 04	Programming of nodemcu or other IoT specialized SoCs: From pin configuration to programming different peripheries.
Lab 05	Implementation of Communication protocols such as I2C, SPI, and UART to communicate with external devices.
Lab 06	App Programming with Blynk to get sensor data and to control a motor connect to nodeMCU7.
Lab 07	
Lab 08	Programming an HTTP Client to get data from some sensor and control an LED
Lab 09	Interfacing a specialized IoT SoC with sensors and live analytics using ThingSpeak
Lab 10	Programming MQTT protocol to Send and Receive Messages between different connected IoT devices/nodes
Lab 11	Interfacing and storage of Data (from IoT nodes) to cloud through Gateway
Lab 12	Implementation of basic Encryption algorithms in IoT SoCs
Lab 13	Implementation of possible use cases in smart city e.g. smart metering
Lab 14	Integration of Low Power communication devices with IoT SoCs and reception and transmission of messages

9. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**
CLO 1	Understand the IoT Concept, its architecture and protocols	PLO 1	C2
CLO 2	Being able to select, develop and apply the technologies used for the Internet of Things, including sensors, actuators, the communication layers, embedded communication protocols, communication standards, programming frameworks, and an understanding of energy and bandwidth constraints.	PLO 5	C2
CLO 3	Understand and be able to analyze the issues which an individual or a society can have and which can be solved by using IoT systems.	PLO 6	C3
CLO 4	Design and implement software for Internet of Things applications, including both low-level firmware on embedded devices and higher-level program for data processing, storage, visualization, and analysis	PLO 3	P3

10. Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	EC-220 Computer System Architecture
Credits:	4 (3+1)
Instructor(s)-in-charge:	Lt Col Hammad Tanveer Butt / LE Abubakar
Course type:	Lecture + Lab
Required or Elective:	Required
Course pre-requisites	EC-210 Logic and Sequential Circuit Design
Degree and Semester	Semester 4
Month and Year	2022

2. Course Schedule	
Lecture:	3 hrs/week, Meets twice weekly
Lab:	3hrs/week
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	7 hrs/week
Office Hours :	3 hrs/week by instructor, 3 hrs/week by teaching assistant/lab engineer

3. Course Assessment		
Exam:	2 One Hour Tests and 1 Final	
Home work:	2 Assignments	
Lab reports:	As per lab manual	
Design reports:	None	
Quizzes:	4 Quizzes	
Grading:	Quizzes:	10%
	Assignments:	5%
	2 One Hour Tests (OHTs):	40%
	Final Exam:	45%
	Lab Work /Reports:	70%
	Lab Mid/Open Lab:	15%
	Lab Final:	15%

4. Course book and Related Course Material	
Textbooks:	1. Computer Organization and Architecture: Designing for Performance, 8th Edition, 2010 by William Stallings.
Reference Books:	2. Computer Architecture - A Quantitative Approach, Fifth Edition by John Hennessy, David Patterson, 2011

5. Catalog Descriptions

Computer arithmetic, register transfer language and micro operations, common bus system design, design of arithmetic logic unit, design of hardwired control unit and micro programmed control unit, instruction sets and addressing modes, memory system design, cache memory, virtual memory system, input/output interface and operations and advanced topics such as parallel processing and pipeline processing.

6. Course Objectives

To teach students about the advanced concepts covering overview of computer architecture, which stresses the underlying design principles and the impact of these principles on computer performance. General topics include design methodology, processor design, control design, memory organization, system organization, and parallel processing.

7. Topics covered in the Course and Level of Coverage

1. Introduction to Computer System Architecture and Digital Computers.	3hrs
2. MIPS Instruction set, Representation of instructions in machine language.	3+3hrs
3. MIPS addressing modes, Memory map and Near and Far Jumps	3hrs
4. Stack operations, Subroutines Stack operations, Subroutines	3hrs
5. Assessing and understanding Computer performance.	3hrs
6. Design of Arithmetic Logic Unit and Control Unit. Building of single cycle processor (Datapath And Control)	3hrs
7. Multi-Cycle processor implementation (Datapath And Control), FSM	3hrs
8. Memory system design, memory hierarchy, primary memory (RAM, ROM), secondary memory, memory address map	3hrs
9. Virtual Memory, Paging.	3hrs
10. Input/Output Interface, memory mapped input/output, isolated input/output. Parallel peripheral interface, serial communication interface, dedicated interface components. Direct memory access.	(3+3) hrs
11. Virtual memory system, Address mapping using pages.	3hrs
12. Cache Memory & its Mapping techniques, Cache Write and Data Replacement	(3+3)hrs

Policies, Different designs of cache memory system.	

8. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outome (CLOs)		PLOs	Learning Level
CLO 1	Explain a wide variety of memory technologies both internal and external.	PLO 1	C2
CLO 2	Analyze the working of components of the CPU including the ALU, registers, program counter, control unit using the Von Neumann Architecture.	PLO 2	C4
CLO 3	Analyze the working and architecture of both single and multiple core processors in different scenarios.	PLO 2	C4
CLO 4	Manipulation of computer architecture to construct solution of given problems through experimentation	PLO 4	P4

9. Program Learning Outcomes

PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
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	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**

	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

10. Lab Experiments	
Lab 01	Introduction to MARS (MIPS Assembler and Runtime Simulator)
Lab 02	MIPS Console
Lab 03	Assembly Arithmetic and Memory Instructions
Lab 04	Loop And Conditional Instructions
Lab 05	Functions
Lab 06	Nested Functions
Lab 07	Transition from High-Level to Assembly language
Lab 08	Open Lab
Lab 09	MIPS Datapath
Lab 10	MIPS Datapath and control unit
Lab 11	MIPS Datapath and control unit (J-type instructions)

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	EC-200 Data Structures
Credits:	4 (3+1)
Instructor(s)-in-charge:	Lec Anum Abdul Salam/ LE Ansa
Course type:	Lecture + Lab
Required or Elective:	Required
Course pre-requisites	Introduction to Programming
Degree and Semester	DE-42-CE, Semester 4
Month and Year	Spring 2022

2. Course Schedule	
Lecture:	3 hrs/week, Meets twice weekly
Lab:	3 hrs/week, Meets once weekly
Office Hours:	3 hrs/week by instructor, 3 hrs/week by teaching assistant/lab engineer

3. Course Assessment		
Exam:	2 Sessional and 1 Final	
Home work:	3 Assignments	
Lab reports:	13 reports	
Design Project:	1	
Quizzes:	5-7 Quizzes	
Grading:	Quizzes:	10%
	Assignments:	10%
	2 One Hour Tests (OHTs):	30%
	Final Exam:	50%
	Lab (Lab Tasks + Open Lab):	85%

	Semester Project:	15%

4. Course book and Related Course Material	
Textbooks:	1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++," Addison Wesley, 4th Ed. 2. Frank M. Carrano, "Data Abstraction and Problem solving with C++: Walls and Mirrors," 6th Ed.
Reference Books:	1. Data Structures & Algorithms in C++ by Michael T. Goodrich, Roberto Tamassia & David Mount, 2nd Ed. 2. C++ How to Program by Deitel & Deitel, 9th Ed.

5. Topics covered in the Course and Level of Coverage

Topics covered	Contact Hrs.
a. Revision of basic concepts of Object-Oriented Programming	1hr
b. Revision of the basic concepts of programming with pointers. i. Dangling and Bad Pointers ii. Static vs Dynamic Memory iii. Dynamic Memory Allocation iv. Need of Dynamic Memory v. Shallow vs deep Copy vi. Need of overwriting Copy Constructor and Destructor vii. Memory Leakage	4hrs
c. Dynamic Array i. Need of Dynamic array ii. Static vs dynamic array iii. Applications of dynamic array iv. Resizing dynamic array	2hrs
d. Linked List i. Limitations of array ii. List vs Array iii. Implementation of Basic operations of linked list iv. Deep copying a list v. Various modifications of list i.e., circular, doubly, doubly circular vi. Applications of List	4hrs
e. Stacks i. Introduction to stacks (LIFO) ii. Stack vs. List iii. Implementation of basic operations of stack iv. Static vs Dynamic Stack v. Applications of stacks • Back Tracking • Activation Record • Undo Operation • Parentheses Balancing • Infix to postfix Expression conversion • Postfix Expression evaluation	3hrs
f. Queues i. Introduction to Queues (FIFO) ii. Priority Queue iii. Implementation of basic operations of Queue (Static, Dynamic, Circular Static) iv. Application of Queue • Printer Spooler • Process Scheduling • Event Simulation e.g.,	3hrs

Bank Counter	
f. Complexity analysis Algorithmic analysis i. Basic Algorithm Analysis ii. Time Complexity Analysis and Algorithm Growth Rate iii. Big-Oh Notation and Upper bound Analysis of an equation iv. Time Complexity analysis of Recursive functions	3hrs
e. Trees i. Linear vs. Non-Linear Data Structures ii. Properties of Tree iii. Applications of Tree iv. Various categories of Binary Trees v. Binary Search Tree and its Properties vi. Implementation of basic operations of BST vii. Applications of Binary Search Trees viii. Time complexity analysis of BST ix. AVL Trees (balanced BST)	5hrs
e. Searching and Sorting Algorithms i. Sequential search ii. Binary search iii. Bubble Sort iv. Quick Sort v. Merge Sort vi. Radix Sort vii. Insertion sort viii. Selection sort ix. Time Complexity Analysis of the algorithms	4hrs
f. Heaps i. Properties of Heap ii. Max and Min Heap iii. Implementation of basic operations of Heap iv. Applications of Heap v. Implementing Priority Queue using Heap (Time Complexity Analysis) vi. Heap Sort	4hrs
g. Hash tables i. Introduction to Hash Tables ii. Hashing and Hash Functions iii. Properties of Ideal Hash Function iv. Collision and Collision Resolution • Probing (Linear, Quadratic) • Re-Hashing • Double Hashing v. Time Complexity Analysis vi. Applications of Hash Tables	4hrs
h. Standard Templated Libraries i. Containers ii. Algorithms iii. Iterators iv. Reusing a built-in container	3hrs

i. Graphs a. Adjacency List and Adjacency Matrix representation of graph b. Various Topologies of graphs i.e., connected, disconnected and complete graph c. Dijkstra's algorithm d. Breadth and Depth First Search 1. Huffman's coding	6hrs

6. Topics covered in the Course and Level of Coverage	
Lab No	**Title**
1	Introduction to pointers and dynamic memory
2	Implementation of Dynamic Arrays & Copy Constructor
3	Basic Linked List Implementation
4	Manipulating Linked List by adding modifier functions
5	Implementation of Static and Dynamic Stack
6	Implementation of Static, Circular and Dynamic Queue
7	Reusing Stack and Queue in various algorithms to understand their applications
8	Open Lab - I
9	Recursion
10	Binary Search Trees
11	Searching and Sorting Algorithms
12	Heaps
13	Open Lab-II
14	Hash Tables & STL
15	Graph Implementation

7. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		PLOs	Learning Level	Assessments
CLO1	Analyse large C++ programs to determine bugs like dangling pointer, bad pointer, memory leakage and shallow copy etc. without using Compiler.	PLO2	C4	A1-A3
CLO2	Learn the use of linear and non-linear data structures, and implement algorithms for them: (stack, queue, linked lists, trees, graphs, heap, priority queue, hash tables, sorting algorithms, min-max algorithm etc.).	PLO1	C3	OHT-1, OHT2, Q1, Q2, Q3
CLO3	Analyse algorithms and data structures for performance comparison in terms of time and space complexity using Asymptotic Analysis.	PLO2	C4	A2, Final
CLO4	Solve complex data organization problems in open-ended labs by applying appropriate data structures.	PLO3	P4	Open Labs
CLO5	Develop a project that solves a real problem in an application domain (Networks, virtual hard disk, Data mining, machine learning etc.) by using data structures learnt in this course	PLO3	P5	Project,

8. Program Learning Outcomes

PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.

PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF BASIC SCIENCES & HUMANITIES

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information

Course Number and Title:	MATH-232 Complex variable and transform
Credits:	3+0
Instructor(s)-in-charge:	Asst Prof Dr Samreen Sheriff
Course type:	Lecture
Required or Elective:	Required
Course pre-requisites	Nil
Degree and Semester	DE-42 Semester 4th
Month and Year	Spring 22

2. Course Schedule

Lecture:	3 hrs/week, Meets twice weekly
Lab:	-
Discussion:	multiple discussion sections offered per quarter
Outside study:	7 hrs/week
Office Hours :	8 hrs/week by instructor

3. Course Assessment

Exam:	2 Sessionals and 1 Final	
Home work:	3 Assignments	
Lab reports:	-	
Design reports:	-	
Quizzes:	6 Quizzes	
Grading:	Quizzes:	10%
	Assignments:	10%
	2 One Hour Tests (OHTs):	30%
	Final Exam:	50%
	Lab:	-
	Semester Project:	-
Plagiarism Policy	Any work (Assignment, Projects, labs etc) if found copied, will have	

	strict penalties

4. Course book and Related Course Material

Textbooks:	**11.** Advanced Engineering Mathematics (9th Edition) by Ervin Kreyszig
Reference Books:	a) Advanced Modern Engineering Mathematics by Glyn James. b) Real and Complex Analysis by Walter Rudin.

5. Catalog Descriptions

This course focuses on complex numbers, functions of a complex variable, analytic functions, elementary functions, integrals, Taylor and Laurent series, residues and poles, conformal mapping, Fourier series, Fourier integrals, Fourier transform, Z transform with applications related to different disciplines of engineering.

6. Course Objectives

The objective of the course is to teach them basic manipulations on complex numbers also enable them to identify the singular points of an analytic function with the construction of series and explaining usefulness of Laurent series. Another main objective of the course is to teach them how to apply Fourier and Z transformations and solve various engineering problems using transforms.

7. Topics covered in the Course and Level of Coverage

Article	Topics	Estimated Contact Hours
13.1-13.2	Review of Complex algebra, Complex functions, Real and imaginary components of a function of a complex variable function, Limit and continuity.	3
13.3-13.4	Derivative, Cauchy Riemann Equations, Properties of UV-function, Analytic Functions, Harmonic functions	3
13.7	Complex logarithms	1
14.1	Line integral in complex plane	2
14.2-14.3	Cauchy Integral theorem, Cauchy Integral formula	3
14.4	Derivatives of analytic functions	1
15.1-15.4	Sequence and Series, Power series, Taylor series	2
16.1	Laurent series	2
16.2	Singularities and Zeros	2
16.3-16.4	Residue integration method, Evaluation of real integrals	4
11.1	Periodic functions, Trigonometric series, Fourier series	2

11.2	Fourier series for functions of any period	3
11.3	Even and Odd functions, Half range expansions	2
11.4	Complex Fourier series	1
11.7	Fourier integral	2
11.8-11.9	Fourier Transform	3
17.1-17.4	Concept of mapping, Complex mapping functions, Conformal Mapping and its applications.	3
James 6.1-6.3	Introduction, Definition, examples and properties of Z transform.	3
James 6.4	Inverse of Z-transform	1
James 6.5	Solution of Difference equation	2

8. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		PLOs	Learning Level	Assessments
CLO 1	Workout the basic properties of the complex function	PLO 1	C2	Q1, Q2, A1, OHT-1, Final 2-questions
CLO 2	Solving integral to the complex function	PLO 1	C3	Q3, Q4, A2, OHT2, Final 2-questions
CLO 3	Represent a given function in terms of Fourier series and Fourier integrals	PLO 2	C2	Q5, OHT2, Final 2-questions
CLO 4	Evaluating Fourier and Z transforms of a given function	PLO 1	C5	Q6, A3, Final 2-questions

9. **Mapping of Topics**	**CLO**	**Chapter(s)**
Review of Complex algebra, Complex functions, Real and imaginary components of a function of a complex variable function, Limit and continuity.	CLO-1	Advanced Engineering Mathematics (9th Edition) by Ervin Kreyszig , Chapter13, 13.1-13.2
Derivative, Cauchy Riemann Equations, Properties of UV- function, Analytic Functions, Harmonic functions	CLO-1	Advanced Engineering Mathematics (9th Edition) by Ervin Kreyszig, Chapter 13, 13.3-13.4
Complex logarithms	CLO-1	Advanced Engineering Mathematics (9th Edition) by Ervin Kreyszig ,

		Chapter 13, 13.7
Line integral in complex plane	CLO-2	Advanced Engineering Mathematics (9th Edition) by Ervin Kreyszig , Chapter 14, 14.1
Cauchy Integral theorem, Cauchy Integral formula	CLO-2	Advanced Engineering Mathematics (9th Edition) by Ervin Kreyszig, Chapter 14, 14.2-14.3
Derivatives of analytic functions	CLO-2	Advanced Engineering Mathematics (9th Edition) by Ervin Kreyszig, Chapter 14, 14.4
Sequence and Series, Power series, Taylor series	CLO-2	Advanced Engineering Mathematics (9th Edition) by Ervin Kreyszig, Chapter 15, 15.1-15..4
Laurent series	CLO-2	Advanced Engineering Mathematics (9th Edition) by Ervin Kreyszig, Chapter 16, 16,1
Singularities and Zeros	CLO-2	Advanced Engineering Mathematics (9th Edition) by Ervin Kreyszig, Chapter 16, 16,2
Residue integration method, Evaluation of real integrals	CLO-2	Advanced Engineering Mathematics (9th Edition) by Ervin Kreyszig, Chapter 16, 16,3- 16.4
Periodic functions, Trigonometric series, Fourier series	CLO-3	Advanced Engineering Mathematics (9th Edition) by Ervin Kreyszig , Chapter 11, 11.1

Fourier series for functions of any period	CLO-3	Advanced Engineering Mathematics (9th Edition) by Ervin Kreyszig Chapter 11, 11.2
Even and Odd functions, Half range expansions	CLO-3	Advanced Engineering Mathematics (9th Edition) by Ervin Kreyszig Chapter 11, 11.3
Complex Fourier series	CLO-3	Advanced Engineering Mathematics (9th Edition) by Ervin Kreyszig Chapter 11, 11.4
Fourier integral	CLO-3	Advanced Engineering Mathematics (9th Edition) by Ervin Kreyszig Chapter 11, 11.7
Fourier Transform	CLO-3	Advanced Engineering Mathematics (9th Edition) by Ervin Kreyszig Chapter 11, 11.8-11.9
Concept of mapping, Complex mapping functions, Conformal Mapping and its applications.	CLO-2	Advanced Engineering Mathematics (9th Edition) by Ervin Kreyszig Chapter 17, 17.1-17.4
Introduction, Definition, examples and properties of Z transform.	CLO-4	Advanced Modern Engineering Mathematics by Glyn James, Chapter 6, 6.1-6.3
Inverse of Z-transform	CLO-4	Advanced Modern Engineering Mathematics by Glyn James, Chapter 6, 6.4
Solution of Difference equation	CLO-4	Advanced Modern Engineering Mathematics by Glyn James, Chapter 6, 6.5

10. Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	EC-221 Operating Systems
Credits:	3 (3+0)
Instructor(s)-in-charge:	Dr. Muhammad Umar Farooq
Course type:	Lecture
Required or Elective:	Required
Course pre-requisites	Nil
Degree and Semester	De-42, Semester 4
Month and Year	Spring 2022

2. Course Schedule	
Lecture:	3 hrs/week, Meets twice weekly
Lab:	None
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	7 hrs/week
Office Hours :	6 hrs/week by instructor

3. Course Assessment		
Exam:	2 Sessional and 1 Final	
Home work:	6 Assignments	
Lab reports:	None	
Design reports:	1 Design reports based on Semester Project	
Quizzes:	6 Quizzes	
Grading:	Quizzes:	10-15%
	Assignments:	05-10%
	2 One Hour Tests (OHTs):	30%
	Final Exam:	45%
	Semester Project:	05%

4.Course book and Related Course Material	
Textbooks:	**12.** Abraham Silberschatz, Peter Baer Galvin and Greg Gagne: Operating System Concepts, 9th Edition, John Wiley and Sons, ISBN 13: 978-1118129388
Reference Books:	1. Andrew S. Tanenbaum, Herbert Bos: Modern Operating Systems, 4th Edition, Pearson, ISBN 13: 978-0133591620 2. William Stallings: Operating Systems, 7th Edition, Prentice Hall,

	ISBN 0-13-031999-6

3. Catalog Descriptions

This course will introduce the core concepts of operating systems, such as processes and threads, scheduling, synchronization, memory management, file systems, input and output device management and security. The course will consist of assigned reading, weekly lectures, two sessionals and final exam, semester project, and a sequence of assignments and quizzes. The goal of the readings and lectures is to introduce the core concepts. The goal of the project and assignments is to give students some exposure to operating system code and concepts. Students are expected to read the assigned materials prior to each class, and to participate in in-class discussions.

4. Course Objectives

To study and discuss the fundamental operating system concepts covering the system structures, process management, threading, CPU scheduling, synchronization, deadlocks, main memory and secondary storage management, virtual memory, file-system implementation, I/O systems, disk scheduling and security, to be able to understand methodologies of parallel and multitasking operating systems

5. Topics covered in the Course and Level of Coverage

• **Operating system structures**: OS Services, OS interface, System Calls, System programs, OS design and implementation, OS structures (Real-time, general purpose & embedded)	6 hrs
• **Processes:** process concept and states, process scheduling, operations on processes, inter-process communications	4 hrs
• **Threads:** Multicore programming, multithreading models, thread libraries, threading issues, operating system examples	3 hrs
• **Process synchronization**: critical section problem, mutex locks, semaphores, classic problems of synchronization, monitors, examples	8 hrs
• **CPU Scheduling:** Scheduling criteria, scheduling algorithms, thread scheduling, multi-processor scheduling, real-time CPU scheduling	4 hrs
• **Deadlocks:** Characterization, handling, prevention, avoidance, detection, recovery	3 hrs
• **Main Memory Management:** Memory allocation, swapping, segmentation, paging, example architectures.	6 hrs
• **Virtual Memory:** Demand paging, page replacement algorithms	3 hrs
• **Mass Storage:** Disk structure, disk scheduling, disk management, RAID structure	4 hrs
• **File Systems:** **Access methods, disk and directory structure, sharing, protection, file system implementations**	3 hrs
• **Distributed Operating Systems**	2 hrs
• **Review** e. Review of important concepts before OHT-1	2hrs

	f. Review of important concepts before OHT-2 g. Review of important concepts after OHT-2 h. Addressing student's queries	

6. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		PLOs	Learning Level
CLO 1	Be able to discuss the characteristics of different structures of the Operating Systems (such as microkernel, layered, virtualization, etc.) and identify the core functions of the Operating Systems.	PLO 1	C2
CLO 2	Be able to explain the principles and compare the algorithms on which the core functions of the Operating Systems are built on.	PLO 1	C2
CLO 3	Be able to analyse and evaluate the algorithms of the core functions of the Operating Systems and explain the major performance issues with regard to the core functions.	PLO 2	C4
CLO 4	Be able to develop parallel applications using techniques and tools available in modern systems (such as threads, system calls, semaphores, etc.).	PLO3	C4

7. Program Learning Outcomes

PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF BASIC SCIENCES & HUMANITIES

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	HU-212 Technical Business Writing
Credits:	2
Instructor(s)-in-charge:	Lec. Zara Rizwan
Course type:	Lecture
Required or Elective:	Required
Course pre-requisites	Nil
Degree and Semester	DCE-42, Semester 4
Month and Year	Spring 2022

2. Course Schedule	
Lecture:	2 hrs/week, Meets once weekly
Office Hours :	3 hrs/week by instructor

3. Course Assessment		
Exam:	2 Sessional and 1 Final	
Home work:	2 graded Assignments	
Quizzes:	4 Quizzes	
	2 One Hour Tests (OHTs):	30%
	Quizzes:	10%
	Assignments	10%
	Final Exam	50%
Plagiarism Policy	Any work (Assignment, Projects, labs etc) if found copied, will have strict penalties	

4. Course book and Related Course Material	
Textbooks:	1. Writing for Science and Engineering - 2nd Edition by Heather Silyn-Roberts

Reference Books:	2. Course Material 1. The Handbook of Technical Writing by Gerald J. Alred, Charles T. Brusaw, Walter E. Oliu, 11th Edition (2015) Macmillan Learning ISBN-13: 978-1457675522 ISBN-10: 1457675528 3. How to Write Technical Reports BY Lutz Hering & Heike Hering, Springer (2010), Springer Heidelberg Dordrecht, London New York ISBN 978-3-540-69928-6 e-ISBN 978-3-540-69929-3 3. Technical Communication by Mike Markel & Stuart A. Selber, Bedford/St. Martin's - Macmillan Learning, Boston, New York, 12th Edition - 2018 ISBN-13: 978-1-319-10788-8 (EPUB) 4. Engineers' Guide to Technical Writing by Kenneth G. Budinski, ASM International, USA (2001) ISBN-10: 0871706938 ISBN-13: 978-0871706935 5. Technical Writing –Process and Product by Sharon J. Gerson & Steven M. Gerson Pearson Publication, 9th Edition (2016) ISBN-10: 0134094034 ISBN-13: 978-0134094038 6. Reporting Technical Information by Kenneth W. Houp, Thomas E. Pearsall, Tebeaux and Dragga , Latest edition, Oxford University Press (2009) ISBN: 0195323521 ISBN: 9780195323528 7. Business Communication: Building Critical Thinking Skills by Kitty O. Locker & Stephen K. Kaczmarek, 6th Edition (2012) McGraw Hills – Irwin ISBN 978-0-07-340326-7

5. Catalog Descriptions

The course deals with the basic and most important aspects of Business and Technical communication. Moreover, through this course, the students will be able to practice and learn the in-demand industry and employment skills.

6. Course Objectives

The main objectives of this course are

a. **To practice Business Communication skills. Such as email writing, memo writing, and cover letters.**
b. **To learn effective presentation skills and how to face the audience with full confidence.**
c. **To learn the in-demand industry skills by practicing writing the necessary Technical Lab Reports and Scientific papers**

5. **Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)**				
Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**	**Assessments**
CLO 1	Describe technical writing, its importance, purpose, characteristics and how it is different from ordinary writing	PLO 10	C2	Quiz 1, Quiz 2 OHT-1 Finals
CLO 2	Discuss the style, content, language, form, clarity and consistency in technical and academic writing by analyzing user manuals, research proposals, technical papers, and project reports	PLO 10	C2	OHT-2 Finals
CLO 3	Write memorandums, cover letters, a variety of workplace genres including resumes, cover letters, statement of purpose and use technology to effectively present written messages	PLO 10	C3	Quiz 3 Assignment-1 OHT-2 Finals
CLO 4	Follow sound presentation skills and demonstrate them effectively in classroom context	PLO 10	A3	Quiz-4 Assignment 2

6. **Mapping of Topics**	**CLO**	**Chapter(s)**
Introduction to the Course Basic Principles of technical/Business Writing – Salient Features Faculty lecture to further explain the characteristics of Technical/Business writing through power point	CLO-1	Writing for Science and Engineering Chapter: 1
Audience Recognition & Involvement Defining Purpose Clearly Communication Model – CMAPP Lecture through power point	CLO-2	Writing for Science and Engineering Chapter: 2
Oral Presentation *Added at the Recommendation of Student Development Committee	CLO-4	Reading: Links to articles in HBR and Business Insider highlighting importance of strong presentation skills shared with students prior to class. Accessed at: https://hbr.org/2016/03/the-most-important-leadership-competencies-according-toleaders-around-the-world

		https://hbr.org/2014/11/how-to-give-a-stellar-presentation http://www.businessinsider.com/skills-you-need-to-succeed-2017-2
Communication Principles (7C's) Writing Process – Three Stages Pre-writing - Techniques Writing/Drafting Revision / Editing	CLO-2	https://businessjargons.com/7-cs-communication.html
Memorandum Writing E Mail – Advantages & Disadvantage Guideline to write an effective E-mail	CLO-3	Business Communication: Building Critical Thinking Skills by Kitty O. Locker & Stephen K. Kaczmarek, 6th Edition
OHT 1		
Approaches to Writing How to Compose: Good News Message (Direct Plan) Persuasive Message (to motivate) Persuasive Message II (Sales Appeal- AIDA Plan)	CLO-3	https://corporatefinanceinstitute.com/resources/knowledge/other/aida-model-marketing/
Approaches to Writing How to Compose: Bad News Message (Indirect Plan - Creating Buffer) Letter Writing : Compulsory & Optional Elements -Format	CLO-3	Online sources
Letter Writing II Types of letter -Acknowledgment & Adjustment, Complaint Letters, Inquiries and Responses Proposal Writing: - Contexts /Strategies Audience and Purpose Proposal Forms Proposal Types (Research, Business)	CLO-3	Online sources www.indeed.com
Report Writing Basic concept Components of Formal Report Bibliography	CLO-2	Writing for Science and Engineering Chapter 6 and chapter 7 www.zotero.com www.googlescholar.com www.purdueowl.edu.com
Report Writing Short & Long Reports - Basic concept Types of reports How to write Abstract &	CLO-2	Writing for Science and Engineering Chapter 6 and chapter 7

Executive Summary		
OHT 2		
Employment Related Skills* (Newly added topic) Job Market Search Skills Job Planning & Organization Skills	CLO-4	www.Indeed.com www.LinkedIn.com SWOT analysis
Employment Communication - Resume writing -Follow up Letter or E-mail	CLO-3	Business Communication: Building Critical Thinking Skills by Kitty O. Locker & Stephen K. Kaczmarek, 6th Edition
Employment Communication Cover Letter or Follow-up Email Writing Instructions/Procedures	CLO-3	Business Communication: Building Critical Thinking Skills by Kitty O. Locker & Stephen K. Kaczmarek, 6th Edition
Students' Presentations	CLO-4	
Finals		

7. **Topics covered in the Course and Level of Coverage**		
Introduction to the Course **Basic Principles of technical/Business Writing – Salient Features** **Faculty lecture to further explain the characteristics of Technical/Business writing through power point**	Handouts are given to students with various types of writing excerpts. Students discuss in pairs the characteristics of different writing styles. Then they share their views with whole class.	2 hr
Audience Recognition & Involvement **Defining Purpose Clearly** **Communication Model – CMAPP** **Lecture through power point**	Students are given a case scenario to apply CMAPP Model. *Newly added topic	2 hr

Oral Presentation *Added at the Recommendation of Student Development Committee	Lecture: Faculty explains hallmarks of a good oral presentation Activity: Students prepare 2-minute individual presentations without any AV aids Reading: Links to articles in HBR and Business Insider highlighting importance of strong presentation skills shared with students prior to class. Accessed at: https://hbr.org/2016/03/the-most-important-leadership-competencies-according-toleaders-around-the-world https://hbr.org/2014/11/how-to-give-a-stellar-presentation http://www.businessinsider.com/skills-you-need-to-succeed-2017-2 Lecture: Faculty explains various principles of presentation skills and what to avoid while using PowerPoint through a video.	2 hr
Communication Principles (7C's) Writing Process – Three Stages Pre-writing - Techniques Writing/Drafting Revision / Editing	Lecture through power point Class Activity: Students solve the worksheets to apply the principles learnt during lecture Students watch video on effective writing tips. Video link available at: https://www.youtube.com/watch?v=IQMKV6a1IWk Class Activity: Students have a class activity based on application of any pre- writing technique	2 hr
Memorandum Writing E Mail – Advantages & Disadvantage Guideline to write an effective E-mail	Students are given sample memos to identify the elements and writing style Lecture, through power point, to explain the various elements of memo writing Lecture on guideline to compose an effective e- mail Class Activity: Students have an on line quiz to assess their existing email etiquette, access at: https://www.netmanners.com/email-etiquette-quiz/ *Newly Added Topic Students re-write the given e-mail to improve tone & style.	2 hr
OTH1		
Approaches to Writing How to Compose: Good News Message (Direct Plan) Persuasive Message (to motivate) Persuasive Message II (Sales Appeal- AIDA Plan)	Students are given sample messages to understand and discuss the direct plan. Faculty explains the components of direct plan through power point. Students watch a video on persuasive strategy. Video link accessed at: https://www.youtube.com/watch?v=8kzuf31fdMw Video 2 link accessed at: https://www.youtube.com/watch?v=lmR58_dqLxY Class Activity: Students read the sample sales message to analyze the elements of persuasive strategy.	2 hr
Approaches to Writing How to Compose: Bad News Message (Indirect Plan - Creating Buffer) Letter Writing : Compulsory & Optional Elements	Students are given sample messages to understand and discuss the indirect plan. Elements of indirect plan and how to create buffer is explained by the faculty. Faculty explains the components and formatting of a letter Class Activity: Students compose a bad news message with buffer. (Application of Indirect Plan)	2 hr

-Format		
Letter Writing II **Types of letter** **-Acknowledgment & Adjustment,** **Complaint Letters, Inquiries and Responses** **Proposal Writing: -Contexts /Strategies Audience and Purpose Proposal Forms Proposal Types (Research, Business)**	Students are given various types of letters as sample to analyze the components. Faculty explains how to compose introduction, discussion and concluding part according to the type of a letter Online article shared prior to the class, accessed at: https://libguides.usc.edu/writingguide/researchproposal Lecture: Faculty explains importance of proposals in academic, research, and professional contexts. Follow-up assignment: Students to submit one-page proposal for their final term paper in a week as per given format.	2 hr
Report Writing **Basic concept** **Components of Formal Report** **Bibliography**	Students are given chapter notes prior to the class. Online source, report writing guideline, shared prior to the class. Accessed at: https://www.lboro.ac.uk/services/library/students/learningsupport/topics/reportwriting/ Faculty explains the concept and components of a formal report Faculty explains the concept of plagiarism & how to develop a reference list or bibliography Class Activity: Student will have a class activity to apply APA style referencing	2 hr
Report Writing **Short & Long Reports -** **Basic concept** **Types of reports** **How to write Abstract & Executive Summary**	Faculty explains the difference between short and long report Student will have a class activity to analyze the components of various types of reports Class Activity: Students identify the problems in sample report and rewrite it in appropriate tone according to writing principles suggested in class lecture. Group Project: Student will submit a formal report as a collaborative project. Follow up presentation: Brief presentation on the report assignment.	2 hr
OTH2		
Employment Related Skills* (Newly added topic) **Job Market Search Skills** **Job Planning & Organization Skills**	Faculty explains the basic concept of job planning, search and organization skills Handouts related to self- evaluation and analysis are given to students prior to the class. Class Activity: Students work in pair to identify their skills, strengths and values and then discuss with the class. Follow-up Activity (Assignment): Student will develop their inventories. Lecture Aid Video: Behaviour based Interview (shared prior to class), accessible at: https://www.youtube.com/watch?v=TNvsbTuWrkI Discussion on the important points of the video	2 hr
Employment Communication **- Resume writing** **-Follow up Letter or E-mail**	Faculty explains the basic elements of resume and types of resume. Handouts of sample CVs are given to students prior to the class. Students work in pair to identify the salient features and then discuss with the class. Follow-up Activity: Student are given the CV template to compose their CVs.	2 hr

	Lecture Aid Video: How to make a video resume, accessible at: https://www.youtube.com/watch?v=S5RDXlRXh8c Discussion on the important points of the video Student are directed to read more about this topic here: http://career-advice.monster.com/resumes-cover-letters/cover-letter-tips/10-cover-letter-donts/article.aspx	
Employment Communication Cover Letter or Follow-up Email Writing Instructions/Procedures	Faculty explains the basic elements of cover letter. Students review sample cover letters Follow-up Activity (Assignment): Student will identify any job advertisement and write a cover letter to apply for the job. Faculty explains the writing style and important components of instructions/procedures Class Activity: Student will re-write the instructions to improve the writing style and tone.	2 hr
Students' Presentations	Students present their collaborative reports. Peer Review: Class will comment on the strong and week points of the presentation as target audience. Faculty's Comments	2 hr
FINAL EXAMS		

8. **Program Learning Outcomes**	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING
College of Electrical and Mechanical Engineering (CEME)
National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	EC-310 Microprocessor and Microcontroller Based Design
Credits:	4 (3+1)
Instructor(s)-in-charge:	Dr. Aimal Khan
Course type:	Lecture + Lab
Required or Elective:	Required
Course pre-requisites	EC-201, EC-202
Degree and Semester	DE 41, 5TH
Month and Year	Fall 21

2. Course Schedule	
Lecture:	3 hrs/week, Meets twice weekly
Lab:	3 hrs/week, Meets once weekly
Office Hours :	6 hrs/week by instructor, 3 hrs/week by teaching assistant/lab engineer

3. Course Assessment		
Exam:	2 Sessional and 1 Final	
Home work:	4-6 Assignments	
Lab reports:	12 reports	
Design Project:	1	
Quizzes:	6 Quizzes	
Grading:	Quizzes:	10%
	Assignments:	10%
	2 One Hour Tests (OHTs):	30%
	Final Exam:	25%
	Lab Work+ Semester Project:	25%

4. Course book and Related Course Material	
Textbooks:	1. Muhammad Ali Mazidi , Rollind D. Mckinlay and Danny Causey, PIC Microcontroller and Embedded Systems Using Assembly and C for PIC18, 15th edition, 2013
Reference Books:	1. PIC Microcontroller: An Introduction to Software and Hardware interfacing By Han-Way Huang, 2005.

5. Catalog Description

It is the second level course for the students who have already taken courses like logic and sequential circuit design and computer organization. The purpose of this course is to teach fundamentals of microprocessors and microcontrollers introducing students the architecture, assembly language and interfacing of a selected microprocessor and a microcontroller. The course is extremely hardware-oriented as students will be trained to design applications where control can be achieved via a microprocessor and microcontroller implementation to achieve a dedicated 'embedded' controller as a component of a larger system. The course includes comprehensive laboratory exercises.

6. Topics Covered

a. . Introduction of Microprocessors and Microcontrollers	3hrs
b. Introduction to computing	3hrs
c. The PIC18 Assembly Language Programming i. Introduction to PIC18 Assembly Programming ii. Assembling, Linking and Running a PIC18 Program iii. PIC18 Data Types and Directives iv. PIC18 Register banks & stacks v. Loop and Jump Instructions vi. Call Instructions vii. Time delay for various PIC18 Microcontroller	3hrs
d. I/O Port Programming i. I/O Bit manipulation programming ii. Bit addresses for I/O and RAM iii. Extra 128-byte on-chip RAM in PIC18	3hrs

e. Arithmetic, Logic Instructions and Programs i. Arithmetic Instructions ii. Signed number concepts and arithmetic operations iii. Logic and compare instructions iv. Rotate instruction and data serialization v. BCD, ASCII & other application programs	3hrs
f. PIC18 Programming in C i. Data types and time delay in PIC18 C ii. I/O Programming in PIC18 C iii. Logic Operations in PIC18 C iv. Data conversion programming in C v. Accessing code ROM space in PIC18 C vi. Data Serialization using PIC18 C	3hrs
g. Serial Port Programming in Assembly and C i. Basics of Timers in Microcontrollers ii. Programming of Timers in PIC18	3hrs
h. Analog to Digital Conversion in Microcontrollers i. Introduction to ADCs in PIC ii. Programming of ADC in PIC18	3hrs
i. Interrupt Handling In Microcontrollers i. Basic concepts of Interrupts in Microcontrollers ii. Interrupts Configuration in PIC18 iii. Interrupts Programming in PIC18	3hrs

7. **Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)**

Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**
CLO 1	Gain comprehensive knowledge of the organization, function, and operation of the microprocessor & microcontroller	PLO 1	C2
CLO 2		PLO 1	C4

	Use assembly language instruction set of Intel's 80x86 series of microprocessors in solving practical problems		
CLO 3	Develop the ability to interface a microprocessor or a microcontroller with sensors, memory units and other peripheral devices	PLO 3	C2
CLO 4	Design and implement an embedded system by using the appropriate software and hardware tools	PLO 3	P4
CLO 5	Analyse the requirements provided by a user for the design of an embedded system	PLO 2	C4

8. Program Learning Outcomes

PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
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	An ability to 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.
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	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
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	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
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	Apply ethical principles and commit to professional ethics and responsibilities and norms of

	engineering practice.
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PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information

Course Number and Title:	EC-330 Computer Networks
Credits:	4 (3+1)
Instructor(s)-in-charge:	Dr. Muhammad Umar Farooq
Course type:	Lecture + Lab
Required or Elective:	Required
Course pre-requisites	Nil
Degree and Semester	DCE-41, Semester 5
Month and Year	Fall 2021

2. Course Schedule

Lecture:	3 hrs/week, Meets twice weekly
Lab:	3 hrs/week, Meets once in a week
Outside study:	8 hrs/week
Office Hours :	6 hrs/week by instructor, 3 hrs/week by lab engineer

3. Course Assessment

Exam:	2 OHTs and 1 Final	
Home work:	6 Assignments	
Lab reports:	12 reports	
Design reports:	1 Design report based on Semester Project	
Quizzes:	6 Quizzes	
Grading:	Quizzes:	7.5%
	Assignments:	7.5%
	2 One Hour Tests (OHTs):	22.5%
	Final Exam:	37.5%
	Lab:	15%
	Semester Project:	10%

4. Course book and Related Course Material

Textbooks:	1. J. Kurose and K. Ross, Computer Networking – A Top-Down Approach Featuring the Internet, 6th edition, Addison-Wesley
	2. J. Kurose and K. Ross, Computer Networking – A Top-Down Approach Featuring the Internet, 7th edition, Addison-Wesley
Reference Books:	1. Garcia and Widjaja, "Communication Networks – Fundamental Concepts and Key Architectures", Second Edition, McGraw Hill, 2002

5. Catalog Descriptions

This course focuses on the principles, algorithms, architectures, protocols and advancements in core areas of computer networks. This course covers computer networks in a top down manner, starting from the application layer to the Physical Layer. Topics include TCP/IP and OSI reference models, Application Layer: Principles of network applications, network application models, and application layer protocols like HTTP, FTP, and DNS etc. Transport layer concepts, services, principles of connection oriented (TCP) and connectionless transport (UDP), Network Layer services, types, network layer devices, IP addressing, Overview of internet protocols (IP, ICMP etc.). Routing algorithms (Link state vs distance vector routing). IPv6, IP multicast, DHCP, NAT etc. Link layer services, devices, medium access protocols, error correction techniques. This course will also cover the basics of network security issues. Although, there are no prerequisites to this course; however, good understanding of programing concepts and operating system concepts can prove helpful

6. Course Objectives

b. Build detailed understanding of the fundamental concepts of computer networks.
c. To describe the layered architecture of the TCP/IP model and explain core functions of each layer including addressing, routing, internetworking, switching, multiplexing, channel access.
d. Be exposed to the recent developments in computer networks research.
e. To gain practical experience of the subject through programming assignments.
f. Enable students to extend their knowledge of computer networks (acquired from the course) towards their final year project
g. Provide students with a detailed insight to the fundamentals of data communication and computer networks.

9. **Topics covered in the Course and Level of Coverage**	
• Introduction to computer networks, internet structure, terminologies, basic concepts etc. a. Introduction to course – course outline, education needs b. Protocol layers and their service models c. Discussion about OSI and TCP/IP reference models	5hrs
• Application Layer: Principles of network applications (Peer-to-peer, client server & hybrid communications) a. Web and HTTP b. DNS c. FTP d. Email e. Torrent	8hrs
• Transport Layer: introduction, services, multiplexing/de-multiplexing etc. a. connectionless transport (UDP) b. Principles of reliable data transfer c. Connection oriented transport (TCP) d. TCP services e. Socket Programming (Creating Network Applications)	8hrs
• Network Layer: Introduction, Services, Routing and Forwarding Concepts a. IP addressing, Packet formats, Forwarding in the internet b. Subnetting, Supernetting c. The routing problem (Link state routing) d. The routing problem (distance vector routing) e. Routing in the Internet, OSPF, RIP etc. f. ICMP g. Broadcast and Multicast routing concepts h. DHCP	8hrs
• Network Layer: IPv4 limitations a. Network Address Translation (NAT) b. IPv6: Addressing, packet format, protocol changes c. Interworking of IPv6 and IPv4 routers	3hrs
• Link Layer: concept, services etc. a. Error detection/correction techniques b. Medium access control (MAC) protocols CSMA, CSMA/CD, CSMA/CA, ALOHA etc. c. ARP d. Ethernet, Link layer switches e. Wireless Networks (WLAN) f. Network Topologies	4hrs
• Security Concepts a. Cryptography, authentication, message integrity etc.	4hrs
• Physical layer functionalities/concepts overview: Communication concepts: data, signal, modulation schemes etc. Network topologies, network types	2hrs
• Review a. Review of important concepts before OHT-1 b. Review of important concepts before OHT-2 c. Review of important concepts after OHT-2 d. Addressing student's queries	2hrs

10. **Lab Experiments**	
Lab 01	Introduction to Network packet headers, protocol layers, packet sniffing tool Wireshark
Lab 02	Introduction to (some) Basic Networking Commands and Familiarization with Networking Equipment
Lab 03	Introduction to Cisco Packet Tracer and Simulating a Simple Local Area Network on Packet Tracer
Lab 04	Simulating multiple networks in Cisco Packet Tracer and Internetwork Communication
Lab 05	Simulation and Implementation of Peer to Peer Connection between Two PCs
Lab 06	Socket Programming (TCP Sockets)
Lab 07	Socket Programming (UDP Sockets)
Lab 08	Socket Programming (Multithreaded Network Applications)
Lab 09	Running DHCP Service on a Server along with HTTP and DNS in Cisco Packet Tracer
Lab 10	Basic Commands in CLI mode of Router IOS In Cisco Packet Tracer
Lab 11	Assigning IP Addresses to Interfaces and Access via Telnet Utility
Lab 12	Completely Configuring a Switch and Router via Telnet Utility for Multiple Networks
Lab 13	Configure DHCP Server on a Router and Check the IP Address Assignment
Lab 14	Socket Programming (RAW Sockets)
Lab 15	RAW Sockets (Protocol/Packet Identification)

11. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		PLOs	Learning Level
CLO 1	Explain the layered architecture of Computer Networks	PLO 1	C2
CLO 2	Rank & criticize various network protocols and algorithms for suitability and effectiveness in different scenarios	PLO 2	C5
CLO 3	Explain different security measure used in computer networks and identify basic security threats	PLO 3	C2
CLO 4	Build multi-party network applications that effectively take care of best practices used for TCP/IP applications development	PLO3	P5

12. Program Learning Outcomes

PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
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	effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF BASIC SCIENCES AND HUMANITIES

College of Electrical and Mechanical Engineering (CEM

National University of Sciences and Technology (NUST

1. Course Information	
Course Number and Title:	MATH-351 Numerical Methods
Credits:	3-0
Instructor(s)-in-charge:	Dr. Asim Aziz
Course type:	Lecture
Required or Elective:	Required
Course pre-requisites	Nil
Degree and Semester	DE 41, Semester 5th
Month and Year	Fall 21

2.Course Schedule	
Lecture:	3 Hrs/week, Meets twice weekly
Lab:	-
Discussion:	1 Hr/discussion, multiple discussion sections offered per week
Outside study:	3 Hrs/week
Office Hours :	5 Hrs/week by instructor

3.Course Assessment		
Exam:	2 Sessional and 1 Final	
Home work:	3 Assignments	
Lab reports:	-	
Design reports:	-	
Quizzes:	6 Quizzes	
Grading:	Quizzes:	10%
	Assignments:	10%
	2 One Hour Tests (OHTs):	30%
	Final Exam:	50%
	Lab:	-
	Semester Project:	-

4.Course book and Related Course Material	
Textbooks:	1. R. L. Burden and J. D. Faires, Numerical Analysis, 10th edition
Reference Books:	2. F. Curtis, G. Patrick and O. Wheatley: Applied Numerical Analysis, Addison-Wesley 3. J. H. Mathews and K. D. Fink, Numerical Methods Using Matlab, 4th edition, Pearson Education 4. E. Kreyszing. Advanced Engineering Mathematics 9th edition

5.Catalog Descriptions

Numerical analysis is the branch of mathematics and computer science that deals with solving a given mathematical problem involving methods based on rigorous mathematical analysis and leads to an approximate (non-exact) solution. Such problems originate generally from the real world. Such problems originate generally from real-world applications of algebra, geometry, and calculus, and these problems occur throughout the natural sciences, social sciences, engineering, medicine, and business. In this course, we introduce the field of computational techniques for solving problems concerning Calculus, Linear algebra and Differential Equations.

6.Course Objectives

a. Use of numerical techniques for solving nonlinear equations
b. Implementation of various methods for interpolating the data
c. Calculate integrals numerically
d. Understanding the numerical techniques in linear algebra
e. Solving ODEs and PDEs using numerical techniques

7.Topics covered in the Course and Level of Coverage	
• Introduction to Numerical Methods a. Introduction to course – course outline, education needs b. What is the difference between analytical and numerical methods c. Types of errors d. Relative and absolute errors	2 hrs
• Iterative Methods for the Solutions of Non-Linear Equations b. Bisection Method c. Fixed point Method d. Newton-Raphson Method e. Secant Method & Regula - Falsi Method	6 hrs
3. Interpolation a. Introduction to interpolation b. Lagrange interpolation Method c. Newton's divided difference interpolation method d. Newton's forward and backward interpolation method e. Cubic spline interpolation f. Natural and clamped cubic spline interpolation	8 hrs

4. Numerical Differentiation and Numerical Integration j. Introduction to differentiation and integration k. First and second order numerical differentiation l. Rectangular rule of integration m. Trapezoidal rule of integration n. Simpson's rule of integration	5 hrs
5. Numerical Methods in Linear Algebra c. LU factorization Dolittle and Crout's methods d. Cholesky's method of LU factorization e. Iterative methods to solve the system of linear equations f. Jacobi's and Gauss Seidel methods g. Iterative method to find eigenvalue and eigenvector (power method)	10 hrs
6. Numerical Solutions of 1st and 2nd order Ordinary Differential Equations a. Introduction b. Euler's Method, Modified Euler's Method, Huen's Method c. 2nd and 4th Order Runge Kutta Methods d. Solution of higher order Initial value problems	9 hrs
7. Numerical Solutions Partial Differential Equations a. Solutions of elliptic partial differential equations b. Solutions of parabolic partial differential equations	6 hrs
8. Review f. Review of important concepts before OHT-1 g. Review of important concepts before OHT-2 h. Review of important concepts after OHT-2 i. Addressing student's queries	2 hrs

8.Course Outcomes and their Relation to Program Outcomes

(Mapping CLO to PLO)

Course Learning Outcome (CLOs)		PLOs	Learning Level	Assessments
CLO 1	Use of numerical techniques for solving nonlinear equations	PLO 2	C3	Q1, A1, OHT-1, Final
CLO 2	Implementation of various methods for interpolating the data	PLO 2	C3	Q2, A1, OHT-1, Final
CLO 3	Calculate integrals numerically	PLO 1	C3	Q3, A2, OHT-2, Final
CLO 4	Understanding the numerical techniques in linear algebra	PLO 1	C3	Q4, A2, OHT-2, Final
CLO 5	Solving ODEs and PDEs using numerical techniques	PLO 2	C3	Q5, Q6, A3, Final

9. Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
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	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF ELECTRICAL ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information

Course Number and Title:	EE-232 Signals and Systems
Credits:	4 (3+1)
Instructor(s)-in-charge:	Dr Qasim Umar Khan, LE Sitwat Mahad
Course type:	Lecture + Lab
Required or Elective:	Required
Course pre-requisite(s)	Math-121 Linear Algebra and ODE, EE-211 Electrical Network Analysis
Degree and Semester	DE-41(CE), Semester 5
Month and Year	Fall 2021

2. Course Schedule

Lecture:	3 hrs/week, Meets twice weekly
Lab:	3 hrs/week, Meets once in a week
Office Hours :	2hrs/week

3. Course Assessment

Exam:	Two OHT examinations and One Final examination	
Home work:	3	
Lab reports:	14	
Design reports:	1 Design report based on Semester Project	
Quizzes:	6	
Grading:	Quizzes:	9%
	Assignments:	5%
	2 One Hour Tests (OHTs):	24%
	Final Exam:	37%
	Lab/Semester Project:	25%

4. Course book and Related Course Material

Textbook(s):	1. Signals and Systems by Alan V. Oppenheim, Alan S. Willsky with S. Hamid Nawab (2nd Edition)
Reference Book(s):	1. Fundamentals of Signals and Systems Using the Web and Matlab by Edward W. Kamen & Bonnie S. Heck. Weblink:http://users.ece.gatech.edu/~bonnie/book/ 2. Computer Explorations in Signals and Systems Using Matlab by John R. Buck, M. Daniel Andrew & C. Singer

5. Catalog Descriptions

This is an introductory course to Signals and Systems. The course will focus on how signals can be represented in time domain and how they can be transformed into other domains. The resultant alternative viewpoint allows more intuitive/ simpler solutions to various engineering problems. The students will also learn about analytical techniques that allow modelling the behaviour of the systems and gain an insight into the characteristics of signals. The course will provide skills to model, analyse and design signals and systems in general.

6. Course Objectives

a) To introduce basic concepts of Signals and Systems.
b) To give comprehensive introduction of the properties of continuous and discrete Signals and Systems.
c) To give concept of transforms and basic understanding of different domains.
d) To give understanding of system impulse response and its use in different scenarios.
e) To introduce concept of system transfer function and frequency response.
f) Is this course sufficient base is prepared for students in Signals and Systems that will help in their future courses of Digital Signal Processing, Digital Controls, and Digital Communications.
g) To give them the feel of real world Problems/ Trends/ Technologies.

7. Topics covered in the Course and Level of Coverage

1. Introduction, Types of Signals ● Motivation, Applications ● Signal Classification ● CT, DT, Analog, Digital, Deterministic, Random, Periodic, aperiodic; Even & Odd signal decomposition	3 hrs
2. Signal Transformations/Signal Fundamentals ● Signal Transformations	3 hrs

• Fundamental signals : Complex Exponentials; Decaying exponentials; sinusoids; Unit Impulse; Unit Step • Signal representation using fundamental signals	
3. System Classification • Continuous/Discrete ; Analog/Digital • Linear/Nonlinear ; Time-invariant/Time varying; Causal/Anti-causal; Stable/Unstable	3 hrs
4. LTI Systems Theory • Intro to LTI Systems • Impulse response as system characterization • LTI System Properties • Commutative/Distributive/Associative • Linearity • Convolution (CT and DT) • Difference equations for LTI system	9 hrs
5. Fourier Series • Frequency domain view of LTI systems • Concept of complex frequency • Fourier series representation of CT periodic signals (CTFS) • Properties of CTFS • Fourier series representation of DT periodic signals (DTFS) • Properties of DTFS	9 hrs
6. Continuous Time Fourier Transform (CTFT) • FT of continuous time aperiodic signals • Properties of CTFT • Fourier Transform of periodic signals	9 hrs
7. Laplace transform (LT) • Convergence of CTFT and motivation of Laplace transform • Properties of LT • Pole-zero plots; significance • Filter design by pole zero placement (time permitting)	9 hrs

8. Course Outcomes and their Relation to Program Outcomes

(Mapping CLO to PLO)

Course Learning Outcome (CLOs)		PLOs	Learning Level
CLO 1	Gain basic knowledge of signals and systems.	1	C2
CLO 2	Explain the transformations on signals.	2	C3
CLO 3	Use of appropriate signal transformations for analysis in complex problems.	3	C4
CLO 4	Develop computer programs to implement different signal processing algorithms	5	P2
CLO5	Demonstrate ability to work effectively as an individual or in a team.	9	A3

9. Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**

	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	ME 100 Engineering Mechanics
Credits:	3-0
Instructor(s)-in-charge:	Asst Prof Dr Faisal Ahmed
Course type:	Lecture
Required or Elective:	Required
Course pre-requisites	None
Degree and Semester	DE-41 Semester 5
Month and Year	Fall 2021

2. Course Schedule	
Lecture:	2 hrs/week, Meets once weekly
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	3 hrs/week
Office Hours :	3 hrs/week by instructor

3. Course Assessment	
Sessional:	30%
Quizzes:	15%
Assignment	5%
Final	50%

2 Course book and Related Course Material	
Textbooks:	1. Engineering Mechanics: Statics & Dynamics, 12th Edition by R.C. Hibbler
Reference Books:	Engineering Mechanics: Statics & Dynamics, Latest Edition. J. L. Meriam & L.G. Kraige

3 Topics Covered
• **Introduction to Statics**
• **Force System**
• **Two dimensional force system**
• **Three dimensional force system**
• **Equilibrium in two dimensions**
• **Equilibrium in three dimensions**

• **Structures**
• **Distributed forces**
• **Friction**
• **Kinematics of a particle**
• **Kinetics of a particle**

4 Course Objectives

The objective of this course is to develop the capacity to predict the effects of force while carrying out the creative design function of engineering. Concepts of properties of forces, moments, couples and resultants are developed. Analysis of two and three dimensional force systems and subsequently the analysis of two-dimensional equilibrium are also introduced to the students. Students are also exposed to the plane trusses and their solution by different methods which help them analyzing the structures and designing new structures. The students are introduced to the concentrated and distributed forces of friction which enables them to understand the design of a machine. The students are also taught the basic concepts of kinematics and kinetics of particle.

7. Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**
CLO 1	Understand force vectors in a plane (2D) and in space (3D)	PLO 1	C2
CLO 2	Compute moments about a point and about an axis	PLO 2	C3
CLO 3	Apply equations of equilibrium in two and three dimensions and analyze trusses by method of joints and method of sections	PLO 2	C3
CLO 4	Solve Problems which include frictional forces and friction angles in equilibrium	PLO 2	C3
CLO5	Understand the concepts of kinematics of particle motion	PLO 1	C2
CLO6	Apply the concept of kinetics on particle motion	PLO 2	C3

8. Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
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	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	EC-313 Digital Signal Processing
Credits:	4 (3+1)
Instructor(s)-in-charge:	Dr Ali Hassan / LE Hamza
Course type:	Lecture + Lab
Required or Elective:	Required
Course pre-requisites	EE-231 Signal And Systems
Degree and Semester	DCE-41
Month and Year	Spring 2022

2. Course Schedule	
Lecture:	3 hrs/week, Meets twice weekly
Lab:	3 hrs/week, Meets once in a week
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	7 hrs/week
Office Hours :	5 hrs/week by instructor, 3 hrs/week by teaching assistant/lab engineer

3. Course Assessment			
Exam:	2 Sessional (OHT) and 1 Final		
Lab reports:	12 reports		
Design reports:	1 Design report based on Semester Project		
Quizzes:	6-8 Quizzes		
Assignments:	4-6 Assignments		
Grading Tentative:	**Lecture 75%**	Quizzes:	10%
		Assignments:	10%
		2 One Hour Tests (OHTs):	30%
		Final Exam:	40%
		Semester Project:	10%
	Lab 25%	Lab Work:	50%
		Lab Mid:	25%
		Lab Final:	25%

4. Course book and Related Course Material

Textbooks:	1. A. V. Oppenheim and R. W. Schafer: Discrete-time Signal Processing, 3rd Edition Pearson Education Limited, 2013 2. J. G. Proakis, C. M. Rader, F. Ling, & L. Nikias Advanced Digital Signal Processing
Reference Books:	1. Ifeachor Jervis Digital Signal Processing- A Practical Approach Prentice Hall 2. James H. McClellan, Ronald W. Schafer, Mark A. Yoder DSP First: A multimedia approach Prentice Hall 3. S. K. Mitra, Digital Signal Processing: A Computer-Based Approach, McGraw-Hill, 1998.

4. Catalog Descriptions

Relationship between continuous-time and discrete-time signals, Z-transform, Discrete Fourier transform, Fast Fourier transform, Structures for digital filtering, Introduction to digital filter design techniques, FIR and IIR based filter design.

5. Course Objectives

1. This course provides an insight to the theory and application of DSP. Upon completion of the course, the student should have a solid foundation in the basics of DSP related to signal and system analysis and design with reasonable exposure to advanced topics in signal processing. In advanced topics the focus will be on different topics in statistical and multi rate signal processing.
2. To enable students to implement all theoretical information gained during the lectures in MATLAB and also to program solutions in MATLAB to practical problems.
3. To enable the use of Digital Signal Processing Kits such as DSK6713 and DSK6416 for real time implementation of DSP based algorithms for embedded solutions

6. Topics covered in the Course and Level of Coverage	
11. Discrete-time signals and systems. • **Linear time-invariant (LTI) systems,** • **Convolution sum,** • **Finite (FIR) and infinite (IIR) impulse responses,** • **Difference Equations**	6 hrs
12. One and two-sided z-transforms, partial fractions, transfer functions, block diagrams.	6 hrs
13. Discrete-time Fourier transform, properties, and applications.	6 hrs
14. Transform analysis of LTI systems: pole-zero representation for rational systems, study of various important systems including all-pass system, inverse system and minimum-phase system.	3 hrs
15. Filter design techniques: filter design as a numerical approximation problem, transformation techniques for the design of IIR filters, FIR filter design by windowing.	3 hrs
16. Discrete Fourier transforms (DFT): definition and properties of the discrete Fourier series, definition of the DFT and its properties, application to linear convolution.	2 hrs
17. Computation of the DFT: the computational problem, most commonly used Fast Fourier Transform (FFT) algorithms (radix-2, decimation-in-time)	2 hrs
18. Sampling of continuous-time signal and sampling rate conversion: the sampling theorem and some of its variations, reconstruction formulae, application to the discrete-time processing of continuous-time signals. Sampling rate conversion in multi-rate systems, multi-rate signal processing, band-pass sampling	4 hrs
19. Examples of applications of DSP (lectures and computer project). outside study	2 hrs
20. Review • **Review of important concepts before OHT-1** • **Review of important concepts before OHT-2** • **Review of important concepts after OHT-2** • **Addressing student's queries**	2 hrs

7. Lab Experiments	
Lab 01	Basics of Signal Processing
Lab 02	Functions and Signal Operations
Lab 03	Blind Source Separation
Lab 04	Linear Predictive Coding
Lab 05	Linear Convolution and Moving Average Filter

Lab 06	Fourier Transform
Lab 07	Fourier Transform Application
Lab 08	Z-Transform
Lab 09	Sampling of Audio Signals and Aliasing
Lab 10	Interpolation & Decimation
Lab 11	Installation and Introduction to Code Composer Studio (v7.4)
Lab 12	Lab Mid
Lab 13	Open Lab
Lab 14	Lab Final

8. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**
CLO 1	Conduct different operations on discrete-time sequences for LTI systems, including linear and circular convolution and analysis of different transforms (DTFT, DFT, z-Transforms) and their applications in DSP.	PLO 1	C4
CLO 2	Illustrate the use of DAC and ADC in DSP systems adhering to Nyquist sampling theorem.	PLO 1	C2
CLO 3	Design digital systems (FIR and IIR filters) using different techniques	PLO 3	C6
CLO 4	Conduct MATLAB and Digital Signal Processing Kits-based project(s) requiring some independent reading, programming, simulations, and technical writing.	PLO 5	P4

9. Program Learning Outcomes

PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and

	synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

10. Week Wise Lecture Breakdown	

• **Introduction to Digital Signal Processing**
• **Properties of LTI system**
• **Linearity**
  ○ Scale property
  ○ Shift in time
• **Additive Property**
	Week 1

• **Linearity**
  ○ Scale property
  ○ Shift in time
• **Additive Property**
• **LTI System and Convolution sum Equations**
	Week 2

• **Convolution using Flip and Drag method**	Week 3
• **Linear Constant Coefficient Difference Equation** • **Stability – BIBO** • **Frequency Response**	Week 4

• **Fourier Transform** • **Properties of Fourier Transform**	Week 5
• **Z-Transform** • **Pole Zero plot** • **ROC** • **All pole and All zeros signals** • **RHSeq and LHSeq**	Week 6
• **Stability of system** • **Causality of System**	Week 7
• **Sampling** • **Down sampling**	Week 8
• **Up-sampling** • **Multi-rate Signal Processing**	Week 9
• **Group Delays**	Week 10
• **Mag Response** • **Filter implementation DF-I, DF-II, TDF-I, TDF-II**	Week 11
• **DFT** • **Coefficient Quantizatio**n	Week 12
• **Filter Design** • **Impulse invariance** • **Bilinear Transform**	Week 13
• **Filter Design Butter worth**	Week 14

DEPARTMENT OF ELECTRICAL ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information

Course Number and Title:	EE-371 Linear Control Systems
Credits:	4 (3+1)
Instructor(s)-in-charge:	Lt Col Dr Atif Qayyum, LE Azmat Saeed
Course type:	Lecture + Lab
Required or Elective:	Required
Course pre-requisites	None; but the prior study of EE-313 Electronic Circuit Design would be extremely helpful.
Degree and Semester	DE-40 (DC&SE) Synd. A & B, Semester 7
Month and Year	Fall 2021

2. Course Schedule

Lecture:	3 hrs/week, Meets twice weekly
Lab:	3 hrs/week, Meets once in a week
Discussion:	1 hrs/week
Office Hours :	3 hrs/week by instructor, 3 hrs/week by lab engineer

3. Course Assessment

Exam:	1 Final Examination	
Home work:	4 Assignments	
Lab reports:	13 Reports	
Design reports:	-	
Quizzes:	4 Quizzes	
Grading:	Quizzes:	10%
	Assignments:	15%
	2 One Hour Tests (OHTs):	25%
	Final Exam:	50%
	Semester Project/ Lab:	-

4. Course book and Related Course Material

Textbooks:	**Design of Feedback Control Systems, (Fourth Edition),** by R.T. Stefani, C.J. Savant, B. Shahian, G.H. Hostetter, Oxford University Press, 2002, ISBN: 0-19-514249-
Reference Books:	1. **Modern Control Systems (Eleventh Edition),** by Richard C. Dorf and Robert H. Bishop, Prentice-Hall, Inc., 2001, ISBN: 0-13-030660-6 2. **Modern Control Engineering (Fourth Edition),** by K. Ogata, Prentice-Hall, Inc., 2002, ISBN: 0-13-060907-2 3. **Control Systems Engineering (Fifth Edition),** by N. Nise, Wiley-VCH, 2008, ISBN: 0-470-16997-42.

5. Catalog Descriptions

It is the job of the of a control engineer to analyze existing systems, and to design new systems to meet specific needs. However, more frequently a controller unit needs to be designed to improve the performance of existing systems. When designing a system, or implementing a controller to augment an existing system, we need to model the system mathematically, analyze the mathematical model, design the system/controller, implement the system/controller and perform testing. This course covers all these aspects of the analysis and design of a control system.

6. Course Objectives

Upon successful completion of the course, the student will demonstrate competency by being able to:

1. The student will have the ability to analyze complex linear systems (single and multivariable, external and internal representation). This includes their stability, controller design and evaluation of closed loop response.
2. Apply mathematical/analytical skills, to analyze system designs using root-locus, frequency response, and state-space methods.
3. Ability to design controllers for linear continuous-time control systems so that their performance meets specified design criteria.
4. Knowledge and understanding to provide a basis or opportunity for originality in developing and applying control concepts in the context of research.
5. The student will be able to use modern analytical tools, test equipment and computer aided design to assemble different types of control systems and measure performance.

7. Topics covered in the Course and Level of Coverage

Basic Concepts	6hrs
Modeling of Electrical, Electro-Mechanical Systems	6hrs
Transfer functions, Block Diagrams and Signal Flow Graphs	3hrs
Response of First and Second Order Systems	4hrs
Asymptotic/BIBO Stability and Routh-Hurwitz Stability Criterion	4hrs
Performance Specifications of Linear Time-Invariant Control Systems	3hrs
Root Locus Analysis	5hrs

Root Locus Design	5hrs
Frequency Response Analysis	3hrs
State Space Analysis	5hrs
State Space Design	4hrs

8. Lab Experiments

Lab 01	Introduction to MATLAB CLO1->PLO1
Lab 02	Introduction to Laboratory Trainer CLO1->PLO1
Lab 03	System Interconnections and Response Analysis CLO1->PLO1
Lab 04	Introduction to DC Motor Control Trainer CLO5->PLO5
Lab 05	DC Motor Control Trainer Modeling (Part – a) CLO5->PLO5
Lab 06	DC Motor Control Trainer Modeling (Part – b) CLO5->PLO5
Lab 07	Pre Lab for Controller Implementation CLO3->PLO3
Lab 08	Introduction to SISO toolbox CLO5->PLO5
Lab 09	Controller + Case Study CLO3->PLO3,CLO2->PLO2
Lab 10	DC Motor Control Trainer Speed Control (Part - a) CLO3->PLO3,CLO5->PLO5
Lab 11	DC Motor Control Trainer Speed Control (Part - b) CLO3->PLO3, CLO5->PLO5
Lab 12	Position Control CLO5->PLO5
Lab 13	Root Locus CLO2->PLO2,CLO5->PLO5
Lab 14	Design Project CLO5->PLO5

9. **Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)**

Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**
CLO 1	The student will have the ability to analyze complex linear systems (single and multivariable, external and internal representation). This includes their stability, controller design and evaluation of closed loop response.	1	C4
CLO 2	Apply mathematical/analytical skills, to analyze system designs using root-locus, frequency response, and state-space methods.	2	C4
CLO 3	Ability to design and evaluate feedback controllers for linear systems so that their performance meets desired specifications.	3	C6
CLO 4	Knowledge and understanding to provide a basis or opportunity for originality in developing and applying control concepts in the context of research.	1	C2
CLO 5	The student will be able to use modern analytical tools, test equipment and computer aided design to assemble different types of control systems and measure performance.	5	P3

10. Program Learning Outcomes

PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	EC-312 Digital Image Processing
Credits:	3 (2+1)
Instructor(s)-in-charge:	Dr. Muhammad Usman Akram
Course type:	Lecture + Lab
Required or Elective:	Required
Course pre-requisites	None
Degree and Semester	DE-41, Semester 6
Month and Year	Spring 2022

2.Course Schedule	
Lecture:	2 hrs/week, Meets once weekly
Lab:	3 hrs/week, Meets once in a week
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	3 hrs/week
Office Hours :	3 hrs/week by instructor, 3 hrs/week by teaching assistant/lab engineer

3. Course Assessment				
Exam:	2 Sessional and 1 Final			
Home work:	3 graded Assignments, 02-04 home tasks (non graded)			
Lab reports:	12-13 reports, 01 open Lab, 01 Lab Final			
Design reports:	1 Design report and 2 presentations based on Semester Project (First 3 Min Brief, Second 10 Min complete project presentation)			
Quizzes:	6-8 Quizzes			
Grading:	Theory (67%)		Lab (33%)	
	2 One Hour Tests (OHTs):	30%	Lab Work/Tasks (Every week)	45%
			Open Lab	10%
	Quizzes:	10%	Lab Final	10%
	Assignments	10%	Home Tasks	05%
	Final Exam	50%	Final Project	30%
Plagiarism Policy	Any work (Assignment, Projects, labs etc) if found copied, will have strict penalties			
4.Course book and Related Course Material				

Textbooks:	1. Digital Image Processing by Rafael C. Gonzalez and Woods, 4th Edition, 2018
Reference Books:	• David A. Forsyth and Jean Ponce, Computer Vision−A Modern Approach, • Fundamentals of Digital Image Processing: A Practical Approach with Examples in Matlab by Chris Solomon, Wiley-Blackwel, 2011 • Digital Image Processing Using Matlab by Rafael C. Gonzalez and Richard E. Woods, Pearson Education, 2009. • Digital Image Processing by Kenneth R. Castleman, Prentice Hall International Edition, 1996. • http://www.imageprocessingplace.com/

5.Catalog Descriptions

This course consists of topics related to image processing from introductory to a bit advanced level. The contents include introduction to image processing systems and applications, Image enhancement in spatial and frequency domains, removal of noise using image restoration, analysis of images using wavelets, shape based analysis using morphological operations, thresholding and clustering based segmentation, feature extraction such as edges, corners and texture based features and image classification. This also includes basic introduction and implementation of convolutional neural networks (CNNs). All lectures are supplemented by home works and laboratory implementations of image processing tasks using Python, OpenCV and MATLAB.

6. Course Objectives

The main objectives of this course are

a. To provide a comprehensive presentation of the fundamentals of image processing and analysis both from a theoretical as well as practical point of view.

b. To familiarize the students with the techniques of image enhancement in spatial and frequency domain.

c. To introduce the students to the image restoration techniques.

d. To familiarize students with the basic concepts relating to the color image processing.

e. To provide broader understanding of image compression, image morphology and wavelets.

f. To give them an idea about low and high level feature extraction from images and to apply classification in order to make decision support system for image processing based applications

g. To enable students to implement all theoretical information gained during the lectures in Python or MATLAB and also to program solutions in Python or MATLAB to practical problems.

7. **Topics covered in the Course and Level of Coverage**	
1. Introduction to image processing and it fundamentals **a. Basics of image processing** **b. Image resolution** **c. Connected component analysis**	5 hrs
2. Image enhancement in spatial domain **a. Intensity transformations** **b. Histogram and its analysis** **c. Convolution and spatial filtering**	6 hrs
3. Edge Detection and analysis **a. Edge segmentation (magnitude and Phase Analysis)** **b. Hough Transform**	2.5 hrs
4. Segmentation using thresholding and clustering **a. Global, local and adaptive thresholding** **b. K-means clustering** **c. Region growing and splitting based segmentation**	2.5 hrs
5. Color image processing **a. Formation of color image** **b. Different color models** **c. Analysis of colored images**	2 hrs
6. Morphological operations for binary and gray images **a. Introduction to morphological operations** **b. Morphological operation for binary images** **c. Gray level morphological operations**	2 hrs
7. Convolution Neural Networks **a. Introduction to Machine Learning** **b. Basic concepts of CNNS related to Fourier transform** **c. Calculating parameters and layer size for CNN architectures** **d. Introduction to segmentation and object detection**	6 hrs
8. Image enhancement in frequency domain **a. Basic concepts related to Fourier transform** **b. Sampling in frequency domain and introduction to DFT** **c. Filtering in frequency**	3 hrs
9. Texture Analysis **a. Statistical descriptors** **b. GLCM analysis**	2 hrs

c. Spectral descriptors	
10. Descriptors **a. Local Binary Pattern** **b. Histogram of oriented gradients**	2 hrs

8. **Lab Experiments**	
Lab 01	Installation & Introduction to Python and OpenCV
Lab 02	Basic Image Processing **(Group formation for semester project)**
Lab 03	Connected Component Analysis **(Assignment-1: Using Connect Component for Image Analysis)**
Lab 04	Transformation Operations
Lab 05	Histogram Equalization and other transformations **(Project Assignment)**
Lab 06	Spatial Filtering **(3 Minute presentation on project Idea)**
Lab 07	Edge Detection and Segmentation **(Assignment-2 Use of filtering, edge detection and segmentation for image analysis)**
Lab 08	**Image segmentation and clustering**
Lab 09	Morphological Operations **(Seminar on using GitHub and Co-Lab)**
Lab 10	Color Processing & Clustering
Lab 11	Frequency Analysis
Lab 12	Image classification & segmentation using deep learning **(Assignment-3: object localization in medical images)**
Lab 13	Open Lab
Lab 14	Lab Final **(Project Presentation and submission)**

9. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**	**Assessments**
CLO 1	**Understanding** the fundamentals and basic concepts of image processing related to image enhancement, filtering and segmentation etc	PLO 1	C2	Q1, Q2, A1, OHT-1, Final 1-question

CLO 2	**Performing** different mathematical transformations, histogram based operations and filtering concepts for solving image enhancement and feature extraction problems	PLO 2	C3	Q3, Q4, A2, OHT2, Final 1-question
CLO 3	Combining the concepts of image processing with machine learning to **analyze and design** decision support systems for image processing based applications	PLO 3	C4	Q6, A3, Final 1-question
CLO 4	Learning the use of Python and OpenCV to **implement** basic image processing algorithms and to **solve** real life and open ended problems	PLO 5	P4	Labs, Open Labs, Project, Presentation

10. **Mapping of Topics**	**CLO**	**Chapter(s)**
1. Introduction to image processing and it fundamentals **a. Basics of image processing** **b. Image resolution** **c. Connected component analysis**	CLO-1	Digital Image Processing by Rafael C. Gonzalez : Chapter-2
2. Image enhancement in spatial domain **a. Intensity transformations** **b. Histogram and its analysis** **c. Convolution and spatial filtering**	CLO-2	Digital Image Processing by Rafael C. Gonzalez : Chapter-3
3. Edge Detection and analysis **a. Edge segmentation (magnitude and Phase Analysis)** **b. Hough Transform**	CLO-2	Digital Image Processing by Rafael C. Gonzalez : Chapter-10
4. Segmentation using thresholding and clustering **a. Global, local and adaptive thresholding** **b. K-means clustering** **c. Region growing and splitting based segmentation**	CLO-1	Digital Image Processing by Rafael C. Gonzalez : Chapter-10
5. Color image processing **a. Formation of color image** **b. Different color models** **c. Analysis of colored images**	CLO-1	Digital Image Processing by Rafael C. Gonzalez : Chapter-6

6. Morphological operations for binary and gray images **a. Introduction to morphological operations** **b. Morphological operation for binary images** **c. Gray level morphological operations**	CLO-1	Digital Image Processing by Rafael C. Gonzalez : Chapter-9
7. Image enhancement in frequency domain **a. Basic concepts related to Fourier transform** **b. Sampling in frequency domain and introduction to DFT** **c. Filtering in frequency**	CLO-2	Digital Image Processing by Rafael C. Gonzalez : Chapter-4
8. Texture Analysis **a. Statistical descriptors** **b. GLCM analysis** **c. Spectral descriptors**	CLO-3	Digital Image Processing by Rafael C. Gonzalez : Chapter-9
9. Convolution Neural Networks **a. Basic concepts of CNNS related to Fourier transform** **b. Calculating parameters and layer size for CNN architectures**	CLO-3	Digital Image Processing by Rafael C. Gonzalez : Chapter-12 Stanford online course on CNN https://www.youtube.com/watch?v=vT1JzLTH4G4
12. Descriptors **a. Local Binary Pattern** **b. Histogram of oriented gradients**	CLO-2	Ahonen, Timo, Abdenour Hadid, and Matti Pietikäinen. "Face recognition with local binary patterns." In European conference on computer vision, pp. 469-481. Springer, Berlin, Heidelberg, 2004. Dalal, Navneet, and Bill Triggs. "Histograms of oriented gradients for human detection." In 2005 IEEE computer society conference on computer vision and pattern recognition

		(CVPR'05), vol. 1, pp. 886-893. IEEE, 2005.

11. **Program Learning Outcomes**	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information

Course Number and Title:	HU-222: Professional Ethics
Credits:	2
Instructor(s)-in-charge:	Dr. Muhammad Zeeshan Mirza
Course type:	Lecture
Required or Elective:	Required
Course pre-requisites	Nil
Degree and Semester	DCE-41
Month and Year	Spring 2022

2. Course Schedule

Lecture:	2 hrs/week
Lab:	Nil
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Office Hours :	6 hrs/week by instructor

3. Course Assessment

Exam:	2 Sessional and 1 Final	
Home work:	2 Assignments	
Design reports:	1 Design report based on Semester Project	
Quizzes:	4 Quizzes	
Grading:	Quizzes:	10%
	Assignments:	10%
	2 One Hour Tests (OHTs):	30%
	Final Exam:	40%
	Semester Project:	10%

4. Course book and Related Course Material	
Textbooks:	1. Ethics – Discovering right and wrong by Louis P. Pojman & James Feiser – 6th Edition Wadsworth Cengage
Reference Books:	• Professional Ethics by R. Subramanian, Oxford University Press

5.Catalog Descriptions

To train students in professional ethics in such a way that they are able to apply their knowledge in all spheres of life in general and in their profession of engineering in particular.

6.Course Objectives

b. Perform his professional duties with the best possible abilities.
c. Get the ability to deal with the clients.
d. Prove himself/herself as an asset for the organization working with. Live a successful professional life

7. Topics covered in the Course and Level of Coverage	
• Introduction/Ice Breaking session • Group Formation • Introductory Lecture	3hrs
• Ethical – The Concept • Moral Development and Moral Reasoning • Ethics and the Changing Environment **a)** Class Discussion	5hrs
• Traditional vs Contemporary Views of Social Responsibility **a)** Class Discussion • Different Views of Ethics **a)** Utilitarian Ethics **b)** Deontology Ethics **c)** Virtue Ethics	6hrs
• Moral Responsibilities of Cross Functional Area Professionals • Managing Crisis and Conflict Resolution • Ethics in the Market Place	6hrs
• Leadership • Organizational Culture • Strategy and Self-regulation	4hrs
• Discrimination and respect for Diversity • Sexual Harassment • Employee's Obligations to Firms • Ethics in Cross-cultural Setting	4hrs
• Project Presentations • Review of important concepts before OHT-1 • Review of important concepts before OHT-2 • Addressing student's queries	4hrs

8. Course Outcomes and their Relation to Program Outcomes

(Mapping CLO to PLO)

Course Learning Outcome (CLOs)		PLOs	Learning Level
CLO 1	To comprehend the importance of professional ethics.	PLO 8	C2
CLO 2	To explain the importance of ethics for professionals	PLO 8	C2
CLO 3	To solve the ethical dilemmas using ethical values in real life.	PLO 6	C3
CLO 4	To analyze the effects of violating ethical standards at workplace.	PLO 6	C4

9.Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF BASIC SCIENCE & HUMANITIES

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information

Course Number and Title:	MATH-361 Probability and Statistics
Credits:	3+0
Instructor(s)-in-charge:	Assoc Prof Dr Yasir Ali
Course type:	Lecture
Required or Elective:	Required
Course pre-requisites	Nil
Degree and Semester	DCE-41
Month and Year	Spring 22

2. Course Schedule

Lecture:	3 hrs/week, Meets twice weekly
Lab:	-
Discussion:	multiple discussion sections offered per quarter
Outside study:	7 hrs/week
Office Hours:	6 hrs/week by instructor

3. Course Assessment

Exam:	2 Sessional and 1 Final	
Home work:	3 Assignments	
Lab reports:	-	
Design reports:	-	
Quizzes:	6 Quizzes	
Grading:	Quizzes:	10%
	Assignments:	10%
	2 One Hour Tests (OHTs):	30%
	Final Exam:	50%
	Lab:	-
	Semester Project:	-
Plagiarism Policy	Any work (Assignments, Projects etc) if found copied, will have strict penalties.	

4. Course book and Related Course Material

Textbooks:	1. Advanced Engineering Mathematics by E.Kreyszig
Reference Books:	a) Probability and Statistics by Murray R. Speigel b) Probability and Statistics for Engineers and Scientists by Walpole

5. Catalog Descriptions

This course focuses on basics of probability and statistics with applications related to different disciplines of engineering.

6. Course Objectives

The Objective of this course is to provide strong foundation for the upcoming courses in the computer engineering program.

7. Topics covered in the Course and Level of Coverage

Topics	Estimated Contact Hours
Graphical Representation of Data: Stem-and-Leaf Plot, Histogram, Boxplot; Mean, Standard Deviation, Variance	3
Sample Space, Experiment Outcomes, and Sampling with and without replacement, Set theory,	3
Introduction to theory of Probability, Theorems of Probability, Conditional probability	3
Permutations and Combinations	3
Random Variables and Probability Distributions	3
Mean and Variance of a Distribution, Expectation, Moments	3
Binomial, Poisson & Hypergeometric distributions.	3
Normal distribution.	3
Distributions of several Random Variables	3
Random Sampling	3
Point estimation of Parameters	3
Confidence intervals.	3
Testing of hypothesis. Decisions	3
Quality control, Control chart	3
Acceptance sampling, errors & rectification.	3

Goodness of Fit, Chi-square test	3
Regression Analysis.	3

8	**Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)**

Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**	**Assessments**
CLO 1	Present sample data and extract its important features	PLO 2	C4	Q1, A1, OHT1, Final 1
CLO 2	Understand different discrete and continuous probability distributions	PLO 2	C2	Q2, Q3, OHT2, A2, Final 1 Qs
CLO 3	Estimate different population parameters on the basis of samples	PLO 2	C3	Q4, Q5, Final 1 qs
CLO 4	Implement quantity control measures	PLO 1	C3	Q6, A3, Final 1 qs

9. Mapping of Topics

Topics	CLO	Chapters/Secs
Graphical Representation of Data: Stem-and-Leaf Plot, Histogram, Boxplot; Mean, Standard Deviation, Variance	CLO1	Advanced Engineering Mathematics by E. Kreyszig Sec 24.1
Sample Space, Experiment Outcomes, and Sampling with and without replacement, Set theory.	CLO2	Advanced Engineering Mathematics by E. Kreyszig Sec 24.2
Introduction to theory of Probability, Theorems of Probability, Conditional probability	CLO2	Advanced Engineering Mathematics by E. Kreyszig Sec 24.3
Permutations and Combinations	CLO2	Advanced Engineering Mathematics by E. Kreyszig Sec 24.4
Random Variables and Probability Distributions	CLO2	Advanced Engineering Mathematics by E. Kreyszig Sec 24.5
Mean and Variance of a Distribution, Expectation, Moments	CLO2	Advanced Engineering Mathematics by E. Kreyszig Sec 24.6
Binomial, Poisson & Hypergeometric distributions.	CLO2	Advanced Engineering Mathematics by E. Kreyszig Sec 24.7

	Normal distribution.	CLO2	Advanced Engineering Mathematics by E. Kreyszig Sec 24.8
	Distributions of several Random Variables	CLO2	Advanced Engineering Mathematics by E. Kreyszig Sec 24.9
	Random Sampling	CLO3	Advanced Engineering Mathematics by E. Kreyszig Sec 25.1
	Point estimation of Parameters	CLO3	Advanced Engineering Mathematics by E. Kreyszig Sec 25.2
	Confidence intervals.	CLO3	Advanced Engineering Mathematics by E. Kreyszig Sec 25.3
	Testing of hypothesis. Decisions	CLO-3	Advanced Engineering Mathematics by E. Kreyszig Sec 25.4
	Quality control, Control chart	CLO4	Advanced Engineering Mathematics by E. Kreyszig Sec 25.5
	Acceptance sampling, errors & rectification.	CLO4	Advanced Engineering Mathematics by E. Kreyszig Sec 25.6
	Goodness of Fit, Chi-square test	CLO4	Advanced Engineering Mathematics by E. Kreyszig Sec 25.7
	Regression Analysis.	CLO4	Advanced Engineering Mathematics by E. Kreyszig Sec 25.9

PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**

	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	CSL-401 Community Service Learning
Credits:	2 (1+1)
Instructor(s)-in-charge:	Asst. Prof Dr. Farhan Hussain
Course type:	Lecture + Lab
Required or Elective:	Required
Course pre-requisites	*Nil*
Degree and Semester	DCE-41, Semester 6th
Month and Year	Spring 2022

2. Course Schedule	
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	7 hrs/week
Office Hours :	5 hrs/week by instructor, 3 hrs/week by teaching assistant/lab engineer

3. Course Assessment		
Seminars:	6x Seminars	
Field Work (Project 1):	10 hrs.	
Field Work (Project 2):	10 hrs.	
Grading:	Non-Graded	Qualified/Unqualified

4. Course Learning Outcomes			
CLO 1	**Students should be able to organize a seminar/project for general population determined by need of the society.**	**PLO 7**	**A4**
CLO 2	**Students should be able to adhere with ethical values during their seminars and project submissions.**	**PLO 8**	**A2**

5. Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	EC-350 Artificial Intelligence and Decision Support Systems
Credits:	4 (3+1)
Instructor(s)-in-charge:	Dr Arslan Shaukat
Course type:	Lecture + Lab
Required or Elective:	Elective
Course pre-requisites	None
Degree and Semester	DE-40, Semester 7th
Month and Year	Fall 2021

2. Course Schedule	
Lecture:	3 hrs/week, Meets twice in a week
Lab:	3 hrs/week, Meets once in a week
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	6 hrs/week
Office Hours :	2 hrs/week by instructor, 2 hrs/week by teaching assistant/lab engineer

3. Course Assessment		
Exam:	2 Sessional and 1 Final	
Home work:	4 Assignments	
Lab reports:	14 reports	
Design reports:	1 Design report based on Semester Project	
Quizzes:	6 Quizzes	
Grading:	**Lecture**	
	Quizzes:	15%
	Assignments:	10%

	2 One Hour Tests (OHTs):	30%
	Final Exam:	45%
	Lab	
	Lab Work:	70%
	Semester Project:	30%

4. Course book and Related Course Material	
Textbooks:	Artificial Intelligence: A Modern Approach, by S. Russell and P. Norvig, 3rd Edition, Prentice Hall, 2009.
Reference Books:	1. Artificial Intelligence: A Systems Approach, by M. Tim Jones, Infinity Science Press, 2008. 2. Pattern Classification, by Richard O. Duda, Peter E. Hart and David G. Stork, Wiley Inter-science, 2nd edition, 2006. 3. Pattern Recognition and Machine Learning, by Christopher Bishop, Springer, 2006.

5. Catalog Descriptions
This course introduces students to the basic search methods, problem solving, and learning methods of artificial intelligence. Upon completion of this course, students should be able to develop intelligent systems by assembling solutions to concrete computational problems; understand the role of search algorithms, problem solving, and learning in intelligent-system engineering; and appreciate the role of problem solving, vision, and language in understanding human intelligence from a computational perspective.

6. Course Objectives

a) Objectives are to learn techniques and theory developed in major areas of Artificial Intelligence and to learn about the state of the art in Artificial Intelligence.

b) To have an appreciation for and understanding of both the achievements of AI and the theory underlying those achievements.

c) To have an appreciation for the engineering issues underlying the design of AI systems.

d) To have a basic proficiency in a traditional AI language including an ability to write simple to intermediate programs and an ability to understand code written in that language.

e) To have an understanding of the basic issues of knowledge representation and blind and heuristic search, as well as an understanding of other topics such as game theory and minimax algorithm, etc. that play an important role in AI programs.

f) To have a basic understanding of some of the more advanced topics of AI such as learning using Bayesian networks, decision trees and neural networks.

7. Topics covered in the Course and Level of Coverage

1. Introduction to Artificial Intelligence, Turing test	3 hrs
2. Agents, PEAS model, Rationality, Nature and properties of environment, Structures of agents	3 hrs
3. Problem solving by searching, Uninformed search strategies, Breadth first search (BFS), Uniform Cost search	3 hrs
4. Depth first search (DFS) , Depth limited search, Iterative deepening DFS	3 hrs
5. Informed search strategies, Greedy best first search, A* search	4 hrs
6. Local search algorithms, Genetic algorithms (GA)	4 hrs
7. Adversarial search, Games, Minimax algorithm, Alpha-beta pruning	4 hrs
8. Introduction to Machine Learning, Feature extraction and classification	3 hrs
9. K-nearest neighbor classifier, Training and testing error, Confusion matrix, Sensitivity and Specificity	4 hrs
10. Bayesian Networks and Naïve Based Bayes Models, Gaussian distribution, covariance matrix	6 hrs
11. Neural networks and single layer Perceptron	3 hrs
12. Multi layer Perceptron	3 hrs
13. Introduction to non-metric method and decision trees, entropy impurity,	

CART algorithm, query selection	3 hrs

8. **Lab Experiments**	
Lab 01	Introduction to Python
Lab 02	Object Oriented Design Practices in Python
Lab 03	Graph Theory & Path Searches in Python
Lab 04	Breadth First Search for Graph and Tree Traversal
Lab 05	Depth First Search for Graph and Tree Traversal
Lab 06	A* Search for Graphs
Lab 07	Minimax with Alpha-Beta Pruning
Lab 08	Mid Term Lab Exam
Lab 09	K-Nearest Neighbors Classification Model
Lab 10	Bayesian and Naïve Bayes Classification Model
Lab 11	K-means Clustering
Lab 12	Single Layered Feed Forward Neural Network (Perceptron)
Lab 13	Open Lab

9. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**
CLO 1	Solving problems using various uninformed and informed search strategies.	PLO 2	C3
CLO 2	Apply local search algorithms like Genetic Algorithm (GA) on optimization problems and perform Minimax search on games.	PLO 2	C3
CLO 3	Design machine learning systems, demonstrating understanding of machine learning concepts including feature extraction and classification.	PLO 3	C6
CLO 4	Implement projects in the lab work that use Python and MATLAB for execution of the theoretical knowledge gained during class lectures, requiring some independent reading, programming and learning.	PLO 12	P2

10. Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF ENGINEERING MANAGEMENT

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	ECO-130 Engineering Economics
Credits:	2 (2+0)
Instructor(s)-in-charge:	Assistant Prof Ali Salman
Course type:	Lecture
Required or Elective:	Required
Course pre-requisites	Nil
Degree and Semester	DE-40 Semester 8
Month and Year	Spring 2022

2. Course Schedule	
Lecture:	2 hrs/week, Meets once weekly
Lab:	Nil
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	4 hrs/week
Office Hours :	06 hrs/week by instructor

3. Course Assessment		
Exam:	2 Sessionals and 1 Final	
Home work:	2 Assignments	
Lab reports:	-	
Design reports:	-	
Quizzes:	4 Quizzes	
Grading:	Quizzes:	10%
	Assignments:	10%
	2 One Hour Tests (OHTs):	30%
	Final Exam:	50%
	Lab:	-
	Semester Project:	-

4. Course book and Related Course Material

Text books:	1. **Engineering Economy** by Gerald J. Thuesen and W J Fabrycky Prentice Hall 2. **Engineering Economy, 9th Ed.** by E. Paul Degarmo, William G. Sullivan, John R. Canada, Macmillan Publishing Company
Reference Books:	1. **Advanced Engineering Economics** by Chan S. Park and Gunter P. Sharp-Bette, John Willey 2. **Cost – Benefit Analysis, Concepts and Practices** by Anthony E. Boardman, David H. Greenberg 2nd Edition, Prentice Hall

6. Catalog Descriptions

This course is designed to present engineering students the basic concepts and techniques of engineering economic analysis that are needed in the decision making process. This course covers the cost concepts, principles of engineering economy, time value of money, capital budgeting techniques, bonds and inflation etc.

7.Course Objectives

b. To describe the importance of economics in decision making process
c. To familiarize the students with the basic concepts of money management
d. To highlight the importance of time value of money

8. Topics covered in the Course and Level of Coverage	
• Introduction to engineering Economics, origins of engineering economy, relationship between engineering and management, capital allocation and engineering economy	4hrs
• Cost concept and the economic environment, cost terminology, application of cost concept, life cycle cost	4hrs
• Principles of engineering economy, the decision-making process, non-monetary factors and multiple objectives, steps in an engineering economics analysis	2hrs
• Break-even analysis, Depreciation	2hrs
• The time value of money, return to capital, origins of interest, simple interest, compound interest, economic equivalence	4hrs
• Nominal and effective interest rates, Methods for assessing economic worth, present worth, annual worth, future worth	4hrs
• Capital budgeting, discounted cash flow analysis, sunk costs, working capital, discount nominal cash flow by the nominal cost of capital	2hrs
• Investment and financing decision, internal rate of return, payback period, benefit-cost ratio	2hrs
• Inflation and time value of money, inflation and interest rate, Value and Utility	2hrs
• Bond, yield to maturity, bond pricing	2hrs
• Accounting and engineering economy studies, reading financial pages	2hrs
• Review j. Review of important concepts before OHT-1 k. Review of important concepts before OHT-2 l. Review of important concepts before final m. Addressing student's queries	2hrs

8. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		PLOs	Learning Level
CLO 1	Comprehend the importance of engineering economics in society.	PLO 6	C2
CLO 2	To apply capital budgeting techniques on different proposals.	PLO 11	C3

- **Program Learning Outcomes**

PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of

	innovation and technological developments

DEPARTMENT OF ENGINEERING MANAGEMENT

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	OTM-455 Engineering Project Management
Credits:	2
Instructor(s)-in-charge:	Dr. Afshan Naseem
Course type:	Lecture
Required or Elective:	Required
Course pre-requisites	Nil
Degree and Semester	DCE-40, Semester 7
Month and Year	Fall 2021

2. Course Schedule	
Lecture:	2 hrs/week, Meets once a week
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	7 hrs/week
Office Hours :	6 hrs/week by instructor

3. Course Assessment		
Exam:	2 Sessional and 1 Final	
Home work:	3 Assignments	
Quizzes:	4 Quizzes	
Grading:	Quizzes:	10%
	Assignments:	10%
	2 One Hour Tests (OHTs):	30%
	Final Exam:	50%

4. Course book and Related Course Material	
Textbooks:	1. PMBOK 6th Edition
Reference Books:	1. Project Management by Harold Kerzner, Latest Edition 2. Modern Production and Operation Management by Elwood S. Buffa, Latest Edition 3. Operation Management by Roger G. Schroeder, Latest Edition 4. Production and Operations Management by Norman Gaither and Greg Frazier, Latest Edition

5. Catalog Description

This course develops a foundation of concepts and solutions that supports the planning, scheduling, controlling, resource management required for successful completion of a project.

6. Course Objectives

a) To develop individual skill in project definition, network construction and critical path analysis.
b) To create an attitude to understanding and developing project management applications across a range of engineering scenarios.
c) To extend numerate competence to cover selected advanced project management procedures, transferring experience and skill in the use of widely available PERT / CPM software package

7. Topics covered in the Course and Level of Coverage

1. Introduction to Planning & Project Management, terminologies, basic concepts etc. a. Introduction to course – course outline, education needs b. Planning c. Project d. Management	2hrs
2. Project Management Body of Knowledge – A Brief Introduction a. Main features of Project b. Operations c. Program & Program Management d. Portfolio & Portfolio Management e. Project Management Knowledge Areas & Process Groups	2hrs
3. Project Life Cycle a. Project Success & Failure b. Case Studies c. Project Phases d. Project Life Cycle	2hrs
4. Management Levels & Skills **a.** Organizational Structure **b.** Management Levels & Styles **c.** Leadership vs Management **d.** Project Manager's Responsibilities	2hrs
5. Project Integration & Scope Management a. Project Integration Management – Project Charter b. Project Scope Management – Work Breakdown Structure	2hrs
6. Project Schedule Management a. Project Schedule Management Processes & Techniques b. Gantt Chart c. Critical Path Method d. Critical Path Analysis e. Program Evaluation & Review Technique f. Crashing Schedule	10hrs

7. Project Resource Management a. Project Teams – Team Development b. Resource Estimation c. Resource Allocation d. Resource Levelling	2hrs
8. Project Communication & Risk Management a. Miscommunication Problems b. Project Communication Processes c. Communication Matrix d. Project Risk Processes e. Risk identification tools & techniques f. Risk Register g. Probability/Impact Matrix	4hrs
9. Project Quality & Stakeholder Management a. Cost of Poor Quality b. Six Sigma & Lean c. ISO Standards - Introduction d. Agile e. Project Stakeholder Processes f. Stakeholder Register g. Power/Interest Grid	2hrs
10. Project Cost, Procurement & Integration Management a. Cost Estimation b. Project Monitoring & Control – Earned Value Analysis c. Project Procurement Management – Request for Proposal d. Project Integration Management – Closing Project e. Configuration Management	4hrs

8. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)			
Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**
CLO 1	Use the planning techniques on engineering projects.	PLO 11	C3
CLO 2	Explain the significance of human resource for project success.	PLO 9	C2
CLO 3	Prepare and explain selected component of a project plan.	PLO 12	A3

9. Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**

	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	Database Engineering
Credits:	3-1
Instructor(s)-in-charge:	Dr Wasi/LE Ansa
Course type:	Lecture and Lab
Required or Elective:	Elective
Course pre-requisites	
Degree and Semester	DE-41
Month and Year	Spring 2022

2. Course Schedule	
Lecture:	3 hrs/week, Twice weekly
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter

3. Course Assessment			
Exam:	2 OHTs and 1 Final		
Home work:	1 graded Assignment		
Lab reports:	13-14 reports, 01 open Lab, 01 Lab Final		
Design reports:	1 Design report and 1 presentation based on Semester Project		
Quizzes:	3 Quizzes		
Grading:	Theory (75%)		Lab (25%)
	2 OHTs	30%	
	Quizzes:	10%	
	Assignments	10%	
	Final Exam	50%	
Plagiarism Policy	Any work (Assignment, Projects, labs etc) if found copied, will have strict penalties		

4. Course book and Related Course Material	
Textbooks:	1. Modern Database Management by Hoffer, Latest Edition
Reference Books:	1. Fundamentals of Database Systems by Elmasri, Navathi

5. Catalog Descriptions
This course is aimed at helping students build up an understanding of how to design and develop a database system for an organization. Also, to give students an understanding of underlying relational algebra. The course also includes advanced concepts like data warehouse design, data mining basics, No SQL databases and query optimization.

6. Week wise topics breakdown	
• **Intro & Basic concepts of Database systems**	Week 1
• **Modeling data in organization, ERD design**	Week 2
• **Enhanced Entity Relationship Diagram**	Week 3
• **Relational Model**	Week 4
• **Normalization**	Week 5
• **Physical Database Design**	Week 6
• **Basic SQL**	Week 7
• **Advance SQL**	Week 8
• **Windows/Web/Mobile Application Development**	Week 9
• **Relational Algebra**	Week 10
• **Query Optimization**	Week 11
• **Distributed Databases and Query Optimization in DDBs**	Week 12
• **Datawarehouse Design, No SQL Databases**	Week 13
• **Online Analytical Processing, Intro to Data mining**	Week 14
• **Final Exam**	Week 15

7. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)				
Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**	**Assessments**
CLO 1	Describe the basic concepts (Entity modelling, Data integrity, Relational modelling, Normalization etc) of relational database management system.	PLO 1	C1	Q 1, A2
CLO 2	Examine the end-user requirements to create a detailed database system design.	PLO 4	C2	OHT 1 Q 1
CLO 3	Formulate information from data and database objects through the use of SQL	PLO 3	C2	FINAL Q2
CLO 4	Design and develop a database system (using backend engines and UI tools) that satisfies relational theory and provides users with business queries, business forms, and business reports	PLO 5	C3	OHT 2 Q 1

8. Topics Mapping	
Topic	CLO
• **Intro & Basic concepts of Database systems**	1
• **Modeling data in organization, ERD design**	2
• **Enhanced Entity Relationship Diagram**	2
• **Relational Model**	2
• **Normalization**	2
• **Physical Database Design**	2
• **Basic SQL**	3
• **Advance SQL**	3
• **Windows/Web/Mobile Application Development**	4
• **Relational Algebra**	1
• **Query Optimization**	4
• **Distributed Databases and Query Optimization in DDBs**	4
• **Datawarehouse Design, No SQL Databases**	4
• **Online Analytical Processing, Intro to Data mining**	4

9. Lab Experiments	
Lab 01	Introduction to SQL server
Lab 02	File Management System
Lab 03	Entity Relationship Diagram
Lab 04	Entity Relationship Diagram Continued
Lab 05	Enhanced Entity Relationship Diagram
Lab 06	Relational Data Model & Integrity Constraints
Lab 07	Normalization
Lab 08	Working with SQL Server Management Studio
Lab 09	Data Definition Language (DDL)
Lab 10	Data Manipulation Language (DML)
Lab 11	Implementation of SQL Select Statement
Lab 12	Implementation of SQL Joins and Conditional Expressions
Lab 13	Implementation of SQL Wild Cards and Sub-Queries
Lab 14	Implementation of SQL Aggregate Functions and Views
Lab 15	Connection between Client and Server
Lab 16	Lab Final (Open Lab)

10.Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**

	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
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	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
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	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING
College of Electrical and Mechanical Engineering (CEME)
National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title	EC-410 Digital System Design
Credits	4 (3+1)
Instructor(s)-in-charge	Asst. Prof. Dr. Muhammad Yasin / TA Mehr Dua
Course type:	Lecture + Lab
Required or Elective:	Required
Course pre-requisites	EC-310 Microprocessor & Microcontroller Based Design
Degree and Semester	DCE-41, Semester 7
Month and Year	Fall 2022

2. Course Schedule	
Lecture	3 hrs/week, Meets twice weekly
Lab	3 hrs/week, Meets once in a week
Discussion	1 hr/discussion, multiple discussion sections offered per quarter
Outside study	7 hrs/week
Office Hours	4 hrs/week by instructor, 3 hrs/week by teaching assistant/lab engineer

3. Course Assessment and Grading	
Exams	1 Mid and 1 Final
Homework	3 Assignments
Lab Work	12 Lab Sessions, 2 Open-ended Lab session(s)
Design reports	1 Design report based on Semester Project
Quizzes:	6 Quizzes

4. Grading			
Theory/ Lecture	Quizzes	20%	75%
	Assignments10%	5%	
	Midterm	35%	
	Final Exam	40%	

Lab	Lab Work: (Lab Tasks, Open Lab, Lab Exam)	80%	25%
	Semester Project	20%	

5. Course book and Related Course Material

Textbooks	Selected Chapters from the following: 1. Introduction to Digital Systems Design by Giuliano Donzellini, Domenico Ponta, Luca Oneto, Davide Anguita, **2018** 2. Digital Design of Signal Processing Systems by Shoab A. Khan, John Wiley & Sons **2010**
Reference Books	**1.** Introduction to Reconfigurable Computing by Christophe Bobda **2.** Xilinx material: IDE, Vivado, Spartan based SDKs **3.** VERILOG HDL-A guide to digital design and synthesis by Samir Palnitkar, Prentice Hall Publisher **4.** Advanced Digital Design with VERILOG HDL by Michael D. Ciletti, Prentice Hall Publisher

6. Catalog Descriptions

The purpose of this is course to train students to take on roles as digital design engineers and/or FPGA engineers.

Digital systems are pervasive in all spheres of life and each design has its unique specifications in terms of functionality, performance, testability, and flexibility for upgradation. Often there is a conflict between performance targets and resources available to achieve those targets. The course teaches fundamental principles and methods of digital design and introduces the core building of these systems. Students will learn how to architect a digital system so that it can achieve the desired performance within the given area and power constraints.

7. Course Objectives

The objective of the course is to teach students

a) Verilog HDL as a hardware description language
b) FPGA architecture
c) System-on-chip (SoC) architecture and Design Flow
d) Converting floating-point algorithms design in MATLAB to Fixed-point format
e) Effective HW mapping techniques: Fully parallel, Time-shared, micro-coded architectures
f) Designing State-machines based architecture
g) Architecture of basic building blocks, adders, multipliers, shifters

8. Topics covered in the Course and Level of Coverage	
1. Reconfigurable Computing and FPGA architecture	2 hrs
2. High-level digital design methodology using Verilog HDL, Design, Implementation, and Verification	6 hrs.
3. SoC Architecture and Design Flow	3 hrs.
4. Application requiring HW implementation, Floating-Point to Fixed-Point Conversion	6 hrs.
5. Algorithm mapping onto Hardware using KPN, DFG and hardware synthesis	3 hrs.
6. Architectures for Basic Building Blocks, Adder, Compression Trees, and Multipliers	6 hrs.
7. Transformation for high-speed using pipelining, retiming, and parallel processing	3 hrs.
8. Dedicated Fully Parallel Architecture, Time shared Architecture, Hardwired State Machine based	4 hrs.
9. Design, Micro Program State Machine based Design	3 hrs.
10. Review • **Review of important concepts before Midterm** • **Review of important concepts before Final Exam** • **Addressing student's queries**	2 hrs.

9. Lab Experiments	
Lab 01	Xilinx ISE 101: Implementation of Seven Segment Display Decoder on FPGA board
Lab 02	Functional Simulation of Combinational blocks (Adders, Subtractor) using Xilinx ISE Simulator
Lab 03	Implementation of Sequential blocks (Counters and Clock Dividers) using Verilog HDL
Lab 04	Use Time-Multiplexing to display Hexadecimal numbers of Seven Segment Display Units on Nexys 3 FPGA Board

Lab 05	RISC 101: ALU Based RISC Processor implemented on Spartan 6
Lab 06	Integrating Peripherals with FPGA Board: Controlling VGA Display using Push Buttons
Lab 07	Open-ended Lab Session –I, Lab Mid **(CLO-5)**
Lab 08	Fixed Point Multiplier Implementation and Area/Speed Analysis using XILINX
Lab 09	Implementation of a parking meter on Spartan 6
Lab 10	String Matcher using FSM
Lab 11	Microprogrammed Processor design inclusive of control flow instructions
Lab 12	Pipelining and IP Core Generation
Lab 13	Open-ended Lab Session-II, Lab Final **(CLO-5)**
Lab 14	Implementation of filters FIR and IIR filters on FPGA
Lab 15	Introduction to ZEDBOARDS
Lab 16	Lab Final and Project (**CLO-5)**

10. Course Learning Outcome (CLOs)

		PLOs	Learning Level
CLO 1	**Implement** basic building blocks of digital systems using HDL VERILOG on FPGAs	PLO 5	C3
CLO 2	**Review** the architecture of basic building blocks of a digital design	PLO 1	C2
CLO 3	**Design** effective mapping of software algorithms/ applications on dedicated application specific hardware	PLO 3	C3
CLO 4	**Design** and **implement** micro-coded state machine for application specific design problems	PLO 3	C5

CLO 5	**Design** a digital system for solving open ended lab sessions and end term projects	PLO 2	P4

11. Mapping of Topics	**CLO**	**Chapter(s)**
1. Reconfigurable Computing and FPGA architecture		
2. High-level digital design methodology using Verilog HDL, Design, Implementation, and Verification	CLO-1	Dr Shoab A. Khan: Chapter 2 **Introduction to Digital System Design:** Introduction to FPGA and HDL Design
3. System on Chip: Basic Blocks and Design Flow	CLO-1	System on Chip: Design and Modelling Lecture Notes by Dr. David J Greaves (Cambridge)
4. Application requiring HW implementation, Floating-Point to Fixed-Point Conversion	CLO-3	Dr Shoab A. Khan: Chapter 3 **Introduction to Digital System Design:** Numeral Systems and Binary Arithmetic
5. Algorithm mapping onto Hardware using KPN, DFG and hardware synthesis	CLO-3	Dr Shoab A. Khan: Chapter 4
6. Architectures for Basic Building Blocks, Adder, Compression Trees, and Multipliers	CLO-2	Dr Shoab A. Khan: Chapter 5
7. Transformation for high speed using pipelining, retiming, and parallel processing	CLO-3	Dr Shoab A. Khan: Chapter 6
8. Dedicated Fully Parallel Architecture, Time shared Architecture, Hardwired State Machine based	CLO-3	Dr Shoab A. Khan: Chapter 9 **Introduction to Digital System Design:** Sequential Networks as Finite State Machines
9. Design, Micro Program State Machine based Design	CLO-4	Dr Shoab A. Khan: Chapter 10

12. Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
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13. Grading Policy	
Assignment Policy	In order to develop comprehensive understanding of the subject, assignments will be given. Late assignments will not be accepted / graded. All assignments will count towards the total (No 'best-of' policy). The students are advised to do the assignment themselves. Copying of assignments is highly discouraged and violations will be dealt with severely by referring any occurrences to the disciplinary committee. The questions in the assignment are meant to be challenging to give students confidence and extensive knowledge about the subject matter and enable them to prepare for the exams.
Plagiarism	NUST CEME maintains a **zero tolerance** policy towards plagiarism. While collaboration in this course is highly encouraged, you must ensure that you do not claim other people's work/ ideas as your own. Plagiarism occurs when the words, ideas, assertions, theories, figures, images, programming codes of others are presented as your own work. You must cite and acknowledge all sources of information in your assignments. Failing to comply with the NUST CEME plagiarism policy will lead to strict penalties including zero marks in assignments and referral to the academic coordination office for disciplinary action.

DEPARTMENT OF ENGINEERING MANAGEMENT
College of Electrical and Mechanical Engineering (CEME)
National University of Sciences and Technology (NUST)

1. Course Information

Course Number and Title:	MGT-271 Entrepreneurship
Credits:	02
Instructor(s)-in-charge:	Asst Prof Dr Syed M Ali
Course type:	Lectures
Required or Elective:	Required
Course pre-requisites	Nil
Degree and Semester	DE-40 Semester 8
Month and Year	Spring 2022

2. Course Schedule

Lecture:	2 hrs/week, Meets once in a week
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	4 hrs/week
Office Hours :	4 hrs/week by instructor

3. Course Assessment

Exam:	2 Sessional and 1 Final	
Home work:	02 Assignments	
Design reports:	1 project report based on Semester Project	
Quizzes:	4 Quizzes	
Grading:	Quizzes:	10%
	Assignments:	10%
	2 One Hour Tests (OHTs):	30%
	Final Exam:	50%

4. Course book and Related Course Material

Textbooks:	1. Entreprenuership 8th or 10th edition by Robert D.Hisrich, M.P.Peters & D.A.Shepherd
Reference Books:	1. Entrepreneurship, Second Edition, by William Bygrave & Andrew Zacharakis, Wiley

5. Catalog Descriptions

This course provides an introduction to the principles of entrepreneurship. Topics include self-analysis of entrepreneurship readiness, the role of the entrepreneur in economic development, sources of financing, budgeting, and cash flow. Upon completion, students should have an understanding of the entrepreneurial process and issues faced by entrepreneurs, identifying problems and opportunities, creative business problem-solving ideas, developing a viable business plan/model, and entrepreneurial significance.

6. Course Objectives

a Understand the importance of Entrepreneurship in society

b Ability to generate ideas for new venture/business

c Development of Business Model/Plan

d Promotion/Marketing Strategies of new venture

e Understand the importance of opportunity recognition and internal and external analyses to the success of a business venture.

f Understand the components and importance of the business plan to entrepreneurial venture development and sustainability.

g Understand the importance of the marketing plan to obtaining, maintaining and expanding an entrepreneur's reach to its target market.

7. Topics covered in the Course and Level of Coverage

• Cultivating the Entrepreneurial Mind-set
  • What are the key ingredients that drive success in entrepreneurial companies?
  • How do entrepreneurs capitalize on new ideas and bring them to market?
	2hrs

• Recognizing & Shaping Opportunities
  • Understand the process entrepreneurs use to generate ideas for new businesses and shape them into opportunities supported by a business model.
  • Compare examples of how entrepreneurs have navigated the process of recognizing and shaping opportunities.
  • Understand the difference between intuitive and analytical thinking and the role of each in recognizing and shaping opportunities.
  • Article: The Questions Every Entrepreneur Must Answer
	2hrs

• Building Business Models
  • An innovative product may be a feat of engineering, but that does not automatically turn it into a commercial success. What makes the difference between success in the lab and success in the marketplace is the business model.
  • How will you create and deliver value for your customers?
  • How will you extract some of that value for your organization?
  • Article: Analyzing New Venture Opportunities
	2hrs

• Building Business Models
  • Guest Talks
  • In Class Business Model Workshop facilitated by Mentors
  • In Class Activity: Build & present a Business Model of your $10 Business Idea
	2hrs

• Business Plan & Pitching Opportunities/ Coaching
  • Understand how to develop an investor pitch/pitch deck.
  • Creating a succinct powerful pitch for a new business plan how to practice and present that pitch so that it conveys the opportunity to different stakeholders.
	2hrs

• Experimenting in the entrepreneurial venture (Lean startup)
  • Firms that follow a hypothesis-driven approach to evaluating entrepreneurial opportunity are called "lean startups."
  • Entrepreneurs in these startups translate their vision into falsifiable business model hypotheses, then test the hypotheses using a series of "minimum viable products," each of which represents the smallest set of features/activities needed to rigorously validate a concept.
  • Based on test feedback, entrepreneurs must then decide whether to persevere with their business model, "pivot" by changing some model elements, or abandon the start up.
	2hrs

• Attracting Talent & Building Ecosystems
  • Understand the opportunities and trade-offs associated with attracting talent in a new venture - including co-founders, employees, and boards of directors and advisors
  • Learn how to build a business network, or "ecosystem," of customers, suppliers, partners, and evangelists needed to develop products and get them to market.
  • Understand how to use outside resources such as incubators and accelerators effectively.
	2hrs

• Start-up Landscape in Pakistan
  • Visit to TIC
  • Guest Talks
  • What is incubation? Role of technology incubators in entrepreneurship, opportunities for products and services beyond technology, Accelerators & Projects
	2hrs

• Financing Entrepreneurial Ventures
  • Guest Talks
  • Describe the intimate connection between business models and the financing needs of ventures
  • Provide an overview of the entrepreneurial finance landscape and the traits of various financiers
  • Identify for students critical issues in their financing choices, such as whether VC investment aligns with their personal motivations
  • Impart tools that students can use as they contemplate the external financing of their ventures
  • Article: Bootstrap Finance and the Art of Start-ups
	2hrs

• Selling & Marketing in the Entrepreneurial Venture/ Go to Market Plan
  • Understand the factors that influence customers to adopt a new product or service offered by a venture
  • Learn how to select potential customers for visits, conduct the visits, and use insights from the visits to refine a venture's offering
  • Gain familiarity with a process for defining a venture's core customers
  • Article: Growing Ventures Can Anticipate Marketing Stages Case: Zipcar
	2hrs

• Intellectual Property
  • Guest Talks
  • Understand the different types of intellectual property rights available to a startup and how they can be used to protect the business against competitors
	2hrs

• Opportunities & Challenges in Digital Innovations
  • Understand how digital innovations have transformed the market landscape.
  • Realize the importance of staying up to date with digital innovations, analyzing how these affect your startup and taking necessary actions to stay
	2hrs

• Exit Strategy
  • Understand the different types of exits options available to the entrepreneur, the pros and cons of each option and how to choose amongst them.
  • Case: Facebook & Whatsapp: Acquire or Ally?
	2hrs

• Final Presentations/ Industry Representative Session	1hrs

8. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		PLOs	Learning Level
CLO 1	Prepare the business model/plan.	PLO 9	C3
CLO 2	Understand the business environment and describe the factors leading to green innovation.	PLO 7	C2

9. Program Learning Outcomes

PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and
	environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**

	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

5. Course Information	
Course Number and Title:	EC-431 Digital Communications
Credits:	3 (2+1)
Instructor(s)-in-charge:	Dr. Rizwan Masood
Course type:	Lecture + Lab
Required or Elective:	Required
Course pre-requisites	Signals and Systems, Probability & Statistics
Degree and Semester	DE-40-CE; 8th semester
Month and Year	Spring 2022

2. Catalogue Descriptions
This course provides a comprehensive introduction to basic principles and techniques of digital communication. The course is focused on numerous topics from the paradigm of digital communication including Analog to digital conversion, PCM, baseband transmission, power spectrum density analysis, inter-symbol interference, matched filters, noise analysis, digital modulation, coherent and non-coherent detections. Laboratory work is based on simulations in MATLAB.

3.Course Schedule	
Lecture:	2 hrs/week, Meet once weekly
Lab:	3 hrs/week, Meet once weekly
Office Hours :	1 hrs/week by instructor, 3 hrs/week by lab engineer

4.Course Assessment		
Exam:	2 Sessional and 1 Final	
Home work:	2 Assignments	
Lab reports:	10 reports	
Design Project:	1	
Quizzes:	3 Quizzes	
Grading:	Quizzes:	6.67%

	Assignments:	3.33%
	2 One Hour Tests (OHTs):	20%
	Final Exam:	26.67%
	Lab:	33.33%
	Semester Project:	10%

5.**Course book and Related Course Material**	
Textbooks:	1. Digital Communication by Bernard Sklar
Reference Books:	1. Digital Communication Systems by Simon Haykin 2. Modern Analog and Digital Communications by B P Lathi

6.**Topics covered in the Course and Level of Coverage**	
Contents	Timeline (Weeks)
1. **Digital Communications Basic Blocks, Introduction, Revision of Basic DSP Concepts**	1-2
2. **Sampling Theorem, Aliasing, Over Sampling, Sampling and Quantizing effects, Channel effects, Signal to Noise Ratio**	3
3. **Random Variables and Random Processes**	4-5
4. **Conversion of analog signals to digital signals, Pulse Code Modulation, Uniform and Non Uniform Quantization, Companding**	6-7
5. **PCM waveform types, Line Coding, Correlative Coding, duo-binary coding and decoding, precoding**	8
6. **Inter symbol Interference, Pulse shaping to reduce ISI, Error Performance, Eye Patterns**	9-10
7. **M-ary Pulse Modulation and Demodulation, Matched Filter, Optimum Detection**	11-12
8. **Error Performance, Degradation in Digital Communication Systems, Fading Channels**	13

9. **Synchronization, Channel Estimation and Channel Equalization**	14
10. **Basics of OFDM System**	15
11. **Basics of Channel Coding Techniques**	16

7. Lab Experiments	
Lab 01	MATLAB Basics for Communication System Design
Lab 02	Communication Signals: Generation and Interpretation
Lab 03	Communication Signals: Signal Operations
Lab 04	Communication Signals: Sampling Theorem and Aliasing
Lab 05	Simulation of a Simple Communication System in MATLAB
Lab 06	Calculation of Bit Error Rate in a Simple Communication System
Lab 07	Generation of Bit Streams for Different Line Codes
Lab 08	Calculating PSD Estimates of Different Line Codes
Lab 09	Plotting the Constellation Diagram for 8-PSK using Natural Mapping
Lab 10	Plotting the Constellation Diagram for 8-PSK using Gray Mapping
Lab 11	Plotting the Constellation Diagram for 16-PSK using Natural Mapping
Lab 12	Plotting the Constellation Diagram for 16-PSK using Gray Mapping
Lab 13	Lab Mid
Lab 14	Open Lab
Lab 15	Lab Final

8.Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)			
Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**
CLO 1	Understand the basic functionality of a digital communication system (transmitter block, receiver block, channel)	1	C2
CLO 2	Demonstrate knowledge about digital modulation, coding techniques and synchronization	1	C3
CLO 3	Analyze the performance of a given system over AWGN as well as fading channels	2	C4
CLO 4	Design and develop a complete digital communication system using a given set of requirements (ab Work)	3	P4

9. Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and
	environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**

	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)
National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	EC-434 Cloud Computing
Credits:	3 (2+1)
Instructor(s)-in-charge:	Dr. Rizwan Masood
Assisting Lab Instructor	Syed Abubakar Bukhari
Course type:	Lecture + Lab
Required or Elective:	Elective
Course pre-requisites	None
Degree and Semester	DE-39-CE; 8th semester
Month and Year	Spring 2021

2. Course Schedule	
Lecture:	2 hrs/week, Meets once weekly
Lab:	4 hrs/week, Meets once in a week
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	3 hrs/week
Office Hours :	3 hrs/week by instructor, 3 hrs/week by teaching assistant/lab engineer

3. Course Assessment			
Exam:	1 Final		
Home work:	3 graded Assignments		
Quizzes:	2 Quizzes (3 taken- Best 2 out of 3 considered in grading)		
Grading:	**Theory (67%)**		**Lab (33%)**
	Quizzes:	10%	30% Lab submissions + 70% Final Exam.
	Assignments	20%	
	Final Exam.	70%	

4. Course book and Related Course Material	
Textbooks:	1. "Cloud Computing Concepts, Technology & Architecture", Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, Prentice Hall, 2013 (Reprint: 2019).

	2. "Cloud Computing", Sandeep Bhowmik, Cambridge University Press, 2017.
Reference Books:	1. Cloud Computing, Theory and Practice, Dan C. Marinescu, Morgan Kauffmann Publishers, 2nd Edition. 2. "Distributed and Cloud Computing: Clusters, Grids, Clouds, and the Future Internet", Kai Hwang, Jack Dongarra & Geoffrey C. Fox.
Web Resources:	https://docs.micrsosoft.com/en-us/azure/ https://docs.aws.amazon.com/ https://support.huawei.com/enterprise/en/doc

5. Catalogue Descriptions

Cloud Computing is a large-scale, distributed paradigm that comprises a pool of virtualized platforms offering computing power, storage, hosting and other services. It is an abstracted and wide scalable technology which offers services on demand, over a network (usually internet). In contrast to other conventional technologies, cloud computing offers distributed resources which are rented or leased, instead of owned e.g., as a utility by the end user. This greatly reduces the superfluous capital required for infrastructure buildup and provides several benefits, by globally utilizing and sharing IT resources for the mutual cause. It has become a key-enabling technology for various information technology (IT) paradigms over the past years, and it aims a future in which we would not be computing on local computers, but on centralized facilities operated by third-party companies offering computing and storage utilities on demand.

This course will primarily focus on a detailed overview of the technology of the cloud, along with the evolution of the internet to support the cloud, from basics to a bit advanced level. The course will provide students with an overview of the field of cloud computing, along with the architecture of stateof-the-art client systems. The course will also present a thorough understanding of fundamental concepts and models of the cloud, the key-enabling technologies, architecture of modern cloud data centers, cloud security, infrastructure mechanisms and other associated technologies.

6. Course Objectives

This course is designed for undergraduate students with a background in Computer /Software engineering and/or IT. Successful students of this course will possess sound knowledge of cloud computing systems and various underlying principles. They would be able to implement the nomenclature and learned technology to design, implement, deploy, and manage innovative solutions on public/private clouds. Good skills of object-oriented programming will also be helpful in gaining hands-on experience for this course.

7. Topics covered in the Course and Level of Coverage

Topic/Subject	Timeline
Introduction to Cloud Computing 1. Fundamentals, Basic Concepts and Terminology Cloud, IT Resource, Cloud Consumers and Cloud Providers, Scaling, Cloud Service, Cloud Service Consumer 2. Technology Innovations - Clustering, Grid Computing, Virtualization 3. Goals and Benefits - Reduced Investments and Proportional Costs - Increased Scalability - Increased Availability and Reliability 4. Risks and Challenges - Increased Security Vulnerabilities - Reduced Operational Governance Control - Limited Portability Between Cloud Providers - Multi-Regional Compliance and Legal Issues 5. Ethical Issues in Cloud Computing 6. Cloud Vulnerabilities	Week 1-3
Fundamental Concepts and Models 1. Roles and Boundaries 2. Cloud Characteristics - On-Demand Usage - Ubiquitous Access - Multitenancy (and Resource Pooling) - Elasticity - Measured Usage - Resiliency	Week 4-6
3. Cloud Main Delivery Models -The SPI Model - Infrastructure-as-a-Service (IaaS) - Platform-as-a-Service (PaaS) - Software-as-a-Service (SaaS) - Comparing Cloud Delivery Models - Combining Cloud Delivery Models o IaaS + PaaS o IaaS + PaaS + SaaS 4. Other Category of Cloud Service Models (XaaS) - Security Management-as-a-Service, IDaaS, Storage-as-a-Service, DBaaS, BaaS, CaaS, DaaS, MaaS 5. Cloud Deployment Models ▪ Public Clouds - Community Clouds - Private Clouds - Hybrid Clouds - Other Cloud Deployment Models	

Cloud-Enabling Technology 1. Broadband Networks and Internet Architecture ▯ Internet Service Providers (ISPs), Connectionless Packet Switching (Datagram Networks), Router-Based Interconnectivity ▯ Physical Network, Transport Layer Protocol, Application Layer Protocol ▪ Connectivity Issues ▯ Network Bandwidth and Latency Issues ▯ Cloud Carrier and Cloud Provider Selection 2. Data Center Technology 3. (Modern) Virtualization Technology 4. Web Technology 5. Multitenant Technology 6. Containerization 7. Case Study -DTGOV Data Center Models	Week 7-10
Fundamental Cloud Security 1. Basic Terms and Concepts ▯ Confidentiality, Integrity, Authenticity, Threat, Vulnerability, Risk etc. 2. Threat Agents 3. Cloud Security Threats ▯ Traffic Eavesdropping ▯ Malicious Intermediary ▯ Denial of Service ▯ Virtualization Attack ▯ Container Attack 4. Security Policy Disparity and Risk Management	Week 11-13
Off-the-shelf (OTS) Cloud Service Solutions 1. Fundamentals of various OTS cloud services ▯ Salesforce.com and Force.com ▯ Eucalyptus, OpenNebula, Nebula, Nimbus, OpenStack, Apache VCL, Apache CloudStack, Enomaly ECP (Elastic Computing Platform) ▯ Microsoft Azure ▯ Amazon Web Services (AWS)	Week 14-16
Final Exam.	Week 17

8. Lab Experiments

Lab 01	Introduction to Cloud and Openstack
Lab 02	Openstack Installation
Lab 03	Openstack Component's GUI Overview; Identity (Keystone)
Lab 04	Manage Projects and Users using CLI
Lab 05	Openstack Image (Glance)
Lab 06	Openstack Neutron (Networking)
Lab 07	ACCESS CONTROL LIST (ACL in vlans)

Lab 08	Network Address Translation (Static NAT)
Lab 09	STANDARD NAMED ACL
Lab 10	Openstack Cinder Volume (Block Storage) 1
Lab 11	Openstack Cinder Volume (Block Storage) 2
Lab 12	Open Lab

9. **Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)**

Course Learning Outcome (CLOs)		PLOs	Learning Level
CLO 1	To identify the fundamental concepts and existing core technologies on which the cloud is built (e.g., clustering, grid computing, virtualization etc.)	PLO 1	C2
CLO 2	To understand the cloud delivery and deployment models. Summarize the core key-enabling technologies of contemporary modern-day clouds.	PLO 2	C4
CLO 3	To discover the fundamental cloud security concepts and threats/attacks common to public cloud environments. Highlight the various off-the-shelf (OTS) cloud technologies to provide IT solutions in specific runtime functions.	PLO 2	C4
CLO 4	To manipulate the learned cloud technology on commercial, or some standard cloud computing platform (such as OpenStack).	PLO5	P3

10. Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**

	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**

	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Science and Technology (NUST)

1. Course Information

Course Code and Title:	EC-460 Software Design and Testing
Credits:	3 (2+1)
Instructor(s)-in-charge:	Dr. Farooque Azam, LE Sundas Ashraf
Course type:	Lecture + Lab
Required or Elective:	Elective
Course pre-requisites	Object-Oriented Programming, Software Engineering
Degree and Semester	DCE-40, Semester 8
Month and Year	Spring 2022

2. Course Schedule

Lecture:	2 hrs/week, Meets once in a week
Lab:	3 hrs/week, Meets once in a week
Outside study:	8 hrs/week
Office Hours:	6 hrs/week by the instructor, 3 hrs/week by teaching assistant/lab engineer

3. Course Assessment

Exam:	1 Final	
Homework:	4 Assignments	
Lab reports:	10 reports	
Design Project:	1 Design project based on Lab	
Quizzes:	5 Quizzes	
Grading:	**Theory**	**66%**
	Quizzes:	10%
	4 Assignments:	10%
	OHTs:	30%
	Final Exam:	50%
	Lab	**34%**
	Lab Work	50%
	Lab Final	25%
	Project Report	15%
	Project Presentation	10%

4. Course book and Related Course Material	
Textbooks:	1. Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development, *Pearson; 3rd edition by Craig Larman* 2.Learning UML 2.0, from Russ Miles and Kim Hamilton, published by O'Reilly. ISBN: 978-0-596-00982-3 3.Software Testing: Principles and Practices, from Naresh Chauhan, published by Oxford University Press. ISBN 13: 978-0-198-06184-7
Video Tutorials:	**Papyrus**: https://www.youtube.com/watch?v=y7grsHY9Fa0&list=PLoWne5q-c9E_Q2_eAUZKPDA5K0V-O5zXs **JUNIT**: https://www.youtube.com/watch?v=09ZZiNgUPVU&list=PLqq-6Pq4lTTa4ad5JISViSb2FVG8Vwa4o&index=6 **Selenium**: https://www.youtube.com/watch?v=zylSll8hsPs
Reference Books:	1.Introduction to Software Engineering Design: Processes, Principles and Patterns with UML2, Christopher Fox, Addison-Wesley Professional

5. Catalog Descriptions

The course is about introduction to design methods, generic design processes, and languages to develop ICT systems with an emphasis on communication between system components. The main topics are: -
- Analysis of design models for detection of realizability problems (implied scenarios) at an early specification level.
- Design of systems according to user requirements and use cases.
- Various GRASP Patterns
- Fundamentals of software testing techniques for SDLC.
- Testing Frameworks like JUnit and Selenium.

6. Course Objectives

b. Classify different types of requirements and explain the main activities during requirements development, explain the utilization of use case diagrams during the requirement engineering phase.
c. Recognize design (modeling) elements in UML, properly explain their semantics, and correctly map them to program code. This comprises sequence, state machine, and activity diagrams among others.
d. Write project deliverables that describe software system design, properties, and solutions.
e. Plan and coordinate the development of larger software products (consisting of more than one single application) within a team of developers.
f. Make proper design choices for the system and document them accordingly.
g. Understand the principles and practices of software testing with an emphasis on automated testing techniques.

Contact Hrs	Topics Covered

	• **Introduction [1]**
	  ○ Course overview
	  ○ Introduction to OOA&D
	  ○ Introduction to Agile Practices
	  ○ Introduction to the Case Studies (ch3)

	• **Identifying Functional Requirements [1,2]**
	  ○ Specifying Functional requirements in three (Brief, Casual, Fully Dresses) Use Case formats (ch6)
	  ○ Introduction to various notations of Use case diagrams (ch2)

	• **Identifying Other Requirements [1] (ch7)**
	  ○ Developing Vision Document
	  ○ Developing Supplementary Requirements
	  ○ Developing Glossary

	• **Developing Domain Models [1] (10-12)**
	  ○ Visualizing Concepts
	  ○ Adding Associations
	  ○ Adding Attributes
	  ○ Semantics of Class and Object Diagram

	• **Modeling Behaviors [1,2]**
	  ○ Specifying Use Cases with Activity Diagram
	  ○ Specifying Use Cases with System Sequence Diagram
	  ○ UML Interaction Diagrams Semantics

	• **Logical Architecture**
	  ○ N+1 Software Architecture
	  ○ Documenting Software Architecture

	• GRASP Patterns [1]
	• GRASP Patterns [2]
	Software Testing • Testing Techniques and Tools
	Software Testing • Testing Techniques and Tools
	Software Testing **Unit Testing** [Craftsman's Approach]: • Boundary Value Testing • Equivalence Class Testing • Decision Table Based Testing • Code Based Testing • Testing OO Software
	Software Testing Selenium Framework • Selenium IDE
	Software Testing Selenium Framework • Selenium WebDriver
	Software Testing Selenium Framework • Selenium Grid
	Course Review

8. Lab Experiments

Lab 01	**Lab Assignment on:** • Learning to Install UML Modeling Tool • Brief Introduction to UML Modeling Environment
Lab 02	**Lab Assignment on:** • Writing Use Cases in three (Brief, Casual, Fully Dresses) formats • Developing Use Case Model in UML Tool
Lab 03	**Lab Assignment on:** • Developing Vision Document • Developing Supplementary Requirements • Developing Glossary
Lab 04	**Lab Assignment on:** • Developing domain models with UML Class Diagram in Papyrus • Developing Object diagrams from classes • Generating Java Code from with Acceleo Plugin
Lab 05	**Lab Assignment on:** • Specifying Use Cases with Activity Diagram • Specifying Use Cases with System Sequence Diagram • Modeling behavior with Communication Diagram
Lab 06	**Lab Assignment on:** Refreshing Java OOP Concepts
Lab 07	**Lab Assignment on:** • Lab on Controller Principal/Pattern using Java Swing Lab on designing a GUI behavior with State Machine Diagram
Lab 08	**Lab Assignment on:** • Lab on Controller Principal/Pattern using Java Swing Lab on designing a GUI behavior with State Machine
Lab 09	Lab on Unit Testing (JUnit) on Monopoly Case Study and Code Coverage
Lab 10	Lab on using Selenium IDE
Lab 11	Lab Final
Lab 12	Presentations
Lab 13	Open Lab

9. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**
CLO 1	Be able to *Understand* various modeling *notations* and *concepts* in software development activities.	PLO 1 Engineering Knowledge	C2
CLO 2	Be able to *Apply* (develop) various artifacts commonly used during *Unified Software development Process*.	PLO 3 Design / Dev of Solutions	C3
CLO 3	Be able to *Understand* object-oriented analysis & design (OOA&D)	PLO 2	C2

	techniques and their roles in large-scale software systems.	Problem Analysis	
CLO 4	Work individually as well as in a team to *justify their choices of the* software design principles to the assigned tasks.	PLO 9 Individual and Teamwork	A2
Lab outcomes			
CLO 5	Extensive knowledge about one tool at least and being able to effectively use it.	PLO 5 Modern Tool Usage	P3
CLO 6	Be able to write project deliverables that describe system requirements, properties, and solutions	PLO 10 Communication	A3

10. Program Learning Outcomes

PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and

	technological developments

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	OHS 101 Occupational Health and Safety
Credits:	1-0
Instructor(s)-in-charge:	Dr. Shahbaz Abbas
Course type:	Lecture
Required or Elective:	Required
Course pre-requisites	None
Degree and Semester	DE-43, Semester 2
Month and Year	Spring 2022

2. Course Schedule	
Lecture:	1 hrs/week, Meets once weekly
Lab:	-
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	-
Office Hours :	1 hrs/week by instructor

3. Course Assessment		
Exam:	2 Sessional and 1 Final	
Home work:	01 Assignment	
Design reports:	1 project presentation (Major assignment)	
Quizzes:	2 Quizzes	
Grading:	Quizzes:	10%
	Assignments:	10%
	2 One Hour Tests (OHTs):	30%
	Final Exam:	50%

4. Course book and Related Course Material	
Textbooks:	1. The A-Z of health and safety by Jeremy Stranks, 2006.

	2. The Manager's Guide to Health & Safety at Work by Jeremy Stranks, 8th edition, 2006.
Reference Books:	**9.** Occupational safety and health law handbook by Ogletree, Deakins, Nash, Smoak and Stewarts, second edition, 2008.

5. Catalog Descriptions

This course introduces the student to the study of workplace occupational health and safety. The student will learn safe work practices in offices, industry and construction as well as how to identify and prevent or correct problems associated with occupational safety and health in these locations as well as in the home.

6. Course Objectives

The main objectives of this course are to

a) Identify hazards in the home, laboratory and workplace that pose a danger or threat to their safety or health, or that of others.

b) Control unsafe or unhealthy hazards and propose methods to eliminate the hazard.

c) Present a coherent analysis of a potential safety or health hazard both verbally and in writing, citing the Ontario Occupational Health and Safety Regulations as well as supported legislation.

d) Demonstrate a comprehension of the changes created by WHMIS and OSHA legislation in everyday life.

7. Topics covered in the Course and Level of Coverage

1. Introduction to OHS **a) Nature and scope of health and safety** **b) Reasons/benefits and barriers for good practices of health and safety** c) **Legal frame work and OHS Management System**	2 hrs
2. Fostering a Safety Culture **a) Four principles of safety- RAMP (Recognize, Assess, Minimize, Prepare)** **b) Re-thinking safety-learning from incidents** **c) Safety ethics and rules** **d) Roles and responsibilities towards safety** **e) Building positive attitude towards safety** f) **Safety cultures in academic institutions**	2 hrs

3. Recognizing and Communicating Hazards **a) Hazards and Risk** **b) Types of hazards: Physical (mechanical and non-mechanical), Chemical (Toxic and biological agents), electrical, fire, construction, heat and temperature, noise and vibration, falling and lifting etc.** c) **Learning the language of safety: Signs, symbols and labels**	2 hrs
4. Accidents & Their Effect on Industry **a) Costs of accidents** **b) Time lost** **c) Work injuries, parts of the body injured on the job** **d) Chemical burn injuries** **e) Construction injuries** f) **Fire injuries**	2 hrs
5. Assessing and Minimizing the Risks from Hazards **a) Risk Concept and Terminology** **b) Risk assessment procedure** **c) Risk Metric's** **d) Risk Estimation and Acceptability Criteria** **e) Principles of risk prevention** **f) Selection and implementation of appropriate Risk controls** g) **Hierarchy of controls**	2 hrs
6. Preparing for Emergency Response Procedures **a) Fire** **b) Chemical Spill** **c) First Aid** **d) Safety Drills / Trainings:** **e) Firefighting** **f) Evacuation in case of emergency**	2 hrs
7. Stress and Safety at Work Environment **a) Workplace stress and sources** **b) Human reaction to workplace stress** **c) Measurement of workplace stress** **d) Shift work, stress and safety** **e) Improving safety by reducing stress** **f) Stress in safety managers** **g) Stress and workers' compensation**	2 hrs

8. Incident Investigation **a) Importance of investigation** **b) Recording and reporting** **c) Techniques of investigation** **d) Monitoring** **e) Review** **f) Auditing Health and Safety**	2 hrs

8. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		PLOs	Learning Level
CLO 1	Understand the significance of health and safety in industry	PLO 6	C2
CLO 2	Comprehend the importance of work practices on sustainable development considering health and safety	PLO 7	C3

9. Program Learning Outcomes

PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**

	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and
	environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEME)

National University of Sciences and Technology (NUST)

1. Course Information	
Course Number and Title:	EC-360 Software Engineering
Credits:	3
Instructor(s)-in-charge:	Assistant Professor Dr Wasi Haider Butt
Course type:	Lecture
Required or Elective:	Required
Course pre-requisites	
Degree and Semester	DCE-41, Semester 7
Month and Year	Fall 2022

2. Course Schedule	
Lecture:	3 hrs/week, Twice weekly
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	3 hrs/week
Office Hours :	3 hrs/week by instructor

3. Course Assessment		
Exam:	1 Midterm and 1 Final	
Home work:	3 Assignments	
Design reports:	1 Design report based on Semester Project	
Quizzes:	6 Quizzes	
Grading:	Quizzes:	10%
	Projects + Assignments:	10%
	Midterm Eam:	30%
	Final Exam:	50%

4. Course book and Related Course Material	
Textbooks:	2. Software Engineering by Ian Sommerville, Latest Edition
Reference Books:	**10.** Object Oriented Analysis and Design by Grady Booch, Latest Edition **11.** Applying UML and Patterns.", Craig Larman, Latest Edition

5. Catalog Descriptions

This course is aimed at helping students build up an understanding of how to develop a software system from scratch by guiding them through the development process and giving them the fundamental principles of system development with object oriented technology using UML. The course will initiate students to the different software process models, software requirements engineering process, software architecture and design, systems analysis and design as a problem-solving activity, key elements of analysis and design, and the place of the analysis and design phases within the system development life cycle.

6. Course Objectives

The Main objectives of the course includes delivering students: -

•Knowledge of basic software engineering methods and practices, and their appropriate application.

•A general understanding of software process models such as the waterfall, evolutionary and agile models like extreme programming and scrum.

•An understanding of software requirements and the SRS document.

An understanding of object oriented analysis and design and UML.

•An understanding of implementation issues such as modularity and coding standards.

•An understanding of software testing approaches such as unit testing and integration testing.

•An understanding of software risk analysis and management.

7. Topics covered in the Course and Level of Coverage	
• **Intro & Basic concepts of SW Engineering.**	6 Hrs
• **Decomposition and Abstraction**	2 Hrs
• **Software development Process**	4 Hrs
• **Software Development Process Models**	6 Hrs
• **Agile software development**	4 Hrs
• **Requirement Engineering**	6 Hrs
• **Software Architecture and Design**	4 Hrs
• **Implementation and Coding Standards**	4 Hrs
• **Software testing**	6 Hrs
• **Debugging**	2 Hrs
• **Software maintenance**	2 Hrs
• **Risk Analysis**	2 Hrs

8. Course Outcomes and their Relation to Program Outcomes

(Mapping CLO to PLO)

Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**
CLO 1	Design a software development strategy and select appropriate software development for any given software project	PLO 11	C3
CLO 2	Understand ethical obligations while developing a software for a client organization	PLO 8	C2
CLO 3	Keep updated with new trends in software development methodologies	PLO 12	A4

9. Program Learning Outcomes	
PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
	An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO 3	**Design/Development of Solutions**
	An ability to 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.
PLO 4	**Investigation**
	An ability to investigate complex engineering problems in a methodical way including literature

	survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
PLO 5	**Modern Tool Usage**
	An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
PLO 6	**The Engineer and Society**
	An ability to 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 solution to complex engineering problems.
PLO 7	**Environment and Sustainability**
	An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PLO 8	**Professional Ethics**
	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO 9	**Individual and Teamwork**
	An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
PLO 10	**Communication**
	An ability to communicate effectively, orally as well as in writing, 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.
PLO 11	**Project Management**
	An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments

DEPARTMENT OF COMPUTER ENGINEERING

College of Electrical and Mechanical Engineering (CEM

National University of Sciences and Technology (NUST

1. Course Information	
Course Number and Title:	EC-303 Mobile Application Development for SMEs
Credits:	3 (2+1)
Instructor(s)-in-charge:	Ali Saeed / LE Kashaf
Course type:	Lecture + Lab
Required or Elective:	Elective
Course pre-requisites	None
Degree and Semester	DE-41, Semester 8
Month and Year	Spring 2023

2. Course Schedule	
Lecture:	2 hrs/week, Meets once weekly
Lab:	3 hrs/week, Meets once in a week
Discussion:	1 hr/discussion, multiple discussion sections offered per quarter
Outside study:	3 hrs/week
Office Hours :	3 hrs/week by instructor, 3 hrs/week by teaching assistant/lab engineer

3. Course Assessment				
Exam:	1 Mid and 1 Final			
Homework:	3 graded Assignments, 02-04 home tasks (non-graded)			
Lab reports:	13-14 reports, 01 open Lab, 01 Lab Final			
Design reports:	1 Design report and 1 presentation based on Semester Project			
Quizzes:	6-8 Quizzes			
Grading:	Theory (67%)		Lab (33%)	
	01 Mid	30%	Lab Work/Tasks (Every week)	45%
			Open Lab	10%
	Quizzes:	10%	Lab Final	10%
	Assignments	10%	Home Tasks	05%
	Final Exam	50%	Final Project	30%
Plagiarism Policy	Any work (Assignment, Projects, labs etc) if found copied, will have strict penalties			

4. Course book and Related Course Material	
Textbooks:	10. Flutter In Action, by Eric Windmill, 1st Edition, 2019
Reference Books:	• Dart for Absolute Beginners by David Kopec • Flutter Recipes – Mobile Development Solutions for iOS and Android by Fu Cheng • http://www.dart-tutorial.com/

5. Catalog Descriptions

The objective of mobile development is creating applications and any other kind of software specific to mobile devices, including tablets. Mobile development seeks to optimize functionality and user experience on mobile devices, as there are important differences between mobile and desktop UX. This course aims to introduce students to the following concepts and cognitive skills.

6. Course Objectives

The main objectives of this course are

a. **To provide a comprehensive presentation of the fundamentals of mobile application development and analysis both from a theoretical as well as practical point of view.**
b. **To make students understand basics of dart, flutter and framework.**
c. **To introduce the students to the use of components and integration.**
d. **To provide broader understanding of state management.**
e. **To give them an idea about data consumption from several sources.**
f. **To enable students to implement all theoretical information gained during the lectures in flutter using visual code.**

7. Topics covered in the Course and Level of Coverage

1. Introduction to dart **a. Basics of dart programming** **b. Datatypes & Operators** **c. User Input and Strings**	1 hrs
2. Conditions and Loops **a. Foreach Loops** **b. Ternary Operator** **c. Exception Handling**	2 hrs

3. Functions in Dart **a. Functions and Anonymous Functions in dart** **b. Parameters (optional and required)** **c. Arrow Function** **d. Scope and Math**	2 hrs
4. Collections **a. List** **b. Set** **c. Map**	2 hrs
5. File Handling **a. Read, Write and Delete Files** **b. Append Data**	2 hrs
6. OOP in Dart **a. Constructors** **b. Encapsulation, Inheritance, Polymorphism** **c. Enums, Interface, Mixins** **d. Generics**	3 hrs
7. Null Safety in dart **a. Null Safety** **b. Type Promotion** **c. Late Keyword**	2 hrs
8. Asynchronous Programming **a. Async and Await in dart** **b. Future in dart** **c. Streams in dart**	2 hrs
9. Flutter Basics **a. Default template try out and environment understanding** **b. Run and debug on browser with dev tools**	2 hrs
10. Widgets Basics **a. Basic concepts of Widgets** **b. Building Widget tree** **c. Stateless and Stateful Widgets**	2 hrs
11. Widgets, Styling and Adding Logic **a. Aligning Rows and Columns** **b. Mapping data into widgets**	2 hrs

c. String Interpolation	
12. Responsive Adaptive User Interfaces and Apps a. Layout Builders b. Responsiveness c. Media Query	2 hrs
13. Navigation and Multiple Screens d. Linear Gradients e. Named Routes	1 hr
14. State Management a. Adding Navigation to the app b. Providers and Listeners c. Local vs App-wide State	2 hrs
15. Working with User Input & Forms	1 hr
16. Sending HTTP Requests a. Use of HTTP libraries b. Use of Futures to create synchronous and asynchronous communications	2 hrs
17. Adding User Authentication	2 hrs

8. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		**PLOs**	**Learning Level**
CLO 1	**Understand** Mobile Application Development fundamentals and flow on multiple devices.	PLO 1	C2
CLO 2	**Develop** Mobile Application using basic functionality, framework and packages and publish it.	PLO 3	C3
CLO 3	**Build rebuild** Mobile Application modules that uses software and hardware resources and evaluate functionality.	PLO 5	P3

9. Mapping of topics		**Chapter(s)**
1. Introduction to dart **a. Basics of dart programming** **b. Datatypes & Operators** **c. User Input and Strings**	CLO-1	Chapter 1 and 2 – Reference book 1
2. Conditions and Loops	CLO-2	Chapter 3 – Reference book 1

a. Foreach Loops **b. Ternary Operator** **c. Exception Handling**		
3. Functions in Dart **a. Functions and Anonymous Functions in dart** **b. Parameters (optional and required)** **c. Arrow Function** **d. Scope and Math**	CLO-2	Online Resources
4. Collections **a. List** **b. Set** **c. Map**	CLO-2	Chapter 5 – Reference book 1 Online Resources
5. File Handling **a. Read, Write and Delete Files** **b. Append Data**	CLO-2	Online Resources
6. OOP in Dart **a. Constructors** **b. Encapsulation, Inheritance, Polymorphism** **c. Enums, Interface, Mixins** **d. Generics**	CLO - 1 and 2	Online Resources
7. Null Safety in dart **a. Null Safety** **b. Type Promotion** **c. Late Keyword**	CLO – 1 and 2	Online Resources
8. Asynchronous Programming **a. Async and Await in dart** **b. Future in dart** **c. Streams in dart**	CLO – 2	Online Resources
9. Flutter Basics **a. Default template try out and environment understanding** **b. Run and debug on browser with dev tools**	CLO – 1 and 3	Chapter 1 and 2 of Textbook
10. Widgets Basics **a. Basic concepts of Widgets** **b. Building Widget tree** **c. Stateless and Stateful Widgets**	CLO – 3	Chapter 3 of Textbook

11. Widgets, Styling and Adding Logic **a. Aligning Rows and Columns** **b. Mapping data into widgets** **c. String Interpolation**	CLO – 3	Chapter 4 of Textbook
12. Responsive Adaptive User Interfaces and Apps f. Layout Builders g. Responsiveness h. Media Query	CLO – 3	Chapter 6 of Textbook
13. Navigation and Multiple Screens i. Linear Gradients j. Named Routes	CLO – 3	Chapter 7 of textbook
14. State Management d. Adding Navigation to the app e. Providers and Listeners f. Local vs App-wide State	CLO – 1 and 3	Chapter 8 of textbook
15. Working with User Input & Forms	CLO -3	Chapter 5 of textbook
16. Sending HTTP Requests c. Use of HTTP libraries d. Use of Futures to create synchronous and asynchronous communications	CLO - 3	Online Resources
17. Adding User Authentication	CLO – 3	Online Resources

10. Lab Experiments	
Lab 01	Installation & Introduction to Dart, extensions and VS code
Lab 02	Testing functions and using different parameters
Lab 03	Implementing Collections **(Assignment-1: Queue vs Stacks)**
Lab 04	File Handling and Basic OOP implementations
Lab 05	Advanced OOP implementations and utilization of Generics
Lab 06	Null Safety and Implementation of Asynchronous Programming
Lab 07	Introduction to Flutter applications and setting up emulator in android
Lab 08	Open Lab **(Project Assignment)**
Lab 09	Implementing internal data through maps in developing a quiz app
Lab 10	Implementing navigation and managing state using patterns
Lab 11	State management through listeners and providers
Lab 12	Implementing responsive and adaptive user interface
Lab 13	Integrating weather APIs to fetch data

Lab 14	Exploiting user forms for data input
Lab 15	Implementation of Google SignIn and Firebase Authentication
Lab 16	Lab Final **(Project Presentation and Submission)**

11. Program Learning Outcomes

PLO 1	**Engineering Knowledge**
	An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem Analysis**
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PLO 12	**Lifelong Learning**
	An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments