# Jordan University of Science and Technology

## Faculty of Engineering

## Electrical Engineering Department

EE757 Spread Spectrum Communications - JNQF Level: 9

First Semester 2024-2025

| Course Catalog |
|---|
| 3 Credit Hours. Major topics include: direct sequence and frequency hopping methods, synchronization, resistance to jamming, low probability of detection, spreading codes and their generation, system performance, Rake receivers, Code division multiple access (CDMA), cellular CDMA applications, wireless LAN applications, as well as commercial and military applications. Fundamentals: jamming, energy allocations, system configurations, energy gain, applications such as anti-jam, low probability of intercept, multiple access, time of arrival. Anti-jam systems: parameters, jammer waveforms, uncoded and coded direct sequence BPSK, uncoded and coded direct sequence BFSK, interleaver/hop trade-offs, coded BER bounds, cutoff rates, DS-BPSK and pulse jamming bounds, FH-MFSK and partial band jamming bounds, diversity for FH-MFSK, concatenation of codes. Pseudonoise generators: storage/generation, linear recursions, memory-efficient linear generators, statistical properties of m-sequences, Galois field connections, nonlinear feed forward logic. DS and FH multiple access design. Code synchronizers: single dwell and multiple dwell serial PN acquisition for DS, delay-locked loop and Tau-dither loop PN tracking for DS, time and frequency synchronization for FH. |
| **Teaching Method:** On Campus |

| Text Book | |
|---|---|
| **Title** | Introduction to spread spectrum communications` |
| **Author(s)** | ] R. Peterson, R. Ziemer and D. Borth |
| **Edition** | 2nd Edition |
| **Short Name** | Required Textbook |
| **Other Information** | Prentice-Hall, Inc., Englewood Cliffs |

**Course References**

| Short name | Book name | Author(s) | Edition | Other Information |
|---|---|---|---|---|
| Required Textbook | Spread spectrum communications | ] M. Simon, J. Omura, R. Scholtz and D. Levitt | 2nd Edition | McGraw-Hill, Inc. |
| Ref-1 | CDMA Systems Engineering Handbook | Lee and L. E. Miller | 2nd Edition | Artech House |

| | | | | |
|---|---|---|---|---|
| Ref. 2 | Principles of Spread Spectrum Communication | A. J. Viterbi | 1st Edition | Addison-Wesley |
| Ref. 3 | Spread Spectrum Systems with Commercial Applications | R. C. Dixon | 3rd Edition | John Wiley \& Sons, |
| Ref. 4 | Mobile Communications Engineering: Theory and Applications | W. C. Y. Lee | 2nd Edition | McGraw Hill |
| Ref-5 | IEEE Commu. Magazine; IEEE Wireless Commu.; IEEE Trans. Commun.; IEEE Trans. VT ; IEEE Trans. Wireless Commun. | IEEE | 1st Edition | IEEE |

| **Instructor** | |
|---|---|
| Name | **Dr. Ibrahim Ghareeb** |
| Office Location | E1L3 |
| Office Hours | Sun : 08:00 - 08:30<br>Sun : 09:30 - 10:30<br>Sun : 13:30 - 14:30<br>Tue : 08:00 - 08:30<br>Tue : 09:30 - 10:30<br>Wed : 08:00 - 09:30<br>Thu : 08:00 - 08:30<br>Thu : 09:30 - 10:30 |
| Email | ghareeb@just.edu.jo |

| **Class Schedule & Room** |
|---|
| Section 1:<br>Lecture Time: Sun : 10:30 - 13:30<br>Room: U |

| **Tentative List of Topics Covered** | | |
|---|---|---|
| **Weeks** | **Topic** | **References** |
| Weeks 1, 2, 3 | Spread spectrum techniques (direct sequence, frequency hop, and time hop,...) | From **Required Textbook** |
| Weeks 4, 5, 6 | Introduction to spread spectrum applications (resistance to jamming, ...) | From **Required Textbook** |
| Weeks 7, 8, 9 | Spreading (pseudo-noise) sequences | From **Required Textbook** |
| Weeks 10, 11, 12 | Communication over fading channels | From **Required Textbook** |
| Weeks 13, 14 | Code division multiple access (CDMA) and multiuser detection techniques | From **Required Textbook** |
| Week 15 | PN code acquisition and tracking | From **Required Textbook** |

| Mapping of Course Outcomes to Program Outcomes and NQF Outcomes | Course Outcome Weight (Out of 100%) | Assessment method |
|---|---|---|
| Recognize the spread-spectrum communication fundamentals and it?s applications to wireless communication systems [1SO1] [1L9K1] | 15% | Midterm exam, Final Exam |
| Understand and recognize the spreading sequences fundamentals, generation mechanism of sequences and waveforms, properties of spreading sequences, Galois field mathematics, Concept of code generator polynomial and characteristic equation. [1SO1] [1L9K1] | 20% | Midterm exam, Project, Final Exam |
| Understanding of basic principles of the anti-jamming capability of spread spectrum signals and analyze the systems performance under different Jamming strategies. [1SO1] [1L9K2] | 20% | Midterm exam, Project, Final Exam |
| Gain insights into how diversity afforded by spread spectrum system and radio propagation channel can be exploited to improve system performance. [1SO2] [1L9S3] | 20% | Project, Final Exam |
| Analyze and examine the use of code-division multiple access in digital cellular systems. [1SO1] [1L9S1] | 15% | Project, Final Exam |
| Design and develop the spread spectrum communication system for commercial and military applications. [1SO2] [1L9S3] | 10% | Project, Final Exam |

| Relationship to Program Student Outcomes (Out of 100%) | | | | | | |
|---|---|---|---|---|---|---|
| SO1 | SO2 | SO3 | SO4 | SO5 | SO6 | SO7 |
| 70 | 30 | | | | | |

| Relationship to NQF Outcomes (Out of 100%) | | | |
|---|---|---|---|
| L9K1 | L9K2 | L9S1 | L9S3 |
| 35 | 20 | 15 | 30 |

| Evaluation | |
|---|---|
| **Assessment Tool** | **Weight** |
| Midterm exam | 25% |
| Project | 25% |
| Final Exam | 50% |

| Policy |
|---|

| | |
|---|---|
| Class Project: | Students taking the course for graduate credit are required to complete a project on a topic related to Spread spectrum communications. The primary intent of the project is to expand the learning beyond the material presented in class in a focused area. Students are strongly encouraged to select projects based on their own research/learning interests. Projects must have a simulation/analysis element and purely literature surveys are not acceptable. Team projects are preferred over individual projects and you may work in groups of up to 2 students. Each group is expected to share their work with the class in a brief seminar and turn in a report. Grading will be based on the project report, presentation, implementation demonstration, and in-class participation during presentations.<br>Project Topic:<br>The project is your opportunity to explore an area of spread spectrum communications for deeper exploration. It is your job to identify an area that interests you and enough of your peers (in order to form a project team). For this purpose, you may find it helpful to read articles published in IEEE Communications Magazine and IEEE Wireless Communications Magazine. These provide tutorial/review articles covering the significant developments in the field. You may also wish to consult recent issues of IEEE Transactions in the Communications and Wireless Communications areas for ideas. By the project proposal deadline you should have your topic identified and one/two key journal paper references on which you will base your work. These should be included along with your proposal. NOTE: Conference papers will not be acceptable as primary references for your project.<br>Each of student is required to submit an 1-page proposal outlining the project (with some key references), a project report (of about 8-10 pages) and to provide an oral presentation (no more than 20 minutes) at the end of the semester. The (tentative) time line is as follows:<br><br>- Project proposal must be turned in by November 1. You should meet with the instructor well in advance for a discussion about the chosen topic.<br>- Project report is due on the December 31.<br>- The project presentations shall be organized in the last week of the semester. |

Date Printed: 2024-10-28