University of Mosul

College of Engineering

Department of Electrical Engineering

Postgraduate studies

PHD – First Semester

2023-2024

Department of Electrical Engineering

University of Mosul

College of Engineering

Department: Electrical

Instructor: Ass. Prof. Dr. Ahmed Alsammak

Course Title: Power Systems Stability

Course Code: EED712

Hours/ Units: 2 / 2

Level/Term: PhD

Course Description:

A bulk electricity system must remain intact and robust to a wide range of disturbances to provide reliable service. Consequently, it is essential to design a power system that is operable in a controlled and secure manner, such that probable contingencies can be sustained without load loss and cascading power interruptions.

This course is an introductory course for Power Systems Stability. It concentrates on steady state stability, Frequency stability, transient stability, and voltage stability in order to assist students in analyzing stability issues in power systems. It emphasizes the importance of dynamic modelling of generators, loads, excitation systems, and prime movers in stability analysis.

References:

[1] Computer Methods in Power System Analysis by Stagg and El-Abiad, 1968.
[2] Electric Machinery Fundamentals 5th Ed By Stephen J Chapman.
[3] Power system stability and control by kundur, 1994.
[4] Introductory Chapter: Power System Stability, by Kenneth, 2019 .
[5] Electric Power Systems Analysis and Control, by Fabio, 2003.
[6] Power System Analysis, by Murty, 2007.

Course Details:

Subject	Week
Introduction and Power system components	1
Advance Load Flow analysis.	2
Synchronous Machine Modeling	3
Synchronous Machine Control Models	4
Multimachine Dynamic Models	5
Steady-State Stability	6
Transient Stability- part 1	7
Transient Stability-part 2	8
Voltage Stability	9
Frequency stability	10
Effect of adding wind farms and PV systems on power system stability	11
Application of Power-System Stability Programs	12
Project discussion	13
Monthly Exam	14
General review of previous topics with problem solving	15

University of Mosul

College of Engineering

Department: Electrical

Instructor:Ass. Prof. Dr. Yessar Ezzaldeen

Course Title: Advanced Antenna Theory

Course Code: EED708

Hours/ Units: 2 / 2

Level/Term: PhD

Course Description:
As a result of the spectacular growth of the wireless industry in recent years, research and development activity in antenna technology is more vibrant and exciting than ever. New emerging technologies include antennas for cellular mobile communications, vehicle mounted antennas, phased arrays for mobile satellite communications, low profile and integrated antennas, antenna miniaturization, adaptive "smart" antennas etc. This course provides the solid antenna background required for any serious research work in antenna engineering for wireless applications, emerging wireless communications techniques based on smart antennas and broadband wireless front-end electronics.
References:1- Antenna Theory: Analysis and Design', 4th Edition, by Constantine A. Balanis, Wiley, 2016
Course Details:

Subject	**Week**
Review: (Antenna Types and their Parameters, Linear Wire Antennas, Uniform Amplitude Uniform Spacing Arrays).	1&2
N-Element Linear Array: Uniform Spacing, Non-uniform Amplitude: (Binomial Array, Dolph-Tschebyscheff Array).	3&4
Self Impedance: (EMF Method). **Mutual impedance Between Linear Elements:** (EMF Method).	5
Broadband Dipoles: (Biconical Antenna, Triangular Sheet, Flexible and Conformal Bow-Tie, and Wire Simulation, Vivaldi Antenna , Cylindrical Dipole, Folded Dipole)	6&7
Matching Techniques: (Stub Matching, Quarter Wavelength Transformer).	8
Aperture Antennas: (Field Equivalence Principle, Radiation Equations, Directivity, Rectangular Apertures).	9
Microstrip Antennas: (Rectangular Patch, Circular Patch, Quality Factor, Bandwidth, and Efficiency, Input Impedance).	10&11
Broadband Antennas:	12
Antenna Miniaturization: (Monopole Antenna, Patch Antenna, Antenna Miniaturization using Metamaterials.	13
Antennas for Mobile Communication Systems	14&15

University of Mosul
College of Engineering
Electrical Department
Instructor:
A. Prof. Dr. Saad Ahmed Ayoob

Course Title:
Advanced Communication Systems
Course Code: EED709
Hours/ Units: 2
Level/Term: Ph.D course/ 1

Course Description:

This course gives advanced communication systems starting with digital communication, the main topics, sampling, quantization, multi-level, probability of errors, and spread spectrum. Also, gets information and coding. Then it gives an introduction to satellite communication and mobile communication. In addition, 4G and 5G technologies (MIMO, MasiveMIMO, mmWave, Beamforming) are included.

Refernces:

- **Wireless Communications Principles and Practice by Theodore S. Rappaport**
- **Communication systems by Simon Haykin**
- **Communication Systems by Carlson**
- **Fundamentals of Communication Systems by Proakis**
- **Digital Modulation Techniques by Fuqin Xiong**
- **Introduction to Digital Communications by Ali Grami**

Course Details:

Subject	Week
- Introduction to digital communication - PCM, sampling and quantization, bit rate and baud rate	1-2
- Base band and Pass band signaling techniques, ASK, FSK, PSK, QPSK	3
- Signal to noise ratio, error rates	4
- Spread spectrum, OFDM, OFDMA, Report Discussion	5-6
-Coding, the Cyclic Codes, Cyclic Redundancy Check Codes (CRC)	7-8
- Introduction to satellite communication - Earth segment, space segment -Transmission losses, Link losses in satellite communication - GPS, Iridium	9-10
- Introduction to mobile communication - Cellular mobile systems - Frequency management, channel assignment, Report Discussion	11-12
- 4G, LTE, CoMP	13
-5G technologies (MIMO, MasiveMIMO, mmWave, Beamforming)	14-15

University of Mosul

College of Engineering

Department: Electrical

Instructor: Asst. Prof. Dr. Mohammed Obaid Mustafa

Course Title: Advanced Control Systems

Course Code: EED710

Hours/ Units: 2 / 2

Level/Term:PhD

Course Description:

The course of Advanced Control Engineering considers modeling, analysis, and design for control systems. The analysis in this course includes stability, realization and minimality of the state-space model, while the design methods are divided into pole placement for state feedback and observer design, and optimal methods such as linear quadratic regulator. This course will give the advance knowledge for control courses, such as nonlinear control, and system identification.

References:

[1] Nonlinear and Optimal Control Theory, Editors: P. Nistri and G. Stefani, 2004

[2] Automatic Control Systems, Farid Golnaraghi and Benjamin Kuo, 9th Edition, 2010.

[3] Control Systems Engineering 7th Ed - Nise

Course Details:

Subject	Week
Review of State space modelling of dynamical systems	1
Modelling and State space analysis	2
Design of Lead, Compensation	3
Design of Lag, Lead- lag Compensation	4
Time-Domain Analysis for MIMO systems	5
Root Locus Analysis with PID control	6
Observability and state observer controller design	7
Design of State feedback	8
PID Control	9
Pole placement	10
Modelling for Nonlinear system	11
State space analysis for Nonlinear system	12
system identification.	13
Design of Optimal Control	14
Exam	15

University of Mosul

College of Engineering

Department of Electrical Engineering

Instructor: Dr. Mohammed Younis Thanoun

Course Title: Advanced DSP

Course Code:

Hours/ Units: 2

Level/Term: PhD Program

Course Description:

The objective of this course is to provide a comprehensive understanding of basics, principles, operation, and applications of the advanced digital signal processing DSP. Students in this course will learn the techniques, algorithms, and their practical applications. Through theoretical concepts. They will be able to explain, analyze, and design digital systems.

The course list of topics includes introduction to advanced DSP, discrete-time signals and systems, sampling theorem and aliasing, multi-rate signal processing, adaptive filtering, spectral estimation and analysis, time-frequency analysis, filter design and implementation, optimization techniques for efficient DSP algorithms. Students will be introduced to the important developments of future technologies in advanced DSP.

The assessment in this course includes homework, quizzes, seminars, midterm and final exams.

References:

[1]" Discrete-Time Signal Processing ", Alan V. Oppenheim, Ronald W. Schafer, John R. Buck, Prentice-Hall, 3rd edition, 2009 (ISBN: 0131988425)

[2]"Digital Signal Processing: Principles, Algorithms, and Applications",4th Edition, by John G. Proakis & Dimitris G. Manolakis.

[3]"Digital Signal Processing",1st Edition, by Alan V. Oppenheim and Ronald W. Schafer.

Course Details:

Subject	Week
Introduction to advanced DSP	1
Discrete-time signals and systems, linear time-invariant (LTI) systems and their properties	2
The Z-transform and its application in the analysis of LTI systems	3
Frequency domain representations including the Discrete-time Fourier transform (DTFT)	4
Discrete Fourier transform (DFT) and fast Fourier transform (FFT)	5
Design of digital filters (FIR, IIR)	6
Realization of discrete-time systems	7
Brief introduction to feature extraction and pattern recognition techniques	8
Sampling and reconstruction , Analog/Digital and Digital/Analog converters	9
Upsampling / downsampling	10
Multi-rate signal processing	11
Statistical signal processing	12
Optimization techniques for efficient DSP algorithms	13
DSP applications including audio signal processing and biomedical data analysis	14
Future trends in advanced DSP	15

University of Mosul

College of Engineering

Department: Electrical

Instructor: Prof Dr. B.M Saied

& Dr. Yasir M.Y. Ameen

Course Title: Advanced Electrical Drives

Course Code: EED714

Hours/ Units: 2

Level/Term:Ph.D/1

Course Description:

The course titled "Advanced Electrical Drives" has been specifically developed to provide PhD students with an enhanced understanding of electrical drives and their practical implementation in present-day industrial systems. The course involves an investigation of the theoretical aspects and practical issues related to electrical drives. It features an investigation of power electronics technology, motor control systems, and the application of advanced applications within numerous industrial sectors.

Objective
With a focus on electric tractions applications, this course aims to give PhD students:
A thorough grounding in the engineering principles underlying traction systems.
Understanding of the evolving technology and practical importance of electric motors.
Understand the importance of traction system design in rail transportation.
Presentation of indicators of the quality of railway operations and their correlations with the efficiency of traction motors and traction power supply systems.
Identify the future technologies required to improve the quality of railway service.
Aims:
Students will be able to:
Recognise the significance of EVs in terms of environmental protection, energy conservation, and climate change.
Learn about the many technologies that make current EVs possible, including electric motor drives, energy storage, batteries, charging techniques, infrastructure, and ancillary systems.
Investigate how new technologies, such as HEVs, FEVs, and energy storage, are changing the automotive and transportation industries.

Assessment methods *commonly employed in educational settings encompass a range of activities such as homework, assignments, quizzes, exams, and the presentation of a study case during a seminar. This particular study case requires students to apply their acquired knowledge to address a real-world problem within the domain of electrical drives.*

Refernces:

1. "Electric Drives: Concepts and Applications" by Vedam Subrahmanyam
2. “Power semiconductor contrlloed drives”by G. K. Dubey
3. "Electric Motor Drives: Modeling, Analysis, and Control" by R. Krishnan
4. "Power Electronics and Motor Drives: Advances and Trends" edited by Bimal K. Bose
5. "Control of Electric Machine Drive Systems" by Seung-Ki Sul
6. "Electric Drives and Control Laboratory Using MATLAB/Simulink" by Mohammad A. Haque

Course Details:

Subject	Week
Overview of basic concepts of electric drives	1
The characteristics of DC motors, Types of DC Motors, steady-state speed torque relations, methods of speed control, *Soft Starting and Braking*, multiquadrant operation of separately excited dc motor with regenerative braking , loss minimization in adjustable speed dc drives.transfer function of separately excited dc motor.	2&3
Analysis and design of BLDC Drive System	4&5
Sensor and sensorless technologies for precise drive system	6&7&8
Electric traction systems: power trains, electric vehicles, Maglev Drive System	9&10
Unmanned Aerial Vehicle (UAV) and Drone Drive Systems	11&12
Fault-tolerant drive system.	13
Research methodologies and literature review in advanced drive technologies	14
Student-led presentations and discussions on ongoing research	15

University of Mosul

College of Engineering

Department: Electrical

Instructor:

Course Title: Advanced Topics in Electrical Engineering

Course Code: EED720

Hours/ Units: 2

Level/Term:Ph.D/1

Course Description:

Course Description:
This course is designed to provide PhD students in Electrical Engineering with an opportunity to explore advanced and emerging topics within the field. The course content will be updated annually to reflect the latest developments in electrical engineering, allowing students to delve into cutting-edge research areas and technologies. Through a combination of lectures, seminars, and student-led discussions, participants will gain a deep understanding of diverse topics and their applications.

Course Objectives:

To expose students to advanced and rapidly evolving areas of Electrical Engineering.

To foster critical thinking, problem-solving, and analytical skills.

To encourage independent research and exploration of novel concepts.

To facilitate interdisciplinary connections by incorporating relevant topics from related fields.

Assessment methods *Assessment methods will include:*

Class participation in discussions and debates.

Presentations on selected research topics.

Literature review papers analyzing recent advancements.

Group projects exploring real-world applications of course topics.

Mid-term and final exams assessing conceptual understanding.

Course Details: *Note: The outline below includes general topic areas. The specific subtopics and focus areas can be adjusted each year based on the latest trends and research breakthroughs.*

Subject	Week
Advanced optimization algorithms for electrical engineering applications	1&2&3
Data Science and Machine Learning in Electrical Engineering	4&5&6
Advanced Electronics and Devices • Nanoelectronics and nanomaterials • Flexible and wearable electronics • Neuromorphic computing and brain-inspired devices • Quantum computing and quantum electronics • Advanced semiconductor technologies	7&8&9
Wireless power transfer (near and far field) applications	10&11&12
Batteries and charging system: Beyond Lithium-ion: Next-Generation Energy Storage Solid-state batteries: materials, challenges, and opportunities Redox flow batteries for large-scale energy storage Supercapacitors and hybrid energy storage devices Charging techniques:Fast and extreme fast charging system for EV.	13&14&15

University of Mosul

College of Engineering

Department of Electrical Engineering

Instructor:

Course Title: CMOS Integrated Circuits

Course Code:

Hours/ Units: 2

Level/Term: PhD Program

Course Description:
The objective of this course is to provide a comprehensive understanding of basics, principles, operation, and applications of the CMOS integrated circuits. Students in this course will learn the important physical structure, materials, operation concepts, and models of CMOS devices. They will be able to describe, explain, analyze, CMOS devices and circuits. The course list of topics includes introduction to CMOS technology, MOS devices and circuits, power and noise calculation, MOS amplifiers, CMOS analog and digital circuits, and CMOS applications. Students will be introduced to the important developments of future technologies of microelectronics. The assessment in this course includes homework, quizzes, seminars, midterm and final exams.
References:
[1] “Microelectronics Circuit Analysis and Design”, 4th Edition, by Donald Neamen. [2] “Introduction to Solid State Physics”, 8th Edition, by Charles Kittel.

Course Details:

Subject	**Week**
Introduction to CMOS technology	1
Semiconductor materials & devices	2
CMOS technology significance	3
CMOS transistors	4
CMOS logic gates	5
CMOS devices operation and characteristics	6
CMOS circuit design	7
Power efficiency in CMOS circuits	8
Noise in CMOS circuits	9
Midterm Exam	10
CMOS amplifiers	11
CMOS analog circuits	12
CMOS digital circuits and memories	13
CMOS applications	14
Future trends in CMOS technology	15

University of Mosul

College of Engineering

Department: Electrical

Instructor: Dr. Omar Sh. Yehya

Course Title: Flexible A C Transmission System (FACTS)

Course Code: EED706

Hours/ Units: 2

Level/Term: PhD Students

Course Description:	
Flexible AC Transmission System (FACTS) research in Electrical Engineering and Power systems is quite interesting. PhD candidates interested in this discipline can investigate a range of subjects that develop FACTS technology, its uses, and its integration into power systems. In this course, Principles of operation, power electronic devices, FACTS components, power quality, principles and monitoring, smart network, and reliability of power systems. As well as More information will be presented in front of students to be familiar with working on it during their research.	
References:	
1. "Flexible AC Transmission Systems (FACTS): Modeling and Simulation" by Bhim Singh, Ambrish Chandra, Kamal Al-Haddad (2015) 2. "FACTS Controllers in Power Transmission and Distribution" by Bikash Pal (2013) 3. "Flexible AC Transmission Systems: Modelling and Control" by Xiao-Ping Zhang, Christian Rehtanz (2012) 4. "Flexible AC Transmission Systems: FACTS" by Y. H. Song, Allan T. Johns (2012) 5. "Flexible AC Transmission Systems: Modelling and Control" by Hasmat Malik, Iqbal Husain (2012) 6. "Flexible AC Transmission Systems: Facts" by E. W. Kimbark, D. J. Nelson (2013) 7. "Flexible AC Transmission Systems: Concepts and Benefits" by Vijay K. Sood (2010) 8. "Voltage-Sourced Converters in Power Systems: Modeling, Control, and Applications" by Amirnaser Yazdani, Reza Iravani (2010)	
Course Details:	
Subject	**Week**
Defintion, Components and Principle Operation of FACTS	1
FACTS Applications in Transmission Networks	2
Power System Stability Enhancement with FACTS	3
Voltage-Sourced Converters	4
Types of FACTS Devices : Static Synchronous Compensator (STATCOM) and Static Var Compensator (SVC)	5
Static synchronous series compensator (SSSC) - Thyristor-Controlled Series Compensator (TCSC)	6
Exam 1	7
Series Capacitive Compensation	8
Unified Power Flow Controller (UPFC)	9
Interline Power Flow Controller (IPFC)	10
Control and Optimization of FACTS Devices	11
FACTS and Power Quality Improvement	12
Exam 2	13
Reliability of Power System and Fault Current Limiter	14
FACTS Integration in Renewable Energy Systems and Smart Grid	15