جامعة الملك خالد
KING KHALID UNIVERSITY

Department of Electrical Engineering

BSc Program Study Plan (1439-40)

2026

KING KHALID UNIVERSITY
COLLEGE OF ENGINEERING – DEPARTMENT OF ELECTRICAL ENGINEERING

بسم الله الرحمن الرحيم

King Khalid University

College of Engineering
Electrical Engineering Department

Bachelor of Science in Electrical Engineering

Program Study Plan

1439-1440

Course Code	Course Title	Weekly Distribution of Credit Hours				Prerequisites	Co-requisites
		Lectures	Lab	Credit Hours	Contact Hour		
First Year - First Level							
011-ENG-6	Intensive English Program-1	-	6	6	12	--	--
107-CHEM- 4	General Chemistry	3	1	4	5	--	--
119-MATH-3	Differentiation and Integration-1	3	-	3	3	--	--
111-ICl-2	The Entrance to the Islamic Culture	2	-	2	2	--	--
201-ARAB-2	Language Skills	2	-	2	2	--	--
Total Number of Hours		**10**	**7**	**17**	**24**		
First Year – Second Level							
012-ENG-6	Intensive English Program-2	-	6	6	12	011-ENG-6	--
104-CMS-2	Computer Science	1	1	2	3	--	--
219-MATH-3	Differentiation and Integration-2	3	-	3	3	119-MATH-3	--
129-PHYS-4	Physics-1	3	1	4	5	--	--
112-IC1-2	Islamic Culture-2	2	-	2	2	--	--
Total Number of Hours		**9**	**8**	**17**	**25**		
Second Year – Third Level							
111-GE-3	Engineering Drawing	-	3	3	6	--	--
202-ARAB- 2	Arabic Writing	2	-	2	2	--	--
211-EE-3	Electric Circuits 1	2	1	3	4	219MATH-3 129PHYS-4	--
211-GE-2	Learning skills	2	-	2	2	--	--
219-PHYS-4	Physics-2	3	1	4	5	129-PHYS-4	--
229-MATH- 3	Differentiation and Integration-3	3	-	3	3	219-MATH-3	--
Total Number of Hours		**12**	**5**	**17**	**22**		
Second Year – Fourth Level							
221-ME-3	Production Technology and Workshop	1	2	3	5	111-GE-3	
221-EE-3	Electric Circuits 2	2	1	3	4	211-EE-3	
319-PHYS-3	Physics-3	2	1	3	4	219-PHYS-4	
221-GE-2	Creativity and Innovation	2	-	2	2	--	
222-EE-1	Electric Circuits Lab	-	1	1	2	--	221-EE-3
319-MATH- 3	Differential Equations	3	-	3	3	219-MATH-3	
Total Number of Hours		**10**	**5**	**15**	**20**		

Third Year – Fifth Level							
212-ME-2	Engineering Mechanics (statics)	2	-	2	2		
311-EE-2	Electrical Measurements	2	-	2	2	211-EE-3	
312-EE-1	Electrical Measurements Lab	-	1	1	2		311-EE-2
329-STAT-2	Principles of Statistics and Probability	2	-	2	2		
113-IC1-2	Islamic Culture-3	2	-	2	2	--	
329-MATH- 3	Linear Algebra	3	-	3	3	--	
313-EE-3	Logic Design	2	1	3	4	211-EE-3	
314-EE-1	Logic Design Lab	-	1	1	2	313-EE-3	
Total Number of Hours		**13**	**3**	**16**	**19**		
Third Year – Sixth Level							
301-NGL-2	Technical Reports Writing	2	-	2	2	012-ENG-6	
321-EE-3	Computer Programming	2	1	3	4	104-CMS-2	
322-EE-3	Signals and Systems	2	1	3	4	229-MATH-3	
323-EE-3	Electromagnetics	2	1	3	4	319-MATH-3 129-PHYS-4	
324-EE-3	Introduction to Microprocessors and Microcontrollers	2	1	3	4	313-EE-3	
325-EE-1	Microprocessors and Microcontrollers Lab	-	1	1	2		324-EE-3
114-IC1-2	Islamic Culture-4	2	-	2	2	--	
Total Number of Hours		**12**	**5**	**17**	**22**		
Summer Internship							
400-EE-0	Summer Internship	0	0	0	0	Completion of 95 credit hours	
Fourth Year–Seventh Level							
311-ME-2	Engineering Mechanics (dynamic)	2	-	2	2		
411-EE-3	Automatic Control	2	1	3	4	322-EE-3	
412-EE-1	Automatic Control Lab	-	1	1	2		411-EE-3
414-IE -2	Engineering and Project Management	2	-	2	2		
413-EE-3	Basics of Electronic Devices	2	1	3	4	221-EE-3	
414-EE-1	Electronic Devices Lab	-	1	1	2		413-EE-3
411-GE-2	Professional Ethics and practice	2	-	2	2	--	
XXX	Free course - 1	3	-	3	3	--	
Total Number of Hours		**13**	**4**	**17**	**21**		

Fourth Year– Eighth Level							
421-EE-3	Electromechanical Energy Conversion - 1	2	1	3	4	221-EE-3	
564-IE-2	Safety and Environment Engineering	2	-	2	2		
423-EE-3	Analog Communications	2	1	3	4	322-EE-3	
	Elective -1	2	-	2	2		
422-EE-3	Numerical Methods	2	1	3	4	319-MATH-3	
XXX	Free course- 2	2	-	2	2		
Total Number of Hours		**12**	**3**	**15**	**18**		
Fifth Year–Ninth Level							
511-GE-2	Entrepreneurship and Venture Engineering	2	-	2	2		
512-EE-3	Digital Signal Processing	2	1	3	4	322-EE-3	
513-EE-1	Digital Signal Processing Lab	-	1	1	2		512-EE-3
514-EE-3	Electric Power System	2	1	3	4	221-EE-3	
515-EE-1	Electric Power System Lab	-	1	1	2		514-EE-3
	Elective-2	2	1	3	4	Refer to elective courses lists	
571-EE-2	Senior Design Project-1	2	-	2	2	Complete127 Cr. Hr	
Total Number of Hours		**10**	**5**	**15**	**20**		
Fifth Year–Tenth Level							
521-EE-3	Analog and Digital Electronic Circuits	2	1	3	4	413-EE-3	
522-EE-1	Analog and Digital Electronic Circuits Lab.	-	1	1	2		521-EE-3
523-EE-3	Digital Control Systems	2	1	3	4	411-EE-3	
	Elective -3	2	1	3	4	Refer to elective courses lists	
	Elective -4	2	1	3	4	Refer to elective courses lists	
572-EE-2	Senior Design Project-2	2	-	2	2	571-EE-2	
Total Number of Hours		**10**	**5**	**15**	**20**		

Elective courses

Elective courses (2), (3), and (4) are selected according to the following:

1. **Power system and machine engineering path**: choose the courses of Power system and machine engineering path only from the list of elective courses
2. **Students interested in Communication Engineering path**: Choose the courses of Communication Engineering path only from the list of elective courses
3. **Students interested in Electronics Engineering path**: Choose the courses of Electronics Engineering path only from the list of elective courses
4. **Students interested in general path**: choose elective courses without follow any path

List of Elective course -1

Course Code	Course Title	Weekly Distribution of Credit Hours				Prerequisites
		Lectures	Lab	Credit Hours	Contact Hour	
321-GE-2	Knowledge Management	2	-	2	2	--
322-GE-2	Design Thinking	2	-	2	2	--
323-GE-2	System Dynamics	2	-	2	2	--

List of Elective courses (2), (3) and (4)

Path	Course Code	Course Title	Weekly Distribution of Credit Hours				Prerequisites
			Lectures	Lab	Credit Hours	Contact Hour	
Electrical Power and Machine Engineering	531-EE-3	Electromechanical Energy Conversion -2	2	1	3	4	421-EE-3
	533-EE-3	High Voltage Engineering	2	1	3	4	221-EE-3
	534-EE-3	Power System Analysis	2	1	3	4	514-EE-3
	535-EE-3	Power Electronics	2	1	3	4	413-EE-3
Communication Engineering	541-EE-3	Digital Communication	2	1	3	4	423-EE-3
	543-EE-3	Antennas and Wave Propagation	2	1	3	4	323-EE-3
	545-EE-3	Wireless Communication	2	1	3	4	423-EE-3
	546-EE-3	Communication Systems	2	1	3	4	423-EE-3
Engineering Electronics	551-EE-3	Electronic Instrumentation	2	1	3	4	413-EE-3
	552-EE-3	Embedded Systems Design	2	1	3	4	324-EE-3
	554-EE-3	VLSI Design	2	1	3	4	413EE-3
	556-EE-3	Solar Cells and Photovoltaic Systems	2	1	3	4	514-EE-3

College of Engineering

Department of Electrical Engineering

Course Description File

Course Title	**Electric Circuit 1**
Course Code	**211-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+2+0)**
Level-Year	**3 - 2**
Prerequisite (if any)	**129-PHYS-4, 219-MATH-3**

1) Course Objectives:

This course provides basic concepts and theories of the electrical circuit analysis. Also, it provides understanding methodologies of solving electrical circuits and having an experience in the analysis of electric circuits. Also, both DC and AC circuit analysis methods are presented to help the students for solving any types of electrical circuits.

2) Expected Learning Outcomes:

By the end of this course the student will be able to:

1. Identify the basic concepts, components of electric circuits and Ohm's & Kirchhoff's laws (PLO1 [1])
2. Apply different techniques for solving DC electric Circuits (PLO4)
3. Analyze DC networks by applying various laws and theorems (PLO4)
4. Identify the concepts of AC Sinusoidal Sources, Time Domain, Frequency Domain (PLO1 [1])
5. Analyze the concepts of Inductance, Capacitance, Phasor, Impedance & Phasor Diagram (PLO4)
6. Apply different techniques for solving AC electric circuits and steady state power. (PLO4)

3) Course Contents

1. Introduction to the Electrical circuits;
2. Ohm's law and Kirchhoff's laws;
3. Nodal analysis and Mesh analysis;
4. Source transformation, Superposition, and Thevenin and Norton theories
5. AC circuit and Phasor concepts;
6. Energy storage elements;
7. Impedance, AC circuit theorems, and Power in AC circuits;

4) Teaching Methods:

- Lectures
- Videos
- Discussion
- Self-learning
- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Mid-Term Exams
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………..…. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations……. (30 %)
- Final Exam. ……………………………………………..……..……………..……. (40 %)

6) Textbook(s):

- James W. Nilsson and Susan Riedel," Electric Circuits 12th Edition," Pearson, Jun 29, 2022.

7) References:

- C. K. Alexander and M. N. O. Sadiku, Fundamentals of Electric Circuits, 7th ed. New York, NY, USA: McGraw-Hill Education, 2021.

Course Title	**Electric circuits 2**
Course Code	**221-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+2+0)**
Level-Year	**4 – 2**
Prerequisite (if any)	**211-EE-3**

1) Course Objectives:

The course provides students with knowledge, skills and the ability to:

1. Develop the understanding regarding power calculations in ac circuits.
2. Find the circuit frequency response.
3. Understand the condition of resonance.
4. Understand the basic Op-Amp applications.
5. Design a simple passive filter.
6. Understand the mutual inductance and transformers.
7. Analyze a three-phase circuit.
8. Deal with two port circuits.
9. Understand the mutual inductance and transformer

2) Expected Learning Outcomes:

By the end of this course the student will be able to:

1. Recognize the transient and steady-state response of electrical circuits. (PLO6 [4])
2. Identify and solve electric circuits in the sinusoidal steady-state and transient behavior. (PLO1 [1])
3. Identify and formulate resonance phenomenon and the relation between three phase variables. (PLO1 [1])
4. Analyze three-phase circuits. (PLO3 [6])
4. Formulate using Laplace transform and its properties to obtain impulse and step response of simple circuits. (PLO1 [1])
5. Identify different filter types and their working frequencies. (PLO1 [1])

3) Course Contents

1. Revision of fundamentals of electric circuits
2. Frequency response of RLC and selective circuit
3. Series and parallel resonance
4. Transient analysis of first-order circuits
5. Transient analysis of second-order circuits
6. Introduction to operational amplifier ideal characteristics with simple applications

7. Nonlinear circuits, IV characteristics and Diode characteristics,
8. clipping and rectification circuits

4) Teaching Methods:

- Lectures
- Videos
- Discussion
- Self-learning
- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Mid-Term Exams
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………..… (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. ………………………………………………..……………………… (40 %)

6) Textbook(s):

1.Nilsson, J.W., & Riedel, S.A.. Electric Circuits. 11th ed.. Pearson, 2019.

2.Alexander, C.K., & Sadiku, M.N.O.. Fundamentals of Electric Circuits. 7th ed.. McGraw-Hill Education, 2022.

3.Hayt, W.H., Kemmerly, J.E., & Durbin, S.M.. Engineering Circuit Analysis. 9th ed.. McGraw-Hill Education, 2019.

7) References:

1.Dorf, R.C., & Svoboda, J.A.. Introduction to Electric Circuits. 10th ed. (Global ed.). Wiley, 2018.
2.Robbins, A.H., & Miller, W.C.. Circuit Analysis: Theory and Practice. 5th ed.. Cengage Learning, 2018.

3.Ergul, N.. Introduction to Electrical Circuit Analysis. 1st ed.. Wiley, 2017.

Course Title	**Electric Circuits Lab**
Course Code	**222-EE-1**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**1 (0+0+1)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**2 (0+0+2)**
Level-Year	**4 - 2**
Prerequisite (if any)	**221-EE-3**

1) Course Objectives:

The course provides students with knowledge, skills and the ability to

1. Use Kirchhoff's laws, circuit theorems and node voltage methodology to solve simple DC as well as AC circuits.
2. Apply simple steady state sinusoidal analysis to circuits.
3. Demonstrate a basic understanding of phasors and phasor diagrams for AC circuit analysis.
4. Demonstrate basic proficiency in building basic electrical circuits and operating fundamental electrical engineering equipment.

2) Expected Learning Outcomes:

At the end of the course, students will possess the knowledge and skills to

1. Apply fundamental principles to analyze and solve basic electrical circuits using appropriate electrical theories. (PLO4)
2. Utilize measurement instruments, including the oscilloscope, to analyze electrical circuit behavior and verify theoretical principles. (PLO3 [6])
3. Demonstrate proficiency in constructing electrical circuits and operating fundamental electrical engineering equipment. (PLO2 [2])
4. Evaluate practical and theoretical results to validate engineering principles and circuit laws. (PLO3 [6])
5. Interpret experimental data and graphical representations to develop well-structured technical reports. (PLO8 [3])

3) Course Contents:

1. Introductory to lab equipments and basic components
2. Assemble of simple circuits
3. Ohms law, Series and Parallel Connection of Resistors
4. VDR on No-Load operation, VDR under Load
5. Series and parallel connection of Batteries
6. Determining the Internal Resistance of batteries connected in series and Parallel
7. Introduction to AC Circuits using the Oscilloscope

8. Introduction to AC Circuits using the Function Generator
9. Power Factor measurements and improvement
10. Introduction to Three Phase circuits.

4) Teaching Methods:

- Practical demos
- Videos
- Discussion
- Self-learning
- Tutorial sheets

5) Mode of Evaluation:
Course Assessment Methods

- In Lab discussion
- Writing reports with results presentation
- Mid-Term practical Exams
- Final practical and oral Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)………………………….…. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. ……………………………………………..………………………… (40 %)

6) Textbook(s):

- Electric Circuits Lab Manual for designed specifically for this course with referring to the experiments listed

7) References:

- James W. Nilsson and Susan Riedel,” Electric Circuits 12th Edition,” Pearson, Jun 29, 2022.

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Course Title	Electrical Measurements
Course Code	311-EE-2
No. of Credit Hrs (Lecture)	2 (2+0+0)
No. of Contact Hrs (Lecture)	2 (2+0+0)
Level-Year	4-7
Prerequisite (if any)	211-EE-3

1) Course Objectives:

To inculcate in students about the measurement methods and needed equipment of various electrical quantities and the operation of electrical measuring instruments and their constructional details.

2) Expected Learning outcomes:

1. Identify fundamental measurement units, standard units for basic quantities, sources of errors, error analysis techniques, and data presentation methods. (PLO1 [1])
2. Apply appropriate techniques for using measuring instruments to quantify electrical parameters while understanding their working principles and range extension methods. (PLO4)
3. Construct appropriate methods for measuring power and energy, incorporating error identification and compensation techniques (PLO2 [2])
4. Evaluate the key constraints and considerations in the application of resistance and inductance measurement techniques, and analyze their effectiveness and limitations in solving complex engineering problems. (PLO5 [4])
5. Engage in learning the fundamentals of digital instruments and their applications in electrical measurements to support continuous knowledge acquisition. (PLO9 [7])

3) Course Contents

1. Measurement Units, standard units for basic quantities, errors, error analysis, data statistics and presentation
2. Measuring Instruments: -Classification – deflecting, control and damping torques – Ammeters and Voltmeters – PMMC, moving iron type instruments – expression for the deflecting torque and control torque, extension of range using shunts and series resistance.
3. Measurement of Power: -Single phase dynamometer wattmeter
4. Measurement of Energy: -Single phase induction type energy meter – driving and braking torques – errors and compensations.
5. Resistance Measurements: Method of measuring low, medium and high resistance – sensitivity of Wheatstone's bridge – Carey Foster's bridge, Kelvin's double

bridge for measuring low resistance, measurement of high resistance – loss of charge method.

6. A.C. Bridges: -Measurement of inductance, Quality Factor - Maxwell's bridge, Hay's bridge.
7. Introduction to digital Instruments

4) Teaching Methods:

- Lectures
- Videos
- Discussion
- Self-learning
- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Mid-Term Exams
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………….. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. ………………………………………….……….……………… (40 %)

6) Textbook(s):

-Electrical Measurements and measuring Instruments – by E.W. Golding and F.C. Widdis, fifth Edition, Wheeler Publishing

-Sawhney, A. K., and Puneet Sawhney. A Course in Electrical and Electronic Measurements and Instrumentation. 4th ed., Dhanpat Rai & Co.

7) References:

- Electrical Measurements – by Buckingham and Price, Prentice – Hall, latest edition.
- Electrical Measurements by Harris, John Wiley & Sons Inc; latest edition.
- Electrical Measurements: Fundamentals, Concepts, Applications – by Reissland, M.U

Course Title	**Electrical Measurements Lab**
Course Code	**312-EE-1**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**1 (0+0+1)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**2 (0+0+2)**
Level-Year	**4-7**
Prerequisite (if any), Co-requisite	**Co-** (**311-EE-2)**

1) Course Objectives:

To inculcate in students about the testing, calibration and extension of ranges of various measuring devices used for measuring electrical quantities.

2) Expected Learning Outcomes:

The students will be able to

1. Apply measurement techniques to accurately test and calibrate electrical instruments and interpret results in the context of various electrical quantities. PLO1 [1]
2. Design and conduct experiments for measuring electrical quantities using appropriate methods and tools and analyze the experimental data and interpret data accurately. PLO2 [2]
3. Select and apply the knowledge of modern test & measurement tools and techniques for testing and analyzing electrical systems. PLO3 [6]
4. Write experimental results and technical findings effectively, using clear and structured technical reports & presentation, visual data representation, and appropriate terminology. PLO7 [5]
5. Collaborate with team members to perform electrical measurements and calibration experiments, demonstrating effective teamwork, problem-solving, and communication skills, ensuring the success of the experiments and the quality of the results. PLO8 [3]

3) Course Contents:

1. Calibration and Testing of PMMC meters: ammeters and voltmeters, extension of range using shunts and series resistance.
2. Measurement of resistance: Wheatstone's bridge – Carey Foster's bridge, Kelvin's double Bridge – Determination of Tolerance.
3. Measurement of 3 phase reactive power with single-phase wattmeter.
4. Calibration and testing of single-phase energy Meter.
5. Measurement of inductance: Quality Factor - Maxwell's bridge, Hay's bridge.

4) Teaching Methods:

- Practical demos
- Videos

- Discussion
- Self-learning
- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- In Lab discussion
- Writing reports with results presentation
- Mid-Term practical Exams
- Final practical and oral Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………..…. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. ……………………………………………..……….…………… (40 %)

6) Textbook(s):

- Laboratory manual provided by the department.
- Bartiromo, Rosario, and Mario De Vincenzi. Electrical measurements in the laboratory practice. Cham, Switzerland: Springer International Publishing, 2016.

7) References:

- Electrical Measurements – by Buckingham and Price, Prentice – Hall, latest edition.
- Electrical Measurements by Harris, latest edition.
- Electrical Measurements: Fundamentals, Concepts, Applications – by Reissland, M.U, New Age International (P) Limited, Publish, latest edition.

Course Title	Logic Design
Course Code	313-EE-3
No. of Credit Hrs (Lecture + Tutorial/Lab)	3 (2+1+0)
No. of Contact Hrs (Lecture + Tutorial/Lab)	4 (2+2+0)
Level-Year	5 - 3
Prerequisite (if any)	211-EE-3

1) Course Objectives:

This course provides students with a comprehensive overview of

1. Logic Design concepts and ideas.
2. Number system
3. Design and optimization of different logic function using gate circuits.
4. Using logic design for replacing the switches in control system.
5. Sequential clocked synchronous circuits
6. work in the field of electronics operation and maintenance.
7. Topics and concepts taught as co-requisite in logic design lab,
8. Prepare students to work efficiently for their graduation project.

2) Expected Learning Outcomes:

1. Identify and apply fundamental concepts of number systems (binary, octal, decimal, hexadecimal) and conversions, and use these to solve engineering problems in digital systems. PLO1 [1]
2. Design, analyze, and optimization of Boolean functions and their logic implementation using basic logic gates such as AND, OR, NOT, XOR, etc. PLO2 [2]
3. Design and analyze combinational digital circuits, applying experimental investigation and engineering judgment to interpret data and solve complex engineering problems. PLO3 [6]
4. Investigate and analyze the behavior of sequential circuits using modern engineering tools and techniques, while understanding their limitations. PLO4

3) Course Contents

1. Introduction to Number System, Binary, Octal, Decimal and Hexadecimal numbers and base conversions, Complements, binary Codes.
2. Boolean Functions, Basic Logic Gates (OR, AND & NOT, NOR, NAND XOR & XNOR Gates).
3. Adder & Subtractor.
4. Decoders & Encoders.
5. Multiplexers.

6. Code Converters,
7. Latches.
8. Flip-Flops,
9. Registers & Shift Registers,
10. Synchronous & Asynchronous Counters

4) Teaching Methods:

- Lectures
- Videos
- Discussion
- Self-learning
- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Mid-Term Exams
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)………………………………..…. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. ………………………………………………..……….……………….…… (40 %)

6) Textbook(s):

- Mano, M. Morris, and Michael D. Ciletti. Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog. 6th ed., Pearson, 2018.

7) References:

- Floyd, Thomas L. Digital Fundamentals. 11th ed., Pearson, 2021.

Course Title	**Logic Design Lab**
Course Code	**314-EE-1**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**1 (0+0+1)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**2 (0+0+2)**
Level-Year	**5 - 3**
Prerequisite (if any)	**CO(313-EE-3)**

1) Course Objectives:

This course provides students with a comprehensive overview of

1. Well knowledge of Logic Design concepts and ideas.
2. Understanding of number system
3. Ability to construct and analyze different logic gate circuits
4. Introduction to sequential clocked synchronous circuits
5. Students should get ready and prepare to work in the field of electronics operation and
6. maintenance.
7. Specially focus on the topics and concepts taught as co-requisite in logic design lab,
8. Prepare students to work efficiently for their graduation project.

2) Expected Learning Outcomes:

1: Identify and apply design procedures for logic circuits, using engineering principles to validate results against theoretical concepts. (PLO1 [1])

2: Design and analyze logic gates, combinational, and sequential circuits for engineering applications, considering safety, and relevant standards. (PLO2 [2])

3: Conduct experiments, troubleshoot, and analyze data related to logic circuits to draw valid conclusions based on engineering knowledge. (PLO3 [6])

4: Identify and apply the correct procedures for laboratory equipment, while recognizing and adhering to ethical and professional responsibilities in various engineering situations. (PLO6 [4])

3) Course Contents

1. Introduction to laboratory equipment and their use.
2. Digital electronic training system, Connectivity of ICs, logic Gates, equipment.
3. Lab Familiarization, Basic Logic Gates (OR, AND & NOT, NOR, NAND XOR & XNOR Gates).
4. Boolean Functions, Adder & Subtractor.
5. Decoders & Encoders, Multiplexers & Magnitude Comparator.
6. Code Converters, Latches & Flip-Flops, Registers & Shift Registers.
7. Synchronous & Asynchronous Counters

4) Teaching Methods:

- Practical demos
- Videos
- Discussion
- Self-learning
- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- In Lab discussion
- Writing reports with results presentation
- Mid-Term practical Exams
- Final practical and oral Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………….. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. …………………………………………….………………………… (40 %)

6) Textbook(s):

- Logic Design Lab Manual designed specifically for this course with referring to the experiments listed

7) References:

- Mano, M. Morris, and Michael D. Ciletti. Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog. 6th ed., Pearson, 2018.
- Floyd, Thomas L. Digital Fundamentals. 11th ed., Pearson, 2021.

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Course Title	**Computer Programming**
Course Code	**321-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+2+0)**
Level-Year	**6-3**
Prerequisite (if any)	**104-CS-2**

1) Course Objectives:

This Course qualifies engineering and computing students to know the principles and the basics of programming, which will be the focus of future studies. Students will learn programming terminology and will obtain a solid grasp of the basic mechanics of programming.

2) Expected Learning outcomes:

1. Identify and apply basic programming concepts in problem solving using appropriate tools and techniques. PLO1 [1]
2. Solve practical problems by integrating fundamental programming concepts and techniques in Object Oriented Programming Language. PLO2 [2]
3. Construct simple programs by recalling and applying core programming steps PLO4
4. Identify and evaluate the issues and constraints in C++ programming language to solve engineering problems. PLO 5 [4]
5. Engage in self-learning to acquire and apply foundational C++ programming knowledge PLO9 [7]

3) Course Contents

1. Computer Fundamentals: Computer Environments, Computer languages and System Development
2. Computer Fundamentals: System software (SW) [compilers, interpreters, utility programs, programming languages]
3. Algorithmic Development: Techniques of problem solving
4. Algorithmic Development: Flowcharting, decision table.
5. Algorithmic Development: Structured Programming concepts.
6. Basics of C++: Structure of C++ program, keywords and identifiers
7. Basics of C++: Constants, variables, data types and type conversion.
8. Basics of C++: Types of operators and expressions
9. Basics of C++: Input and output functions in C++.
10. Basics of C++: Decision Statement: IF-ELSE statement, break, continue, go-to, switch case and nested IF statement.

11. Basics of C++: Loop Control Statements: For loop, While loop, Do-while loop and nested loops.

4) Teaching Methods:

- Lectures
- Videos
- Discussion
- Self-learning
- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Mid-Term Exams
- Tutorial Sheets
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………….. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. …………………………………………..………………………… (40 %)

6) Textbook(s):

- C++ How to Program, 7/e. By Paul and Harvey Deitel. 2010
- Dale, Nell B., and Chip Weems. *Programming and problem solving with C++*. Jones & Bartlett Publishers, 2014.

7) References:

- Introductory Problem Solving and Programming:Robotics versus Traditional Approaches Amanda Oddie, Paul Hazlewood, Stewart Blakeway, Alma Whitfield Department of Computer Science, Liverpool Hope University, Hope Park, Liverpool, L16 9JD oddiea@hope.ac.uk, hazlewp@hope.ac.uk, blakews@hope.ac.uk,whitfia@hope.ac.uk http://journals.heacademy.ac.uk/doi/abs/10.11120/ital.2010.09020011

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Course Title	**Signals and Systems**
Course Code	**322-EE3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+2+0)**
Level-Year	**6-3**
Prerequisite (if any)	**229-MATH-3**

1)Course Objectives:

To inculcate in students the understanding of signals and systems. Help the student to analyze signals in both time and frequency domain. Make the student able to relate system behavior to circuit time and frequency response.

2) Expected Learning Outcomes:

1. Analyze the characteristics of continuous-time and discrete-time signals and systems (PLO-1 [1])
2. Evaluate the properties and behavior of Linear Time-Invariant (LTI) systems using convolution techniques. (PLO-2 [2])
3. Apply frequency domain techniques to analyze signals (PLO-4)
4. Compare different Fourier transform techniques and their applications in analyzing continuous and discrete-time signals (PLO-9 [7])
5. Recognize the fundamental concepts of Laplace and Z transforms and their applications in signal analysis PLO-5 [4]
6. Use frequency domain techniques to identify formulate and solve signals and systems PLO-1 [1].

3) Course Contents:

1. Motivation and Applications, Signal Classifications, Signal Operations.
2. Singularity Functions; Linear time-Invariant Systems and Convolution.
3. Correlation; Fourier Series and Transform for continuous and discrete time signals; Applications
4. Laplace transform and applications; Introduction to z-transform.

4) Teaching Methods:

- Lectures
- Videos
- Discussion
- Self-learning
- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Mid-Term Exams
- Tutorial Sheets
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………….. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations……. (30 %)
- Final Exam. …………………………………………..………………………… (40 %)

6) Textbook(s):

- Signals and Systems by Oppenheim, Alan V, Willsky, Alan S., Hamid, with S. (2013)

7) References:

- Haykin, Simon, and Barry Van Veen. Signals and systems. John Wiley & Sons, 2007.

Course Title	**Electromagnetics**
Course Code	**323-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+2+0)**
Level-Year	**6-3**
Prerequisite (if any)	**229-MATH-3+129-PHYS-4**

1) Course Objectives:

To introduce basics of electromagnetics and establish the fundamentals of devices in electromagnetic applications, as required by engineers in energy systems, telecommunications, computing and other technologies.

2) Expected Learning Outcomes:

1. Demonstrate a general understanding of the laws of electricity and magnetism. (PLO4)
2. Apply knowledge of vector algebra, vector calculus and coordinate systems for solving electromagnetic problems. (PLO1 [1])
3. Analyze various law's in that are applied in electromagnetism and their simulation(PLO4)
4. Analyze laws and theorems of electromagnetics and their applications. (PLO1 [1])

3) Course Contents

1. Vector Algebra – Scalars and Vectors, Unit Vector, Vector Addition, Subtraction, Multiplication, Position and Distance Vectors, Components, Simulations. Coordinate Systems and Transformations – Cartesian, Cylindrical and Spherical Coordinate Systems, Constant Coordinate Surfaces, Simulations. Vector Calculus - Differential Length, Area, and Volume, Line, Surface, and Volume Integrals, Del Operator, Gradient of a Scalar, Divergence of a Vector and Divergence Theorem, Curl of a Vector and Stokes's Theorem, Laplacian of a Scalar, Classification of Vector Fields, Simulations.
2. Electrostatic Fields - Coulomb's Law and Field Intensity, Electric Fields Due to Continuous Charge Distributions, Electric Flux Density, Gauss's Law-Maxwell's Equation, Applications of Gauss's Law, Electric Potential, Relationship between E and V-Maxwell's Equation, Electric Dipole and Flux Lines, Energy Density in Electrostatic Fields, Simulations
3. Electric Fields in Material Space - Properties of Materials, Convection and Conduction Currents, Conductors, Polarization in Dielectrics, Dielectric Constant and Strength, Linear, Isotropic, and Homogeneous Dielectrics, Continuity Equation and Relaxation Time, Boundary Conditions, Simulations. Electrostatic Boundary-Values Problems - Poisson's and Laplace's Equations.
4. Magnetostatic Fields - Biot-Savart's Law, Ampere's Circuit Law-Maxwell's Equation, Applications of Ampere's Law, Magnetic Flux Density-Maxwell's Equation, Maxwell's Equations for Static Fields, Magnetic Scalar and Vector Potentials, Simulations.

5. Magnetic Forces, Materials and Devices - Forces Due to Magnetic Fields, Magnetic Torque and Moment, A Magnetic Dipole, Magnetization in Materials, Classification of Materials, Magnetic Boundary Conditions, Inductors and Inductances, Magnetic Energy, Magnetic Circuits, Force on Magnetic Materials, Simulations

4) Teaching Methods:

- Lectures
- Discussion
- Self-learning
- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Mid-Term Exams
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………….. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. …………………………………………..………………………… (40 %)

6) Textbook(s):

- Matthew N. O. Sadiku, "Elements of Electromagnetics," Oxford University Press. (7th Edition) 2021.

7) References:

- William H. Hayt, JR, John A. Buck, "Engineering Electromagnetics ," McGraw-Hill International Edition, Nine 2017 Edition,

Course Title	**Introduction to Microprocessors and Microcontrollers**
Course Code	**324-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+2+0)**
Level-Year	**6-3**
Prerequisite (if any)	**313-EE-3**

1) Course Objectives:

At the end of this course, the student should be able to

1. Understand components of the computers, microprocessors and microcontrollers
2. Understand role of CPU, registers, and modes of operation.
3. Understand concept of memory mapping and addressing modes.
4. Understand interrupt vectors, interrupt process, interrupt priorities, external and advanced interrupts.
5. Ability to work independently and as part of a team and manage resources.
6. Ability to write the formal report and to increase the confidence of the students.

2) Expected Learning Outcomes:

1. Select the suitable 8086 microprocessor pins with their basic role defined by Intel and Interpret the internal architecture in term of logic architecture ad its mode of operation PLO4.
2. Apply the suitable addressing mode to calculate the logical and physical address showing how the 8086 microprocessor access the internal register and the external 1 MB memory PLO4 .
3. Solve technical and engineering problems using the theory of the 8086 assembly language programming PLO1-SO1 [1]
4. Present and Explain technical reports and Communicate in teams PLO8-SO3 [3]
5. Design and build interface circuit using programmable peripheral interface 8255 to distinguish its various operating modes (or interfacing Atmega 328 with several peripherals PLO2-SO2 [2]

3) Course Contents

1. Introduction to microprocessors and microcontroller systems
2. Microprocessor model
3. Techniques used in microprocessor

4. Microprocessor programming techniques
5. Looping, counting, and indexing
6. Flowchart
7. Timing delay using counters
8. Stacks and subroutines
9. I/O memory interface with microprocessor
10. Input output system
11. I/O data transfer techniques
12. DMA transfer
13. I/O interfacing techniques with microprocessor
14. Microcontrollers and microprocessors
15. Microcontrollers in control systems

4) Teaching Methods:

- Lectures
- Videos
- Discussion
- Self-learning
- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Mid-Term Exams
- Tutorial Sheets
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………….. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. ……………………………………………………………………………… (40 %)

6) Textbook(s):

- Godse, Atul P., and Deepali A. Godse. Microprocessors & microcontrollers. Technical publications, 2021.

7) References:

- Triebel, Walter A. The 8088 And 8086 Microprocessors: Programming, Interfacing Software, Hardware And Applications, 4/E. Pearson Education India, 2007.

Course Title	**Microprocessors and Microcontrollers Lab**
Course Code	**325-EE-1**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**1 (0+0+1)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**2 (0+0+2)**
Level-Year	**6-3**
Prerequisite (if any)	**Co(324-EE-3)**

1) Course Objectives:

At the end of this course, the student should be able to do the following Experiments:

1. Programs for 16 bit arithmetic operations for 8086 (using Various Addressing Modes).
2. Program for sorting an array for 8086.
3. Program for searching for a number or character in a string for 8086.
4. Program for string manipulations for 8086.
5. Program for digital clock design using 8086.
6. Interfacing ADC and DAC to 8086.
7. Parallel communication between two microprocessors using 8255.
8. Serial communication between two microprocessor kits using 8251.
9. Interfacing to 8086 and programming to control stepper motor.
10. Programming using arithmetic, logical and bit manipulation instructions of 8051.
11. Program and verify Timer/Counter in 8051.
12. Program and verify Interrupt handling in 8051.
13. UART Operation in 8051.
14. Communication between 8051 kit and PC.
15. Interfacing LCD to 8051.
16. Interfacing Matrix/Keyboard to 8051.
17. Data Transfer from Peripheral to Memory through DMA controller 8237/8257.

2) Expected Learning Outcomes:

1. Engage in self-directed learning to recognize and explain the roles of various registers and segments in the microprocessor memory model (PLO9[7])
2. Select and define the fundamental components of the microprocessor memory model and basic assembly language programming constructs PLO4
3. Develop and implement assembly language programs to solve specific computational tasks using appropriate software tools (PLO1 [1])
4. Conduct experiments using MASM, LINK, and EDIT tools to construct and validate assembly language programs (PLO3[6])
5. Design and optimize assembly programs with accurate syntax and relate the program outcomes to theoretical microprocessor concepts (PLO2[2])
6. Write technical reports and co-operate in teams (PLO8 [3])

3) Course Contents:

1 Introduction to microprocessors and microcontroller systems
2 Microprocessor model
3 Techniques used in microprocessor
4 Microprocessor programming techniques
5 Looping, counting, and indexing
6 Flowchart
7 Timing delay using counters
8 Stacks and subroutines
9 I/O memory interface with microprocessor
10 Input output system
11 I/O data transfer techniques
12 DMA transfer
13 I/O interfacing techniques with microprocessor
14 Microcontrollers and microprocessors
15 Microcontrollers in control systems

4) Teaching Methods:

- Practical demos
- Videos
- Discussion
- Self-learning
- Tutorial sheets

5) Mode of Evaluation:
Course Assessment Methods

- In Lab discussion
- Writing reports with results presentation
- Mid-Term practical Exams
- Final practical and oral Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)…………………………….. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. ……………………………………………………………………… (40 %)

6) Textbook(s):

- Lab Manual
- Godse, Atul P., and Deepali A. Godse. Microprocessors & microcontrollers. Technical publications, 2021.

7) References:

- Triebel, Walter A. The 8088 And 8086 Microprocessors: Programming, Interfacing, Software, Hardware And Applications, 4/E. Pearson Education India, 2007.

Course Title	**Automatic Control**
Course Code	**411-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+ 2+0)**
Level-Year	**7^{th} Level/ 4^{th} Year**
Prerequisite (if any)	**322-EE-3**

1) Course Objectives:

The main objective of the course is to acquire the basic concepts of control systems' analysis; particularly, to learn the basics of control systems representations/modeling and stability analysis (in time and frequency domains).

2) Expected Learning Outcomes:

1. Recognize and describe the fundamental principles of modeling electrical and mechanical systems using appropriate engineering tools (PLO4)
2. Engage in self-learning to summarize and explain the key properties of feedback control systems and basic control actions (PLO9 [7])
3. Apply control system design techniques to analyze and solve single-variable continuous systems in both time and frequency domains (PLO1 [1])
4. Select and justify suitable basic control schemes for different types of engineering systems (PLO4)
5. Collaborate effectively in small teams to identify and present simple, real-world applications of control systems (PLO7 [5])

3) Course Contents

1. Introduction and System Modeling: Laplace Transformer, Electrical Circuits Modeling
Block Diagram reduction technique: Block diagrams, their components, and their underlying mathematics. Transfer function of systems through block diagram manipulation and reduction.

2. Introduction to the signal-flow graphs. Block diagrams and signal-flow graphs. The use of Marson's gain formula for finding transfer function of systems.

3. Performance of Feedback Control System: What is feedback control? Why do computer systems need feedback control? Test input signals Response of a first-order system, Performance of a second-order system. Control design methodology.

4. System modeling. Controller design

5. Stability of feedback Control System: Stability of Linear Feedback Systems. Routh-Hurwitz Stability Test. Root Locus Method. System Types and Steady-State Error. Time-Domain Performance Indices

6. Frequency response: Determination of transfer function. Bode plot for control analysis. Gain and Phase margins. Stability in frequency response

4) Teaching Methods:

- Lectures
- Videos
- Discussion
- Self-learning
- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Mid-Term Exams
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………..… (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. ………………………………………..…………………….…… (40 %)

6) Textbook(s):

1. N. S. Nise, Control Systems Engineering, 8th ed. Hoboken, NJ, USA: John Wiley & Sons, 2020.
2. K. Ogata, Modern Control Engineering, 5th ed. Upper Saddle River, NJ, USA: Pearson, 2010.

7) References:

1. Golnaraghi, F., & Kuo, B.C.. Automatic Control Systems. 10th ed.. McGraw-Hill Education, 2017.
2.Nakhmani, A.. Modern Control: State-Space Analysis and Design Methods. 1st ed.. McGraw-Hill Education, 2020.
3. Fadali, M.S., & Visioli, A.. Digital Control Engineering: Analysis and Design. 3rd ed.. Academic Press (Elsevier), 2019.

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Course Title	**Automatic Control Lab**
Course Code	**412-EE-1**
No. of Credit Hrs (Theoretical + Tutorial/Lab)	**1 (0+1)**
No. of Contact Hrs (Theoretical + Tutorial/Lab)	**2 (0+ 2)**
Level-Year	**7th Level/ 4th Year**
Prerequisite (if any)	**411-EE-3 Co-requisite)**

1) Course Objectives:

The main objective of the course is to supplement the Automatic Control Theory Course (411EE-3) through practical experiment in the laboratory.

2) Expected Learning Outcomes:

1. Utilize knowledge practically to model fundamental electrical and mechanical systems (PLO4)
2. Implement the basic and feedback control actions in la (PLO2-SO2 [2]).
3. Implement design control methodologies for single-variable continuous systems in both time and frequency domains (PLO3-SO6 [6]).
4. Capability to select various techniques to control the concerned systems (PLO4).
5. Utilize and justify the used methodologies for modeling electrical, mechanical, and electromechanical systems that are actually applicable. (PLO3-SO6 [6]).
6. Write technical reports and collaborate among teams (Group of students) (PLO8-SO3 [3])

3) Course Contents

Experiments are organized in several groups of real time applications, such as:

- Step Response analysis of 1st and 2nd order System.
- Frequency Response of 1st and 2nd order System.
- Root Locus Plot of a given system.
- Bode plots of a given system
- Nyquist plots of a given system
- Lead-Lag compensation design
- PID controller design
- Speed control of DC motor
- Position Control.

4) Teaching Methods:

- Lectures

- Videos
- Discussion
- Self-learning
- Lab manuals

5) Mode of Evaluation:
Course Assessment Methods

- Short quizzes
- Experiment Manual
- Experiment Sheets
- Mid-Term Exams
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………..… (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. ……………………………………………..……………………… (40 %)

6) Text Books

1.Dorf, R.C., & Bishop, R.H.. Modern Control Systems. 14th ed. (Global ed.). Pearson, 2021.
2.Moore, H.. MATLAB for Engineers. 6th ed.. Pearson, 2022.

3.Hernandez, A.. MATLAB and Simulink Crash Course for Engineers. 1st ed.. Springer, 2022.tbook(s):

7) References:

1.Fadali, M.S., & Visioli, A.. Digital Control Engineering: Analysis and Design. 3rd ed.. Academic Press (Elsevier), 2019.
2.Nise, N.S.. Control Systems Engineering. 8th ed.. Wiley, 2020.

3.Nakhmani, A.. Modern Control: State-Space Analysis and Design Methods. 1st ed.. McGraw-Hill Education, 2020.

Course Title	**Basics of Electronic Devices**
Course Code	**413-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (3+ 1+0)**
Level-Year	**7-4**
Prerequisite (if any)	**211-EE-3**

1) Course Objectives:

To introduce students to the basic physics and operation of semiconductor devices as well as some simple applications. Students will gain good background for more advanced courses.

2) Expected Learning Outcomes:

1. Apply mathematics, science, engineering fundamentals, to understand and analyze semiconductor materials, e.g., Germanium, Silicon, etc. and semiconductor devices. PLO1 [1]
2. Design, construct, and analyze a semiconductor-based electronic circuit, considering its practical applications in electronic systems. PLO2 [2]
3. Investigate and analyze the characteristics and behavior of semiconductor devices using engineering principles to achieve a valid conclusion. PLO3 [6]
4. Identify, evaluate and explain various biasing techniques and operating modes to understand the operation and limitations of electronic devices in semiconductor circuit design. PLO5 [4]

3) Course Contents:

1. Intrinsic and doped semiconductors, drift and diffusion currents.
2. PN junction diode: basic structure, I-V characteristics, large and small-signal models.
3. Diode circuit applications.
4. Bipolar junction transistor (BJT): basic structure, modes of operation, dc biasing, dc and small-signal models, single stage BJT amplifiers.
5. Field-effect transistors (FET): structure and operation of enhancement and depletion MOSFETs, I-V characteristics, dc biasing.
6. Introduction to JFET.

4) Teaching Methods:

Lectures

- Discussion

- Self-learning
- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Mid-Term Exams
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)…………………………….…. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. …………………………………………….………………………… (40 %)

6) Textbook(s):

- Floyd, Thomas L., et al. Electronic Devices (Electron Flow Version). 11th ed., Pearson, 2021.

7) References:

- A. S. Sedra and K. C. Smith, "Microelectronic Circuits: Theory and Applications", Oxford University Press, 2014.

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Course Title	Electronic Devices Lab
Course Code	414-EE-1
No. of Credit Hrs (Lecture + Tutorial/Lab)	1 (0+0+1)
No. of Contact Hrs (Lecture + Tutorial/Lab)	2 (0+0+2)
Level-Year	7-4
Prerequisite (if any)	Co(413-EE-3)

1) Course Objectives:

The course is designed to develop practical knowledge of basic electronic devices, their operation and application in designing modern electronic circuits.

2) Expected Learning Outcomes:

1. Explain fundamental concepts of semiconductor physics and their relevance to electronic devices. (PLO4)
2. Analyze, design, and construct electronic circuits using semiconductor devices while considering their applications and practical constraints. (PLO3 [6])
3. Apply foundational semiconductor knowledge to support learning in advanced electronic courses. (PLO4)
4. Evaluate practical results against theoretical expectations to validate circuit laws and principles. (PLO3 [6])
5. Prepare structured technical reports and collaborate effectively in team-based projects. (PLO8 [3])

3) Course Contents

Conduct experiments that cover the following topics

1 PN junction diode: basic structure, I-V characteristics, large and small-signal models.
2 Diode rectifier circuits, clipping and clamping, Zener diode simple regulator
3 Bipolar junction transistor (BJT): basic structure, modes of operation, dc biasing, dc and small-signal models, single stage BJT amplifiers.
4 Field-effect transistors (FET): structure and operation of enhancement and depletion MOSFETs, I-V characteristics, dc biasing.

4) Teaching Methods:

- Practical Demos
- In Lab experimental setup
- Discussion
- Self-learning

- Tutorial sheets

5) Mode of Evaluation:
Course Assessment Methods

- In Lab discussion
- Writing reports with results presentation
- Mid-Term practical Exams
- Final practical and oral Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………….. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. …………………………………………….……….……………… (40 %)

6) Textbook(s):

- Electronic Device Lab Manual designed specifically for this course with referring to the experiments listed

7) References:

- A. S. Sedra and K. C. Smith, "Microelectronic Circuits: Theory and Applications",Oxford University Press, 2014.
- Floyd, Thomas L., et al. Electronic Devices (Electron Flow Version). 11th ed., Pearson, 2021.

Course Title	**Electromechanical Energy Conversion 1**
Course Code	**421-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+2+0)**
Level-Year	**9-5**
Prerequisite (if any)	**221-EE-3**

1) Course Objectives:

This course aims at providing the basic knowledge required by practicing engineers for dealing with the principals and different types direct-current machines and transformers in order to:

1. Enhance the information about construction and main types of direct-current machines and transformers
2. Acquire the applications of direct-current machines and transformers
3. Assist to know the main characteristics of direct-current machines and transformers
4. Encourage Knowing the design aspects of direct-current machines and transformers
5. Enhance thought about main methods of deriving the equivalent circuit of direct-current machines and transformers
6. Enable Studying the main characteristics of transformers and their type and routine tests
7. Assist the knowledge about the concept of instrument transformers.

2) Expected Learning Outcomes:

1. Explain the fundamental principles of magnetic circuits, electromagnetic induction, and electromechanical energy conversion and relate them to the operation of transformers and electrical machines. (PLO1 [1])
2. Identify the different types and formulate the mathematical models of direct-current machines and transformers PLO1[1]
3. Apply magnetic-circuit principles, MMF equations, Faraday's law, and electromagnetic relationships to analyze and design electrical machines and electromechanical systems PLO2[2]
3. Apply traditional and computer-aided design methods to analyze the performance of transformers and electrical machines, including calculations of losses, efficiency, voltage regulation, current, power, torque, and machine parameters PLO4
4. Identify and evaluate the different methods of controlling the speed of direct-current motors. (PLO5 [4]) PLO5[4]
5. Identify and evaluate the issues and constraints of the safety procedures and act appropriately in critical situations when experimenting with transformer and electrical machines PLO5[4]

6. Compare the advantages, disadvantages, applications, and performance characteristics of transformers, DC machines, induction machines, synchronous machines, and their control methods PLO6 [4]

3) Course Contents:

1. 1. Fundamentals of Magnetic Circuits and Electromechanical Energy Conversion: Magnetic flux, flux density, magnetic field intensity, permeability, magnetomotive force (MMF), reluctance, magnetic-circuit analogy, series and parallel magnetic circuits, magnetic circuits with air gaps, B−H characteristics, saturation, hysteresis and eddy-current losses, Faraday's law, induced EMF, self and mutual inductance, magnetically coupled coils, magnetic-field energy and co-energy, and basic principles of electromagnetic force and torque production.

2.Transformer: Construction and operating principle of single-phase transformers; equivalent circuit; open-circuit and short-circuit tests; voltage transformation ratio; losses and efficiency; condition for maximum efficiency; voltage regulation under different power-factor loads.

3. DC Machine: Construction and operating principle of DC machines; generated EMF and back EMF equations; DC motor and generator operation; types of DC machines; torque equation; speed control of DC motors; losses, developed power, output power, and efficiency calculations.

4.Induction Machine: Construction and principle of operation of three-phase induction motors; rotating magnetic field; slip and rotor frequency; equivalent circuit; torque-speed characteristics; starting and speed-control methods; input current, input power, rotor copper loss, and efficiency calculations.

5. Synchronous Machine: Construction and operating principle of synchronous generators and motors; cylindrical and salient-pole rotor structures; armature reaction; armature leakage reactance; equivalent circuit; excitation and internal generated EMF; voltage regulation for unity, lagging, and leading power-factor loads; parallel operation and synchronizing torque.

4) Teaching Methods:

- Lectures
- Discussion
- Self-learning
- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Mid-Term Exams
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………..…. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations……. (30 %)
- Final Exam. ……………………………………………..……..……………….… (40 %)

6) Textbook(s):

- P. C. Sen, Principles of Electric Machines and Power Electronics
- Stephen J. Chapman, Electric Machinery Fundamentals

7) References:

- Course Notes: Presentation slides is submitted to student every lecture
- Recommended Books: Theodore Wildi, Electrical Machines, Drives and Power Systems
- Periodicals, Web Sites, … etc: To be cited during the course

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Course Title	**Numerical Methods**
Course Code	**422-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+2+0)**
Level-Year	**8-4**
Prerequisite (if any)	**319-MATH-3**

1) Course Objectives:

The primary goal is to provide electrical engineering majors with a basic knowledge of numerical methods including: root-finding, elementary numerical linear algebra, solving systems of linear equations, curve fitting, and numerical solution to ordinary differential equations.

2) Expected Learning Outcomes:

1. Identify and apply numerical methods to solve linear, nonlinear, and differential equations PLO1[1]
2. Design and evaluate algorithms for solving engineering problems involving different types of equations PLO2[2]
3. Evaluate and interpret the solutions by utilize computational tools for the problems related to linear, non-linear and differential equations PLO3 [6]
4. Evaluate the accuracy and limitations of numerical methods used in solving equations PLO1[1]
5. Formulate and solve real-world engineering problems using suitable numerical models and techniques PLO4

3) Course Contents:

1. Motivation and Basics of Numerical Computation and Interpolation
2. Solutions of Linear Equations: Direct Methods: Cramer’s Rule, Matrix Inversion Method, Gaussian Elimination Method, Gauss – Jordon Method, MATLAB implementation, Iterative Method: Jacobi Method, Gauss – Seidal Method, MATLAB implementation
3. Solutions of Non-Linear Equations: Root of a function, condition for root to lie between to end-points, Bisection Method, Secant Method, Newton-Raphson Method, MATLAB implementation.
4. Solution of Ordinary Differential Equations: 1st order differential equation, nth order differential equation, Solution of 1st order D.E: Taylor Series, Euler’s Method, Modified Euler’s Method, Runge – Kutta Methods
5. MATLAB programming to solve differential equations: Systems of O.D. Equations: Motivation and Basics of Numerical Computation and Interpolation

4) Teaching Methods:

- Lectures
- Discussion
- Self-learning
- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Tutorial Sheets
- Mid-Term Exams
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)…………………………….... (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…..... (30 %)
- Final Exam. ……………………………………………..……..………………… (40 %)

6) Textbook(s):

-Butt, Rizwan. Introduction to numerical analysis using MATLAB. Laxmi Publications, Ltd., 2008.

-MATLAB/SIMULINK: User's Guide" Math Works.

7) References:

- Dukkipati, R. V. "Numerical Methods Fundamentals." (2023): 1-450.

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Course Title	**Analog Communications**
Course Code	**423-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+2+0)**
Level-Year	**8 - 4**
Prerequisite (if any)	**322-EE-3**

1) Course Objectives:

To develop an understanding of signal analysis in time and frequency domain, analog modulation (AM) techniques and their performance in the presence of channel noise moreover, to provide experimental foundation for the theoretical concepts of the AM. The students will also become familiar with pulse modulation techniques.

2) Expected Learning Outcomes:

1. Analyze the spectral characteristics of periodic and aperiodic signals in time and frequency domains. (PLO-1[1])
2. Explain different analog modulation techniques, including AM, DSB-SC, SSB, FM, and PM, and their characteristics. (PLO-4)
3. Evaluate the characteristics and performance of amplitude and angle modulation techniques based on power and bandwidth considerations. (PLO-2 [2])
4. Compare theoretical results of modulation and demodulation techniques to interpret their performance in different conditions. (PLO-9 [7])
5. Asses the role of information theory, including entropy and source coding. (PLO-5[4])

3) Course Contents:

1. Review of spectrum for periodic and aperiodic signals – continuous and line spectra.
2. Linear modulation: Need for modulation, Expression for AM wave, power and BW, expression for DSB-SC/SSB, power and BW, comparison
3. Modulation and Demodulation of AM – Rectifier detector, envelope detector, Product Modulation and demodulation of DSB-SC, SSB – Frequency discrimination method, Hilbert transform, Phase discrimination method

4. Angle Modulation: FM expression, Bessel function analysis, power and BW considerations, Carson's rule for BW approximation, PM expression, relationship between FM and PM, Armstrong method of FM generation, PLL and FM demodulation using PLL
5. Introduction to Information theory – Entropy, Source coding: Huffman code, Shannon Fano code

4) Teaching Methods:

- Lectures
- Lab work
- Videos
- Discussion
- Self-learning
- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- In Lab discussion
- Writing reports with results presentation
- Mid-Term Exams
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………..… (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. …………………………………………..…….………………… (40 %)

6) Textbook(s):

- Simon Haykin, Communication Systems, John Wiley & Sons, Inc., New York, 5th Edition, 2009.
- Lab Nots

7) References:

- Bruce Carlson, Paul B. Crilly, and Janet C. Rutledge, Communication Systems, McGraw Hill, Boston, 4th Edition, 2002.
- B. P. Lathi, Modern Digital and Analog Communication Systems, Oxford University Press, New York, 3rd Edition, 1998.

Course Title	**Digital Signal Processing**
Course Code	**512-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+2+0)**
Level-Year	**9-5**
Prerequisite (if any)	**322-EE-3**

1) Course Objectives:

The course is designed to introduce the students to the representation of signals and systems in time and frequency domains. Mathematical tools fundamental to all DSP techniques shall be taught. An understanding of the design, analysis and implementation of DSP systems shall be developed.

2) Expected Learning Outcomes:

1. Describe time- and frequency-domain concepts and their applications in digital signal processing. (PLO4)
2. Apply digital signal processing (DSP) techniques to process analog signals and analyze the effects of down-sampling and up-sampling. (PLO1 [1])
3. Perform DTFT, DFT, and FFT operations on digital signals for spectral analysis and transformation. (PLO2 [2])
4. Analyze the architecture of DSP processors and compare commercially available DSP chipsets. (PLO3 [6])
5. Utilize hardware and software tools to program, implement, and test DSP operations such as sampling, quantization, convolution, and filtering using FIR and IIR filters. (PLO3 [6])

3) Course Contents:

1. Review of discrete-time signals and systems;
2. The Discrete-Time Fourier transform, Fast Fourier Transform
3. Z Transform, Recursive and no recursive digital filters design and realization;
4. Decimation and interpolation;
5. Applications of digital signal processing in communications.

4) Teaching Methods:

- Lectures
- Discussion

- Self-learning
- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Tutorial Sheets
- Mid-Term Exams
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)………………………………….. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. …………………………………………….……….………………… (40 %)

6) Textbook(s):

1.Proakis, J. G., & Manolakis, D. G. Digital Signal Processing: Principles, Algorithms and Applications, 5th ed., Pearson, 2021.

Pearson

2.Tan, L., & Jiang, J. Digital Signal Processing: Fundamentals, Applications, and Deep Learning, 4th ed., Elsevier/Academic Press, March 11, 2025. Elsevier Shop

3.McClellan, J. H., Schafer, R. W., & Yoder, M. DSP First, 2nd ed., Pearson, 2016

7) References:

1.Ingle, V. K., & Proakis, J. G. Digital Signal Processing Using MATLAB®: A Problem Solving Companion, 4th ed., Cengage, 2017.

2.Salivahanan, S. Digital Signal Processing, 4th ed., McGraw-Hill, 2019.

3.Bellanger, M. Digital Signal Processing: Theory and Practice, 10th ed., Wiley, 2024

Course Title	**Digital Signal Processing Lab**
Course Code	**513-EE-1**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**1 (0+0+1)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**2 (0+0+2)**
Level-Year	**9 - 5**
Prerequisite (if any)	**Co (512-EE-3)**

1) Course Objectives:

The course is designed to complement Digital Signal Processing theory course and intended to provide practical knowledge of digital signal processing

2) Expected Learning Outcomes:

1. Analyze digital signals and systems in time and frequency domains using MATLAB. (PLO4)
2. Interpret digital signals in both time and frequency domains using MATLAB. (PLO1 [1])
3. Apply sampling techniques to convert analog signals to digital and examine the effects based on the sampling theorem. (PLO3 [6])
4. Design and implement digital filters using MATLAB for signal processing applications. (PLO1 [1])
5. Utilize various hardware and software tools for programming, implementation, testing, and measurement of digital signal processing systems. (PLO2 [2], Measured in Lab Assignments & Projects)
6. Prepare structured technical reports and collaborate effectively in team-based projects. (PLO8 [3])

3) Course Contents:

1. Sampling –Sampling theorem
2. Quantization and calculation of quantization error
3. Up-sampling and Down-sampling
4. Fast Fourier Transform
5. FIR filter design
6. IIR filter design
7. Filtering and effects of filtering.

4) Teaching Methods:

- Practical Demos
- In Lab experimental setup
- Discussion
- Self-learning

- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- In Lab discussion
- Writing reports with results presentation
- Mid-Term practical Exams
- Final practical and oral Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)………………………………. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. …………………………………………….…………….………… (40 %)

6) Textbook(s):

1.McClellan, J. H.; Schafer, R. W.; Yoder, M. A.DSP First, 2nd ed., Prentice Hall, 2016. MathWorks
2.Ingle, V. K.; Proakis, J. G. Digital Signal Processing Using MATLAB®: A Problem Solving Companion, 4th ed., Cengage Learning, 2017. MathWorks
3.Schilling, R. J.; Harris, S. L. Digital Signal Processing using MATLAB®, 3rd ed., Cengage Learning, 2016 (some listings show 2017 printing/release).

7) References:

1.Poularikas, A. D.Understanding Digital Signal Processing with MATLAB and Solutions, CRC Press, 2018. MathWorks

2.Tan, L.; Jiang, J.Digital Signal Processing: Fundamentals and Applications, 3rd ed., Academic Press (Elsevier), 2019 (includes MATLAB/Toolbox usage). MathWorks

3.Giron-Sierra, J. M.Digital Signal Processing with MATLAB Examples, Volume 2, Springer, 2017

Course Title	**Electric Power System**
Course Code	**514-EE-3**
No. of Credit Hrs (Theoretical + Tutorial/Lab)	**3 (2+1)**
No. of Contact Hrs (Theoretical + Tutorial/Lab)	**4 (2+ 2)**
Level-Year	**5/9**
Prerequisite (if any)	**221-EE-3**

1) Course Objectives:

This course is aim to help the students to understand the basic components of a power system.

This course also deals the design and performance analysis of power transmission lines. Strong emphasis will be given to the demonstration of the theoretical material with examples drawn from per unit systems and the basic concepts of Power flow and load flow analysis. Application cases will be discussed during the lectures and will be further illustrated during the tutorials with real examples the methodologies for main and alternative sources of electrical energy.

2) Expected Learning Outcomes:

1. Identify the stucture and function of power system. (PLO1 [1]).
2. Formulate the concepts of power system and applications (PLO4).
3. Design, model, and analyze the transmission line and evaluate its performance (PLO2 [2]).
4. Conduct investigation on power system using per-unit system (PLO3 [6])
5. Apply power flow analysis techniques to analyse power system (PLO4)
6. Perform investigations related to transmission line modelling, power flow analysis and fault analysis (PLO3 [6])

3) Course Contents:

1. The Power System,
2. Transmission Line Parameters
3. Line Model and Performance
4. Per unit system calculation, per unit calculations and equivalent diagram
5. Power/ Load Flow Analysis
6. Balanced and Unbalanced Faults

4) Teaching Methods:

- Lectures
- Videos
- Discussion
- Self-learning
- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Mid-Term Exams
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)………………………………. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations……. (30 %)
- Final Exam. ………………………………………………………………………… (40 %)

6) Textbook(s):

- Hadi Saadat, "Power System analysis" McGraw-Hill,
- Stevenson WD,Jr "Elements of Power System analysis" McGraw-Hill, 4th Edition.Series) by Leonard L. Grigsby.

7) References

- Alarainy, et…," Fundamentals of electrical power engineering", King Saud Univ., academic press.
- Gross CA, "Power System analysis" John Wiley.

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Course Title	**Electric Power System Lab**
Course Code	**515-EE-1**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**1 (0+0+1)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**2 (0+0+2)**
Level-Year	**5/9 or 5/10**
Prerequisite (if any)	**Co (514-EE-3)**

1) Course Objectives:

1. Emphasized the concepts taught in the power system theoretical courses.
2. To gain the laboratory benefits of modeling an actual power system under different loading conditions.
3. Prepared to do experimental work in the graduation project when necessary.
4. Prepared to work in the field of operation, control and maintenance of power systems.
5. Giving the student the chance to recognize the induction and dc machine, and teach them how to read the name plate data of the machines and implement it.
6. Teaching the students, the essential experiments which are necessary to determine the parameters and the performance characteristics of the induction and dc machines
7. Emphasizing the concepts taught in the machine theoretical courses, and preparing them to do experimental work in their graduation project when necessary.

2) Expected Learning Outcomes:

1. Identify different electrical machines taught in the electromechanical energy conversion and power system courses,(PLO1 [1]).
2. Implement different tests on AC and DC machine to identify characteristics (PLO3 [6]).
3. Apply techniques to select suitable instruments and materials as per assigned objective of experiment (PLO3 [6]).
4. Design of power transmission lines models to transmission line models PLO2 [2].
5. Apply suitable Power flow analysis techniques for fault analysis (PLO3 [6]).
6. Prepare technical reports for laboratory experiments (PLO8 [3])

3) Course Contents:

Conduct experiments to cover the following topics

1. Symmetrical and unsymmetrical fault analysis;

2. Load-flow simulation;
3. Transient stability simulation;
4. Active and reactive power generator control;
5. Characteristics of isolated and interconnected systems.
6. Equivalent circuit of transformers;
7. Three-phase connections and harmonic problems;
8. Equivalent circuit of three-phase and single-phase induction motors;
9. Load testing of induction motors;
10. Starting of single-phase induction motors;
11. Terminal characteristics of dc machines.

4) Teaching Methods:

- Lab demos
- Videos
- In Lab dissection
- Self-learning

5) Mode of Evaluation:

Course Assessment Methods

- Lab demos
- In lab discussion
- Writing reports and results presentation
- Mid-Term Exams
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………….. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. ……………………………………………………………………………… (40 %)

6) Textbook(s):

1. J. D. Glover, T. J. Overbye, and M. S. Sarma, Power System Analysis and Design, 7th ed. Boston, MA, USA: Cengage Learn, 2023.
2. H. Saadat, Power System Analysis, 3rd ed. Prospect Press, 2022.
3. J. J. Grainger, W. D. Stevenson, and G. W. Chang, Power System Analysis. New York, NY, USA: McGraw-Hill Education, 2016.

7) References:

1. D. P. Kothari and I. J. Nagrath, Modern Power System Analysis, 5th ed. New Delhi, India: McGraw Hill Education (India), 2019.
2. P. Kundur, G. J. Rogers, and D. Y. Wong, "Power System Stability and Control: A Tutorial Introduction," in IEEE Power and Energy Magazine, vol. 19, no. 5, pp. 22-31, Sept.-Oct. 2021, doi: 10.1109/MPE.2021.3097671

Course Title	**Analog and Digital Electronic Circuits**
Course Code	**521-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+2+0)**
Level-Year	**9 - 5**
Prerequisite (if any)	**413-EE-3**

1) Course Objectives:

This course covers the design, construction, and debugging of analog and digital electronic circuits. The main contents are: Op-amp applications: inverting and non-inverting amplifiers, integrator, difference amplifier. Differential amplifier. Current Mirror. Negative and positive feedback. Frequency response of cascaded amplifiers and gain-bandwidth considerations. Concepts of feedback, stability and frequency compensation. Includes weekly laboratory

2) Expected Learning Outcomes:

1. Acquire fundamental knowledge of analog and digital integrated circuits, including their principles and applications. (PLO9 [7])
2. Apply appropriate techniques to analyze and design operational amplifiers, active filters, and power amplifiers for various applications. (PLO4)
3. Design digital and analog circuit solutions while considering practical constraints and performance requirements. (PLO2 [2])
4. Analyze the role of feedback and frequency response in enhancing circuit performance. (PLO5 [4])
5. Identify and analyze modern circuit technologies and their impact on electrical and electronic systems. (PLO1 [1])

3) Course Contents:

1. Introduction and background.
2. Frequency Response.
3. Operational Amplifiers & Active Filters.

4. Power Amplifiers.
5. Digital ICs.
6. Feedback & Oscillators.
7. Digital Circuits

4) Teaching Methods:

- Lectures
- Videos
- Discussion
- Self-learning
- Tutorial sheets
- **Lab Work**

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Mid-Term Exams
- Final Exam
- **In Lab Discussion**

Evaluation

- Mid-Term Tests (Not less than two Exams)………………………………. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. ……………………………………………………………………………… (40 %)

6) Textbook(s):

− Floyd, Thomas L., et al. Electronic Devices (Electron Flow Version). 11th ed., Pearson, 2021.
− Razavi, Behzad. Fundamentals of Microelectronics. 3rd ed., Wiley, 2021.

7) References:

− Sedra, Adel S., Tony Chan Carusone, Vincent Gaudet, and Kenneth C. Smith. Microelectronic Circuits. 8th ed., Oxford University Press, 2020.

Course Title	**Analog and Digital Electronic Circuits Lab**
Course Code	**522-EE-1**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**1(0+0+1)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**2 (0+0+2)**
Level-Year	**9 - 5**
Prerequisite (if any)	**Co (521-EE-3)**

1) Course Objectives:

This course is designed to:

1. Emphasize the concepts taught in the analog and digital electronic course.
2. Gain the laboratory benefits of modeling an actual Ideal and Non-Ideal Op-amp circuits and its applications.
3. Analyze different analog and digital electronic circuits such as BJT, CMOS, TTL and ECL.
4. Emphasizing the concepts taught in the theoretical courses, and preparing them to do experimental work in their graduation project when necessary

2) Expected Learning Outcomes:

1. Explain the fundamental principles and applications of digital logic circuits. PLO4
2. Design and implement periodic signal generators using digital logic circuits PLO2 [2],
3. Analyze filter design principles and circuit technologies for signal processing applications. PLO4
4. Apply theoretical concepts to design, implement, and evaluate analog filter circuits and operational amplifier-based digital electronic circuits by comparing practical results with theoretical expectations. PLO3 [6],
5. Collaborate effectively in teamwork-based projects and assignments. PLO7 [5],
6. Prepare structured technical reports based on lab experiments. PLO8 [3]

3) Course Contents

1. Orientation.
2. Ideal OP-Amp characteristics.
3. Ideal Op-amp Application.
4. Non ideal op-amp characteristics.
5. Non-ideal op-amp applications.
6. Oscillators, Schmitt trigger and unstable multi-vibrator.
7. CMOS inverter characteristics.
8. TTL inverter characteristics.
9. ECL characteristics

4) Teaching Methods:

- Practical Demos
- In Lab experimental setup
- Discussion
- Self-learning
- Tutorial sheets
- Lab Work

5) Mode of Evaluation:

Course Assessment Methods

- In Lab discussion
- Writing reports with results presentation
- Mid-Term practical Exams
- Final practical and oral Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)…………………………….. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations……. (30 %)
- Final Exam. ………………………………………….…….….………….……… (40 %)

6) Textbook(s):

− Analog & Digital Electronic Circuits Lab Manual designed specifically for this course with referring to the experiments listed

7) References:

Floyd, Thomas L., et al. Electronic Devices (Electron Flow Version). 11th ed., Pearson, 2021.

Course Title	**Digital Control Systems**
Course Code	**523-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+ 2+0)**
Level-Year	**9 - 5**
Prerequisite (if any)	**411-EE-3**

1) Course Objectives:

1. The core course in electrical engineering introduces the fundamental concepts, principles and application of digital control system analysis.
2. This course goes deeper into the various aspects of digital control engineering.
3. The topics cover classical control design methods as well as the modern control design techniques.
4. A number of chosen problems are solved to illustrate the concepts clearly. A suite of exercises is also provided in the appendix after each module.

2) Expected Learning Outcomes:

1. Formulate the principle of stability, as well as Interpret variable models and the various types of digital control systems. (PLO4)
2. Analyze the issues faced in sampling, digital data and discrete time systems (PLO1-SO1 [1])
3. Design digital controllers either by emulating continuous time compensators or by direct digital design using the root Locus and frequency response methods (PLO2-SO2 [2])
4. Organize the students into groups to collaborate and identify simple and relevant digital control problems relevant to contemporary needs and implement them using hardware or software. (PLO7-SO5 [5])
5. Evaluate the impact of the digital control techniques on the economic and time-saving for several selected process (PLO2-SO2 [2])

3) Course Contents

1. Introduction, digital control system and Analog control system
2. Discrete time systems and the z-transform and properties of the z-transform
3. Solution of difference equations
4. The inverse z-transform, simulation diagrams and flow graphs,
5. State variables, transfer functions, solutions of the state equations
6. Sampling and reconstruction
7. Open-loop discrete time systems
8. State variable models, discrete state equations.
9. Closed-loop systems: derivation procedure, state-variable models
10. Controllability and Observability
11. Stability analysis techniques

4) Teaching Methods:

- Lectures
- Videos
- Discussion
- Self-learning
- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Mid-Term Exams
- Tutorial Sheets
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………….. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations……. (30 %)
- Final Exam. ……………………………………………………………………….. (40 %)

6) Textbook(s):

1. G. F. Franklin, J. D. Powell, and M. L. Workman, Digital Control of Dynamic Systems, 3rd ed., eEdition-2, Ellis-Kagle Press, 2022.
2. K. Ogata, Discrete-Time Control Systems, 2nd ed., Prentice Hall, 1995.

7) References:

1. C. L. Phillips, H. T. Nagle, and A. Chakrabortty, Digital Control System Analysis & Design, 4th ed., Pearson, 2014.
2. M. S. Fadali and A. Visioli, Digital Control Engineering: Analysis and Design, 2nd ed., Academic Press, 2013.
3. B. C. Kuo, Digital Control Systems, 2nd ed., Saunders College Publishing, 1992.

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Specialization

(Power)

Course Title	**Electromechanical Energy conversion 2**
Course Code	**531-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+ 2+0)**
Level-Year	**9-5**
Prerequisite (if any)	**531-EE-3**

1) Course Objectives:

This course aims at providing the basic knowledge required by practicing engineers for dealing with induction and synchronous machines in order to:

1. Improve knowledge for the construction and the principle of operation of the three phase induction and synchronous machines
2. Acquire information concerning the equivalent circuit and different experimental tests of a three phase induction and synchronous machines
3. Help dealing with the power relation and characteristic curves of the three phase induction and synchronous machines
4. Enable Studying the methods of speed control and starting of induction motor
5. Enhance thought about the Equivalent circuit, starting methods of a single phase induction motor
6. To provide experimental foundation for the theoretical concepts introduced in the theoretical courses of Electromechanical Energy conversion.

2) Expected Learning Outcomes:

1. Identify operating principles of induction and synchronous machines (PLO1 [1])
2.Investigation on induction and synchronous machines using different test (PLO3[6])
3. Adapting different techniques to control the speed and starting AC motors (PLO4)
4. Formulation of mathematical model for evaluation of voltage regulation and efficiency of AC machines (PLO1 [1])
5. Evaluation of performance characteristics to analyse synchronous machines (PLO5 [4])

3) Course Contents:

1. AC armature windings
2. Three phase induction motor types, Construction, principles of operation and modes of operation

3. Equivalent circuit and measurement tests of a three phase induction motor
4. Power balance equations, Torque/speed curves of a 3 phase I.M.
5. Speed control methods of a 3 phase I.M.
6. Starting methods of a three phase induction motor of a 3 phase I.M.
7. Construction of synchronous
8. Armature reaction, armature leakage reactance and equivalent circuit of cylindrical synchronous machine
9. Equivalent circuit of salient pole synchronous machine
10. Determination of parameters
11. Voltage regulation for unity, lagging and leading power factor loads
12. Parallel operation and synchronizing torque
13. Equivalent circuit of synchronous motors
14. V-curves and Synchronous Condenser
15. Synchronous motor starting

4) Teaching Methods:

- Lectures
- Discussion
- Self-learning
- Tutorial sheets
- Lab work

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- In Lab discussion
- Writing reports with results presentation
- Mid-Term Exams
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………..…. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. …………………………………………..……………………… (40 %)

6) Textbook(s):

1.Franchi, C.. Electrical Machine Drives: Fundamental Basics and Practice. 1st ed.. CRC Press, 2019.

2.Boldea, I.. Reluctance Electric Machines: Design and Control. 1st ed.. CRC Press, 2020.

3.Demerdash, N.A.O., et al.. Electric Machinery and Drives: An Electromagnetics Perspective. 1st ed.. Wiley-IEEE Press, 2025.

7) References:

1.Boldea, I.. Reluctance Electric Machines: Design and Control. 1st ed.. CRC Press, 2020.

2.Llorente, S., et al.. Practical Control of Electric Machines. 1st ed.. Springer, 2020.

3.Bianchi, N., et al.. Permanent Magnet Synchronous and Brushless DC Motor Drives. 2nd ed.. Wiley-IEEE Press, 2018.

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Course Title	**High Voltage Engineering**
Course Code	**533-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+ 2+0)**
Level-Year	**10 – 5**
Prerequisite (if any)	**221-EE-3**

1) Course Objectives:

This course is delivered to clearly and understand the basic concepts of high voltage generation, measurement and testing techniques. Furthermore, the properties, applications and conduction and breakdown phenomena in various classes of insulation materials are discussed in this course. To provide experimental foundation for the theoretical concepts introduced in the theoretical courses of High Voltage Engineering.

2) Expected Learning Outcomes:

1. Idenitfy the basic principles of high voltage generation and applications of high votlage engineering(PLO1[1])
2. Investigations on various ionization processes in the field of high voltage engineering (PLO3 [6])
3. Implement solutions to solve problems in high votlage engineering(PLO2 [2])
4. Design of experiments in the high voltage Laboratory (PLO3 [6])
5. Apply appropriate techniques for break down process and applications of high voltage engineering. (PLO4)
6. Communicate Effectively on Engineering Activities. (PLO8[3])

3) Course Contents:

1. Introduction to high voltage (Concepts and types)
2. Generation of high voltage 1

3. Generation of high voltage 2
4. Measurements and testing of high voltage
5. Generalized HV testing circuit
6. High voltage breakdown theories for insulating materials
7. Underground cable (operation and construction)
8. Experiment on solid

4) Teaching Methods:

- Lectures
- Videos
- Discussion
- Self-learning
- Tutorial sheets
- Lab demos

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Lab demos
- Writing reports and results presentation
- Mid-Term and Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)…………………………….…. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. …………………………………………..…….……….…………… (40 %)

6) Textbook(s):

-RIZK, Farouk AM; TRINH, Giao N. ,” High voltage engineering, “CRC Press, 2018.

7) References:

1- KÜCHLER, Andreas. High Voltage Engineering: Fundamentals-Technology-Applications. Springer, 2017.

2- ARORA, Ravindra; MOSCH, Wolfgang. High voltage and electrical insulation engineering. John Wiley & Sons, 2022.

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Course Title	**Power System Analysis**
Course Code	**534-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+ 2+0)**
Level-Year	**10 - 5**
Prerequisite (if any)	**514-EE-3**

1) Course Objectives:

Understanding the fundamentals of both normal and abnormal operations of power systems. Analyzing the normal operation through power flow calculations. Analyzing the abnormal operation through symmetrical fault, symmetrical components and stability calculations. To gain the laboratory benefits of modeling an actual power system under different loading conditions. Prepared to do experimental work in the graduation project when necessary. Prepared to work in the field of operation, control and maintenance of power systems.

2) Expected Learning Outcomes:

1. Analyze basic stability concepts of power systems analysis (PLO1 [1]
2. Evaluate the transient behavior of fault currents in sysnchronous generator. PLO2 [2]
3. Evaluate transient stability problems in power systems. PLO4
4. Design and model of stability of multi-machine systems and small signal disturbances. PLO2[2]
5. Idenitfy and evaluate the load frequency control and automatic voltage regulation in power system stability. PLO5 [4]

3) Course Contents:

1. Per Unit system; Power System Matrices.
2. Bus Admittance Matrix; Bus Impedance Matrix.
3. Load Flow Analysis by Gauss-Seidel Method and Newton-Raphson Method.
4. Fast decoupled solution, Sparsity techniques.
5. Symmetrical Components, Sequence networks of loads, Sequence networks of series impedances, Sequence networks of machines. Sequence networks of transformers
6. System modeling under fault conditions, Fault calculation using Zbus, Circuit breaker selection.
7. Stability Analysis: steady state stability, transient stability and equal area criterion.

8. Symmetrical and unsymmetrical fault analysis
9. Load-flow simulation
10. Transient stability simulation;

4) Teaching Methods:

- Lectures
- Videos
- Discussion
- Lab demos
- In Lab Discussion
- Self-learning
- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Lab demos
- In lab discussion
- Writing reports and results presentation
- Mid-Term Exams
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)………………………………. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations……. (30 %)
- Final Exam. ………………………………………………………………………… (40 %)

6) Textbook(s):

1.Kothari, D.P., Nagrath, I.J., & Saket, R.K.. Modern Power System Analysis. 5th ed.. McGraw Hill, 2022.

2.Glover, J.D., Sarma, M.S., Overbye, T.J., & Birchfield, A.B.. Power System Analysis and Design. 7th ed.. Cengage Learning, 2022.

3. Shertukde, H.M.. Power Systems Analysis Illustrated with MATLAB and ETAP. 1st ed.. CRC Press, 2019.

7) References:

1.Das, J.C.. Power System Analysis: Short-Circuit Load Flow and Harmonics. 2nd ed.. CRC Press, 2
2.Wang, X.-F., et al.. Modern Power Systems Engineering: Analysis, Stability, and Control. 1st ed..

3. Glover, J.D., & others (eds.). Uncertainties in Modern Power Systems. 1st ed.. Academic Press

Course Title	Power electronics
Course Code	535-EE-3
No. of Credit Hrs (Lecture + Tutorial/Lab)	3 (2+1+0)
No. of Contact Hrs (Lecture + Tutorial/Lab)	4 (2+2+0)
Level-Year	5/9
Prerequisite (if any)	413-EE-3

1) Course Objectives:

This course aims at providing the basic knowledge required by practicing engineers for dealing with power electronics in order to:

1. Acquire information concerning the different types of power converters
2. Enhance thought about the main methods of AC regulators
3. Improve knowledge for the main difference between different types of dc chopper circuits
4. Help dealing with the different types of inverter circuits and their applications
5. To provide experimental foundation for the theoretical concepts introduced in the theoretical courses of power electronics such as power converters and rectifiers power switches.

2) Expected Learning Outcomes:

1. Identify the operational principle of various power electronic devices. (PLO1 [1])
2. Identify the difference between AC to DC converters, AC regulators and cycle converter. (PLO1 [1])
3. Identify the advantages and disadvantages of the different regulators of chopper circuits. (PLO1 [1])
4. Identify and formulate mathematical formulas for dealing with three phase inverters. (PLO1 [1])
5. Apply the different methods used for the protection of control units. (PLO4)
6. Create and select suitable firing circuits for power converters and inverters. (PLO4)

3) Course Contents

1. AC to DC converters - AC regulators – Cycle converters
2. Chopper circuits: Buck regulator, Boost regulator, Buk-Boost regulators, and cuk regulators
3. Converter operation - Pulse circuits
4. Three phase voltage source inverter - Stepped inverters – six step inverter - PWM inverters
5. Current source inverters
6. Voltage source inverters
7. Firing circuits
8. Control units – Protection

9. Heat sinks – Isolation

4) Teaching Methods:

- Lectures
- Discussion
- Self-learning
- Tutorial sheets
- Lab work

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment and Tutorial Sheets
- Lab demos
- In lab discussion
- Writing reports and results presentation
- Mid-Term and Final Exams

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………..… (30 %)
- Practical Work and Assignments/HW/Projects/Presentations……. (30 %)
- Final Exam. …………………………………………….……….…………..……… (40 %)

6) Textbook(s):

Muhammed H. Rashid, "Power Electronics Devices, Circuits, and Applications", 3rd edition, 2015

7) References:

1. R. W. Erickson and D. Maksimović, Fundamentals of Power Electronics, 3rd ed. Cham, Switzerland: Springer Nature, 2020

Specialization

(Communication)

Course Title	**Digital Communications**
Course Code	**541-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+2+0)**
Level-Year	**9-5**
Prerequisite (if any)	**423-EE-3**

1) Course Objectives:

To develop an understanding of digital communication systems and the techniques used in digital communication. The trade-off between error probability and data rate shall be understood.

2) Expected Learning Outcomes:

1. Define the fundamentals of digital communications (PLO4)
2. Analyze and design digital communication systems (PLO1 [1])
3. Implement methods to manage the trade-offs between data rate and error probability in digital communication systems. (PLO2 [2])
4. Collaborate in group/team activities in design experiments (PLO7 [5])
5. Analyze the impact of the digital communications techniques on the economic and environmental issues (PLO5 [4])

3) Course Contents:

1. Introduction to Digital Communication
2. Sampling, PCM, DPCM, DM, Line Coding.
3. Review of probability theory; Baseband pulse transmission (matched filters, intersymbol interference); M-ary signaling and error probability in the presence of AWGN, Eye pattern
4. Nyquist criteria;
5. Equalization;
6. Digital Passband transmission: Coherent PSK, FSK, QPSK, MSK.
7. Noncoherent orthogonal modulation; Power spectra and bandwidth efficiency of binary and quaternary modulation schemes.

4) Teaching Methods:

- Lectures
- Videos
- Discussion
- Self-learning

- Tutorial sheets
- Lab work

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- In Lab discussion
- Mid-Term Exams
- Tutorial Sheets
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………….. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. ……………………………………………………………………… (40 %)

6) Textbook(s):

– Simon Haykin, Communication Systems, John Wiley & Sons, Inc., New York, 5th Edition, 2009.

– Lab nots

7) References:

– B. P. Lathi, Modern Digital and Analog Communication Systems, Oxford University Press, New York, 5th Edition, 2019

_ Bruce Carlson, Paul B. Crilly, and Janet C. Rutledge, Communication Systems, McGraw Hill, Boston, 4th Edition, 2002.

Course Title	**Antennas and Wave Propagation**
Course Code	**543-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+2+0)**
Level-Year	**9-5**
Prerequisite (if any)	**323-EE-3**

1) Course Objectives:

To emphasize the concepts of electromagnetics and field theory and develop the capability to apply these concepts to transmission lines and antennas.

2) Expected Learning Outcomes:

1. Analyze time-varying electromagnetic fields, including Faraday's law, displacement current, Maxwell's equations, and power transfer using the Poynting vector (PLO-1 [1])
2. Evaluate plane wave propagation in free space, lossy dielectrics, and good conductors, including polarization and wave reflection (PLO-2[2]
3. Interpret the principles of transmission lines and impedance matching in electromagnetic wave propagation (PLO-4)
4. Explain the fundamental concepts of radiation and antennas, including antenna parameters and wire antennas (PLO-9 [7])
5. Assess the performance of transmission lines and antennas based on the effects of electromagnetic waves in engineering applications (PLO-5 [4])

3) Course Contents:

1. Time varying fields; Faraday's law. Transformer and motional emfs; Displacement current; Maxwell's equations and time harmonic fields; Wave equation; Power transfer and Poynting vector;
2. Plane wave propagation in free space, in lossy dielectrics and in good conductors; Polarization; Reflection of plane wave at normal and oblique incidence.
3. Transmission lines; Impedance matching.
4. Introduction to radiation and antennas; Antenna parameters; Wire antennas.

4) Teaching Methods:

- Lectures
- Videos
- Discussion
- Self-learning

- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Mid-Term Exams
- Tutorial Sheets
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)…………………………….…. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. …………………………………………….……………………… (40 %)

6) Textbook(s):

1. C. A. Balanis, Antenna Theory: Analysis and Design, 4th ed. Hoboken, NJ, USA: Wiley, 2016.
2. W. L. Stutzman and G. A. Thiele, Antenna Theory and Design, 3rd ed. Hoboken, NJ, USA: Wiley, 2018.

7) References:

- Antennas And Wave Propagation, 5th Edition Paperback (2017) John D. Kraus and Ronald J. Marhefka, McGraw Hill.

Course Title	**Wireless Communication**
Course Code	**545-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+2+0)**
Level-Year	**10 -5**
Prerequisite (if any)	**423-EE-3**

1) Course Objectives:

This course provides a comprehensive overview and advanced knowledge of modern mobile and wireless communication systems. The course also provides understanding of the challenges and opportunities brought by the wireless medium in designing current and future wireless communication systems and networks.

2) Expected Learning Outcomes:

After completing this course, the students should be able to:

1. Analyze cellular concepts to evaluate the signal reception performance in a cellular network (PLO-1 [1]
2. Evaluate and solve problems related to various techniques used in wireless communication systems(PLO-2 [2]
3. Evaluate data rate and error performance of various wireless communication techniques (PLO-5 [4]
4. Explain the four generations of wireless standards for cellular networks(PLO-4)
5. Recognize the key principles of 3G (CDMA) and 4G (OFDM) technologies in wireless communication systems (PLO-9 [7]

3) Course Contents:

1. Overview of digital wireless communications and cellular concept;
2. interference and traffic analysis for cellular networks;
3. wireless fading channel modelling and characterization;
4. modulation and detection performance over fading channels;
5. equalization techniques; multi-carrier systems;
6. spread spectrum techniques;

7. receiver and transmitter diversity techniques;
8. information theory of wireless channels;
9. multiple antenna systems and space-time communications;
10. and cooperative communications; 2G standards (e.g. GSM, CDMA), 3G standards and beyond.

4) Teaching Methods:

- Lectures
- Videos
- Discussion
- Self-learning
- Tutorial sheets

5) Mode of Evaluation:
Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Mid-Term Exams
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………..…. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. ……………………………………………..……………………… (40 %)

6) Textbook(s):

– D. Tse and P. Viswanath, Fundamentals of Wireless Communication. Cambridge, U.K.: Cambridge University Press, 2016.

7) References:

1- D. Tse and P. Viswanath, Fundamentals of Wireless Communication. Cambridge, U.K.: Cambridge University Press, 2016.
2- R. W. Heath Jr., Introduction to Wireless Digital Communication: A Signal Processing Perspective. Upper Saddle River, NJ, USA: Prentice Hall, 2017.

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Course Title	**Communication Systems**
Course Code	**546-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+2+0)**
Level-Year	**10-5**
Prerequisite (if any)	**423-EE-3**

1) Course Objectives:

To introduce students to the theory, design analysis and operation of communication systems. This course aims to represent the basic knowledge necessary for transmitting and receiving information using today's communication technologies.

2) Expected Learning Outcomes:

1. Analyze copper wire transmission systems and Digital Subscriber Loops (xDSL) for system design and modelling (PLO-1 [1])
2. Evaluate radio transmission techniques, including Wireless Local Loops (WLL), satellite communication systems (GEO, MEO, LEO), and VSATs (PLO-2 [2]
3. Evaluate the impact of noise parameters, including Noise Figure, Signal-to-Noise Ratio (SNR), and link budget, on the performance of communication systems (PLO-1 [1])
4. Explain the concepts of spectrum management, frequency planning, spread spectrum, and CDMA (PLO-9 [7])
5. Assess the role of key 3G (CDMA) and 4G (OFDM) technologies in wireless communication systems (PLO-5 [4])

3) Course Contents

1. copper wire transmission systems, Digital subscriber loops (xDSL)
2. Introduction to radio transmission systems; wireless local loops (WLL); satellite systems for fixed and mobile communications (GEO, MEO, LEO) ; VSATs systems.
3. Noise, Noise – Figure and SNR analysis in communication systems.
4. Link budget analysis, Principles of cellular mobile systems.
5. Mobile Communications; Spectrum Management and Frequency Planning, Spread Spectrum and CDMA

4) Teaching Methods:

- Lectures
- Videos
- Discussion
- Self-learning
- Tutorial sheets

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Mid-Term Exams
- Tutorial Sheets
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)…………………………….... (30 %)
- Practical Work and Assignments/HW/Projects/Presentations……. (30 %)
- Final Exam. …………………………………………..……………………… (40 %)

6) Textbook(s):

- Forouzan, Behrouz A. Data communications and networking with TCP/IP protocol suite. McGraw-Hill US Higher Ed USE, 2021.
- Communication Networks, Fundamental Concepts and Key Architectures, Alberto Leon-Garcia & Indra Widjaja, Mc Graw Hill, 2002.

7) References:

- Telecommunication Transmission Handbook, Roger Freeman, Wiley Inter-sciences, 1991
- Wireless Communications: Principles and Practice By T.S. Rappaport, Prentice Hall

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Specialization

(Electronics)

Course Title	**Electronic Instrumentation**
Course Code	**551-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+ 2+0)**
Level-Year	**9-5**
Prerequisite (if any)	**413-EE-3**

1) Course Objectives:

The purpose this course is to introduce students to the basic electronic components and circuits used in instrumentation systems. They will also gain a good understanding of their design and applications.

2) Expected Learning Outcomes:

By the end of this course the student will:

1. Identify and analyze the operating principles of electrical transducers and instrumentation systems used in electronic measurements. PLO1 [1]
2. Construct an electronic measurement system including transducers, recorders, and display systems based on engineering requirements and constraints. PLO2 [2]
3. Explain the operation and application of instrumentation tools, such as DMMs, DSOs, and signal analyzers, in performing and interpreting electronic measurements. PLO8 [3]
4. Evaluate the sustainability and impacts of electronic measurement systems and technologies used in various engineering applications. PLO5 [4]

3) Course Contents:

1. 555 Timer and its applications.
2. Analog switches and Analog multipliers.
3. Operational trans-conductance amplifier (OTA).
4. Current conveyor.
5. Switched capacitor circuits.
6. Phase-locked-loop (PLL) with applications.
7. Data conversion: digital-to-analog and analog-to-digital converters.
8. Digital PLL.

4) Teaching Methods:

- Lectures

- Videos
- Discussion
- Self-learning
- Tutorial sheets
- Lab Work

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Mid-Term Exams
- Tutorial Sheets
- Final Exam
- In Lab Discussion

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………..…. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. …………………………………………….…………..……………… (40 %)

6) Textbook(s):

- Electrical and Electronics Measurements and Instrumentation, Prithwiraj Purkait et al, McGraw Hill Education Private Limited (2013).

7) References:

- Electronic Instrumentation and Measurements David A bell 2nd edition
- Sawhney, A. K., and Puneet Sawhney. A Course in Electrical and Electronic Measurements and Instrumentation. 4th ed., Dhanpat Rai & Co.
- "Design with Operational Amplifiers and Analog Integrated Circuits", Franco, 3 rd Edition, McGraw Hill, 2001.

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Course Title	**Embedded system design**
Course Code	**552-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+2+0)**
Level-Year	**9 - 5**
Prerequisite (if any)	**324-EE-3**

1) Course Objectives:

In this course, the fundamentals of embedded system hardware and firmware design will be explored. This course presents state-of-the-art methods, concepts, tools and techniques for system-level design and modeling of complete multi-processor systems from specification down to implementation across hardware-software boundaries. Using the SpecC and SystemC languages and the System-On-Chip Environment (SCE), we will specify, simulate, analyze, model and design systems based on examples of typical embedded applications.

2) Expected Learning Outcomes:

1. Identify the fundamental principles of embedded systems. (PLO1[1])
2. Implement solutions to solve problems in the embedded system domain. (PLO2[2])
3. Analyze the requirements of an embedded system. (PLO5[4])
4. Apply modern engineering tools and techniques to embedded systems. (PLO4)
5. Communicate Effectively on Engineering Activities. (PLO8[3])

3) Course Contents

1. Embedded systems,
2. electronic system-level (ESL) design;
3. System-level design languages (SLDLs): SpecC, SystemC;
4. Models of Computation (MoCs): finite state machines (FSMs), dataflow, process networks, discrete event;
5. System specification, profiling, analysis and estimation;

6. System-level design: partitioning, scheduling, communication synthesis;
7. System-level modeling: processor and RTOS modeling, transaction-level modeling (TLM) for communication;
8. System-level synthesis: design space exploration (DSE);
9. Embedded hardware and software implementation:
10. synthesis and simulation;
11. System design examples and case studies.

4) Teaching Methods:

- Lectures
- Videos
- Discussion
- Self-learning
- Tutorial sheets
- Lab Work

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Mid-Term and Final Exams
- Tutorial Sheets
- In-Lab Discussion

Evaluation

- Mid-Term Tests (Not less than two Exams)……………………………….. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. …………………………………………………………………………… (40 %)

6) Textbook(s):

- D. D. Gajski, S. Abdi, A. Gerstlauer, G. Schirner, Embedded System Design: Modeling, Synthesis, Verification, ISBN 978-1-4419-0503-1, Springer, 2009.

7) References:

- Gerstlauer, Andreas, et al. System design: a practical guide with SpecC. Springer Science & Business Media, 2012.
- T. Groetker, S. Liao, G. Martin, S. Swan, System Design with SystemC, ISBN-10 : 1441952853, 3rd, 2010.
- F. Vahid, T. Givargis, Embedded System Design: A Unified Hardware/Software Introduction, ISBN 978-0-471-38678-0, John Wiley & Sons, 2001.

Course Title	**VLSI Design**
Course Code	**554-EE-3**
No. of Credit Hrs (Lecture + Tutorial/Lab)	**3 (2+1+0)**
No. of Contact Hrs (Lecture + Tutorial/Lab)	**4 (2+ 2+0)**
Level-Year	**10 - 5**
Prerequisite (if any)	**413-EE-3**

1) Course Objectives:

At the end of this course the student should be able to:

1. Understand the concepts history of LSI integration
2. Understand the fabrications steps of IC
3. Understand the concepts of design rules
4. Layout and verify the different passive element and CMOS and BJTs.
5. Design a digital integrated circuit and characterize using simulators.
6. Implement a simple digital system on FPGA.

2) Expected Learning Outcomes:

1. Analyze and apply CMOS technology principles to design and characterize digital circuits, considering logic components, interconnects, and performance metrics. PLO1 [1]
2. Design, simulate, and optimize CMOS-based combinational and sequential circuits to meet specified functional and performance requirements. PLO2 [2]
3. Apply layout design rules to efficiently place and route transistors in CMOS digital circuits, ensuring the validity of functionality and performance. PLO4
4. Evaluate and compare different state-of-the-art CMOS fabrication processes and their impact on circuit design, power, timing, and parasitic effects. PLO5 [4]
5. Design, Simulation, and Implementation of Logic Circuits & systems in the FPGA based VLSI Design Projects. PLO7 [5]

3) Course Contents:

1. Introduction to VLSI Systems
2. CMOS logic, fabrication and layout

3. MOS Transistor theory
4. Layout Design Rules
5. Circuit characterization and performance estimation
6. Circuit Simulation
7. Combinational and sequential circuit design
8. Memory system design
9. Introduction about digital system implementation on FPGA

4) Teaching Methods:

- Lectures
- Videos
- Discussion
- Self-learning
- Tutorial sheets
- Lab Work

5) Mode of Evaluation:

Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Mid-Term Exams
- Final Exam
- In Lab Discussion

Evaluation

- Mid-Term Tests (Not less than two Exams)…………………………….. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. ………………………………………………………………… (40 %)

6) Textbook(s):

- Weste, Neil H. E., and David Money Harris. CMOS VLSI Design: A Circuits and Systems Perspective. 4th ed., Pearson, 2023.

7) References:

- Mano, M. Morris, and Michael D. Ciletti. Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog. 6th ed., Pearson, 2018.
- Principles of CMOS VLSI design by N H E Weste & K Eshraghian, **Addison Wesley** Second Edition
- Wolf, Wayne H. Modern VLSI Design: IP-Based Design. 4th ed., Prentice Hall , 2010.

Course Title	Solar Cells and Photovoltaic Systems
Course Code	556-EE-3
No. of Credit Hrs (Lecture + Tutorial/Lab)	3 (2+1+0)
No. of Contact Hrs (Lecture + Tutorial/Lab)	4 (2+ 2+0)
Level-Year	10-5
Prerequisite (if any)	514-EE-3

1) Course Objectives:

Through this course, the students will gain awareness about the relevance of PV systems as an alternative energy source. The knowledge of the modelling, analysis, design and application of photovoltaic systems will also be acquired.

2) Expected Learning Outcomes:

By the end of this course the student will be able to:

1. Explain the principles of semiconductor physics and their application in solar cell operation and photovoltaic systems. PLO1 [1]
2. Design and analyze photovoltaic systems, considering their components, performance, and efficiency using solar cell parameters. PLO2 [2]
3. Apply the concepts of Photovoltaic Cells, Modules, Arrays, and Systems in optimizing the performance of solar energy systems. PLO3 [6]
4. Evaluate the challenges and solutions for designing and deploying solar energy systems, including balance of systems, standalone systems, and alternative materials. PLO5 [4]

3) Course Contents:

Solar Insolation (radiation); Generation, recombination, and basic equations of semiconductor device physics; P-N junction Diode solar cells: Operation and construction; Solar cell parameters; Design of Silicon solar Cells; Photovoltaic Modules, Arrays, and Systems; Balance of the System (BOS); Design of Stand-alone PV Systems; Other Devices Structure; Other Semiconductor Materials. Theory and operation of "Maximum Power Point Tracking" MPPT as used in solar electric charge controllers.

4) Teaching Methods:

- Lectures
- Videos
- Discussion

- Self-learning
- Tutorial sheets

5) Mode of Evaluation:
Course Assessment Methods

- Short quizzes on Blackboard
- Writing assignment
- Tutorial Sheets
- Mid-Term Exams
- Tutorial Sheets
- Final Exam

Evaluation

- Mid-Term Tests (Not less than two Exams)………………………………. (30 %)
- Practical Work and Assignments/HW/Projects/Presentations…….. (30 %)
- Final Exam. …………………………………………………………………………… (40 %)

6) Textbook(s):

-Marta Victoria (Ed.). Fundamentals of Solar Cells and Photovoltaic Systems Engineering, Elsevier, 2023.

-Messenger, R. A., & Abtahi, H. A. Photovoltaic Systems Engineering, 4th Edition, CRC Press, 2018.

-Green, M. A. Third Generation Photovoltaics: Advanced Solar Energy Conversion, Springer, 2016.

7) References:

-Markvart, T., & Castañer, L. Practical Handbook of Photovoltaics: Fundamentals and Applications, 3rd Edition, Academic Press, 2018.

-White, S. Solar Photovoltaic Basics: A Study Guide for the NABCEP Associate Exam, 2nd Edition, Routledge, 2019.

-Nelson, J. The Physics of Solar Cells, 2nd Edition, Imperial College Press, 2022.