## Course Syllabus: Digital Communication and Coding - EE 242

<table>
<thead>
<tr>
<th>Division</th>
<th>Computer, Electrical and Mathematical Sciences &amp; Engineering</th>
</tr>
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<tbody>
<tr>
<td>Course Number</td>
<td>EE 242</td>
</tr>
<tr>
<td>Course Title</td>
<td>Digital Communication and Coding</td>
</tr>
<tr>
<td>Academic Semester</td>
<td>Fall</td>
</tr>
<tr>
<td>Academic Year</td>
<td>2019/2020</td>
</tr>
<tr>
<td>Semester Start Date</td>
<td>08/25/2019</td>
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<tr>
<td>Semester End Date</td>
<td>12/10/2019</td>
</tr>
<tr>
<td>Class Schedule (Days &amp; Time)</td>
<td>09:00 AM - 10:30 AM</td>
</tr>
</tbody>
</table>

### Instructor(s)

<table>
<thead>
<tr>
<th>Name</th>
<th>Email</th>
<th>Phone</th>
<th>Office Location</th>
<th>Office Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tareq Al-Naffouri</td>
<td><a href="mailto:tareq.alnaffouri@kaust.edu.sa">tareq.alnaffouri@kaust.edu.sa</a></td>
<td>+966128080298</td>
<td>3303, 1, Al-Khawarizmi (bldg. 1)</td>
<td>Sunday 1:00 PM to 2:30 PM or by appointment</td>
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### Teaching Assistant(s)

<table>
<thead>
<tr>
<th>Name</th>
<th>Email</th>
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<tr>
<td>TBD</td>
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### Course Information

#### Comprehensive Course Description
This course is designed to introduce to the student the fundamentals of the theory of digital communications and coding. The course will provide in-depth knowledge of communication fundamentals, which include Digital transmission of information across discrete and analog channels. Sampling; quantization; noiseless source codes for data compression: Huffman’s algorithm and entropy; block and convolutional channel codes for error correction; channel capacity; digital modulation methods: PSK, MSK, FSK, QAM; matched filter receivers. Signal Design for bandlimited channels. Performance analysis: power, bandwidth, data rate and error probability.

#### Course Description from Program Guide
Digital transmission of information across discrete and analog channels. Sampling; quantization; noiseless source codes for data compression: Huffman’s algorithm and entropy; block and convolutional channel codes for error correction; channel capacity; digital modulation methods: PSK, MSK, FSK, QAM; matched filter receivers. Performance analysis: power, bandwidth, data rate and error probability.
### Goals and Objectives
1. Learning communication theory fundamentals
2. Learning basic concepts in source coding,
3. Learning basic concepts in block and convolutional codes,
4. Developing skills in the design and analysis of digital modulation methods.

### Required Knowledge
Probability and Random variables/Basic knowledge of linear Algebra

### Reference Texts

### Method of evaluation
- 22.00% - Midterm exam
- 13.00% - Homework/Assignments
- 36.00% - Final exam
- 25.00% - Course Project(s)
- 4.00% - Attendance and Participation

### Nature of the assignments
The HW will consist of a set of problems assigned biweekly. HW is to be submitted in class. Late HW's are not accepted.

There will be two simulation based projects. Project 1 (10%) and Project 2 (15%).

### Course Policies
- Late HW's are not accepted
- HW has to be solved individually
- Class participation and attendance constitutes 4% of the final grade.

### Additional Information
<table>
<thead>
<tr>
<th>Week</th>
<th>Lectures</th>
<th>Topic</th>
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</table>
| 1    | Mon 08/26/2019<br>Thu 08/29/2019 | Introduction  
• Basic Elements of Digital Communication Systems  
• Communication Channels |
| 2    | Mon 09/02/2019<br>Thu 09/05/2019 | Source Coding  
• Entropy and mutual information  
• Coding for discrete memoryless sources |
| 3    | Mon 09/09/2019<br>Thu 09/12/2019 | Source Coding  
• Coding for discrete memoryless sources |
| 4    | Mon 09/16/2019<br>Thu 09/19/2019 | Optimum Receivers for the Vector Channel |
| 5    | Mon 09/23/2019<br>Thu 09/26/2019 | Characterization of Communication Signals and Systems  
• Representation of Band-Pass Signals and Systems  
• Signal Space Representations  
• Representation of Digitally Modulated Signals |
| 6    | Mon 09/30/2019<br>Thu 10/03/2019 | Characterization of Communication Signals and Systems  
• Representation of Band-Pass Signals and Systems  
• Signal Space Representations  
• Representation of Digitally Modulated Signals |
| 7    | Mon 10/07/2019<br>Thu 10/10/2019 | Optimum Receivers for the Additive White Gaussian Noise Channel  
• Optimum Receiver for Signals Corrupted by Additive White Gaussian Noise  
• Performance of the Optimum Receiver for Memoryless Modulation  
• Trade off of power, bandwidth, data rate, and error probability |
| 8    | Mon 10/14/2019<br>Thu 10/17/2019 | Optimum Receivers for the Additive White Gaussian Noise Channel  
• Optimum Receiver for Signals Corrupted by Additive White Gaussian Noise  
• Performance of the Optimum Receiver for Memoryless Modulation  
• Trade off of power, bandwidth, data rate, and error probability |
| 9    | Mon 10/21/2019<br>Thu 10/24/2019 | Optimum Receivers for the Additive White Gaussian Noise Channel  
• Optimum Receiver for Signals Corrupted by Additive White Gaussian Noise  
• Performance of the Optimum Receiver for Memoryless Modulation  
• Trade off of power, bandwidth, data rate, and error probability |
| 10   | Mon 10/28/2019<br>Thu 10/31/2019 | Nyquist Pulse Shaping & Equalization |
| 11   | Mon 11/04/2019<br>Thu 11/07/2019 | Nyquist Pulse Shaping & Equalization |
| 12   | Mon 11/11/2019<br>Thu 11/14/2019 | Error Correcting Coding and Channel Capacity  
• Block coding |
| 13   | Mon 11/18/2019<br>Thu 11/21/2019 | Error Correcting Coding and Channel Capacity  
• Convolutional coding |
• Convolutional coding |
| 15   | Mon 12/02/2019<br>Thu 12/05/2019 | Error Correcting Coding and Channel Capacity  
• Channel capacity |
| 16   | Mon 12/09/2019 | Multi-Access Modulation Techniques |

**Note**  
The instructor reserves the right to make changes to this syllabus as necessary.