University of Mosul
College of Engineering
Department of Electrical Engineering
B.Sc. Electrical Engineering / Communication Engineering

Course Code: EEC 403

Course Title: Communication Engineering

Catalogue Description:

Satellite Communication, Geosynchronous orbit satellite, Frequency bands used, Earth segment, Channel, Space segment. Uplink and down signal budget calculations, Multiple access techniques, Centralized and Decentralized control. SPADE system. Mobile radio propagation, Large scale path loss, Small scale fading and multipath. The cellular concept, Frequency reuse, Channel assignment strategies, Handoff, Interference and system capacity, Improving coverage and capacity in cellular systems. Wireless System and standards (AMPS, ETACS, GSM). Spread spectrum (frequency hopping direct sequence). CDMA cellular system. Mobile Satellite System LEO, MEO, HEO, Satellite system for low data rate and high date rate communication satellite (Iridium, Teledesic,). Global positioning system (GPS).

Other Course Material:

- Lecture Notes

Course Learning Objectives:

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

1. Describe the fundamental features and basic building blocks of satellite communications systems.
2. Identify and compare different satellite constellations including LEO, MEO and GEO systems and conduct performance/cost trade-off analysis of such systems.
3. Understand and compare different multiple access technologies including FDMA, TDMA and CDMA along with some random-access technologies.
4. Perform link budget analysis including the calculation of the received signal and noise powers, detailed apportionment of transmission and reception resources, identifying noise sources, signal amplifiers and attenuators, interference sources, etc… Through the link budget analysis, the student should be able to understand several aspects in system design and performance measures such as BER, E_b/N_o, SNR, etc.. and perform trade-off analysis.
5. Identify and model propagation characteristics of cellular radio and satellite channels including free space path loss, short and long-term fading, flat and selective frequency fading, Doppler spread, coherence bandwidth, ISI, fade margins, etc…
6. Understand the fundamentals of cellular system design including the cell concept, frequency reuse, cell splitting and Sectorization, channel allocation and handoff strategies. Using trunking theory (Erlang B & C models), students will be able to evaluate cell capacity, GoS, cell coverage and conduct trade-off analysis.
7. Analyze the co-channel interference, CCI, for different deployment environment such as urban, suburban and rural.
8. Understand the advantages of using spread spectrum techniques including Direct Sequence and Frequency Hopping in mitigating interference and multi-path conditions
9. Model satellite up/down/cross links and identify the required on-board processing. Both linear and non-linear transponder models will be developed.
10. Identify and compare different standards for cellular mobile radio systems including AMPS, IS-95, GSM, 3G and 4G(LET-A) systems.

Class Schedule:

Lecture: 1 two-hour session per week.
Lecture: 1 one-hour session per week.

Assessment scheme:

- Two term examinations: 30%
- Quizzes & Assignments: 10%
- Final examination: 60%

Course Topics (1): 2021 - 2022

Week	Topics
1 Week	Introduction to Satellite Communications Evolution of Satellite Communication Elevation Angle to Satellite, Azimuth Angle to Satellite Applications of Satellites Frequency allocation for satellite
2 Week	Type of Satellites (Based on Orbits): (GEO, LEO, MEO, HEO, Polar Orbit). Satellite Examples (INTELSAT, U.S DOMSATS). Direct Broadcast Satellite System DBS.
1 Week	Kepler's Laws (First and Second).
1 Week	Satellite Communications Segments. Radio Wave propagation.
2 Week	Ionospheric Effects, Rain Attenuation, Other Propagation Impairments, Angle of Elevation and propagation impairments, Propagation delay. Satellite Construction: Satellite Transponder. Tracking, Telemetry, Command, and Monitoring.
2 Week	Satellite Link Parameters Equivalent Isotropic Radiated Power (EIRP), Transmission Losses, Bad weather loss, Noise Temperature.
1 Week	Uplink and down signal budget calculations. Microwave Interference.
1 Week	Satellite Access (FDMA, TDMA, CDMA, SDMA).
1 Week	International Standards (The T-carrier TDM/PCM telephony system). Compressor and expander (Compander).
1 Week	Centralized and Decentralized Control. SPADE system.
1 Week	Satellite system for low data rate and high date rate communication satellite: (Iridium, Teledesic).
1 Week	Global Positioning System (GPS).
	First Term Exam.

Textbook :

[1] Louis J. Ippolito, Jr, "Satellite Communications Systems Engineering", 2008.

[2] Bruce R. Elbert, "Introduction to Satellite Communication", 3rd Edition, 2008.

[3] G. Maral & M. Bousquet," Satellite Communications Systems", 5th Edition, 2009.

Course Topics (2): 2021 - 2022

Week	Topics
1 Week	Wireless Communication Systems. Types of Mobile Communication Systems. The Cellular Concept - System Design Fundamentals.
1 Week	Frequency Reuse. Channel Assignment Strategies.
1 Week	Handoff Strategies. Practical Handoff Considerations.
1 Week	Interference and System Capacity. Co-channel Interference, Adjacent Channel Interference. Power Control for Reducing Interference.
1 Week	Trunking and Grade of Service. Blocked Calls Cleared (Erlang B). Blocked Calls Delayed (Erlang C). Improving coverage and capacity in cellular systems.
2 Week	Cellular Systems. 1G: AMPS, ETACS, N-AMPS, USDC(D-AMPS).
1 Week	2G: Global System for Mobile GSM. GSM System Architecture.
1 Week	Spread spectrum (frequency hopping direct sequence). Frequency Hopping Spread Spectrum (FH-SS). Direct Sequence Spread Spectrum (DS-SS).
1 Week	2G: Code Division Multiple Access (CDMA). Comparison of the IS-95, IS-54, and GSM systems.
1 Week	3G: Universal Mobile Telecommunications System (UMTS). 4G: Worldwide Interoperability for Microwave Access (WiMAX). 4G: Long-Term Evolution (LTE).
2 Week	Large Scale Propagation Models Practical Link Budget Design Using Path Loss Models Outdoor Propagation Models Okumura Model, Hata Model, Walfisch-Bestoni Model
2 Week	Indoor Propagation, Small Scale Fading and Multipath. Properties of Small-Scale Multipath Propagation Doppler Shift, Shadowing, Multipath Propagation Parameters of Mobile Multipath channels Types of Small-Scale Fading, Rayleigh and Ricean Distributions

Textbook :

[1] T. S. Rappaport," Wireless Communications", 2nd edition, 2002.

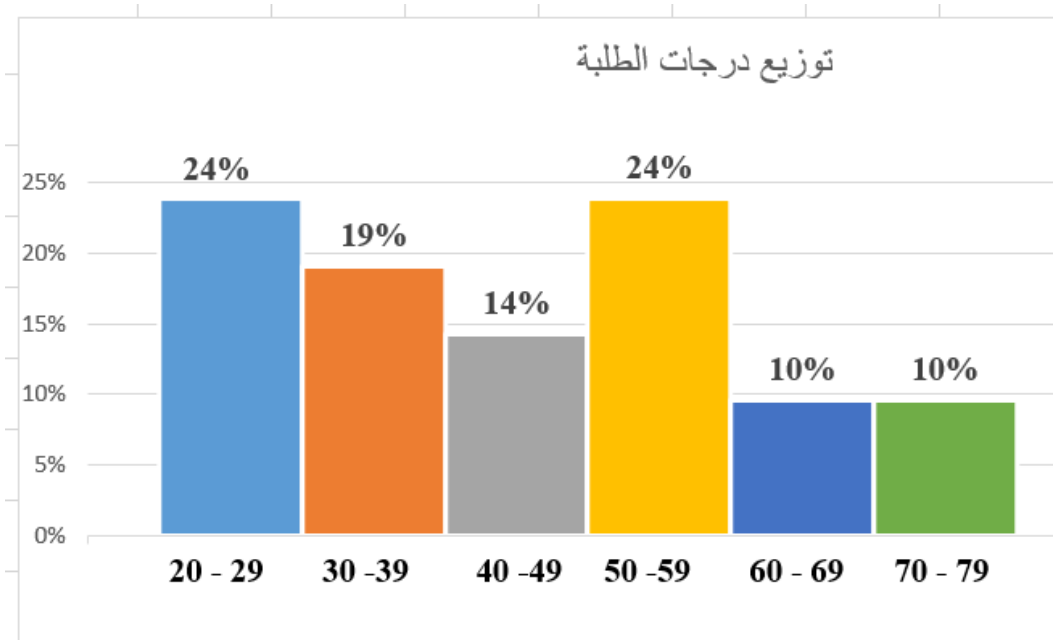
[2] J. H. Schiller," Mobile Communications", 2nd edition, 2003.

[3] Sassan Ahmadi," LTE-Advanced", Elsevier Inc., 2014.

University of Mosul
College of Engineering
Electrical Engineering Department
Results Analysis Report

Course Title	Communication Engineering		
Course Code	EEC403	Academic year	2021-2022
Instructor	د. سعد أحمد ايوب	Co-instructor	
Exam Date	13/4/2022	Exam Type	Term Exam (2)

Results Chart



If the Exam results are diverted, state the reason and the methodology to rectify problem next time	Your satisfaction rate: (5) Very satisfied (4) Satisfied (3) Okay (2) Just acceptable (1) poor results
Any hints:	2