Course Title: Remote Sensing

Course Type: Main Course (Group 2)
Unit Type: Theoretical
Units: 3
Prerequisites (Concurrent): Digital Image Processing
Project: Optional
Teaching Hours: 48

Objectives:
The aim of this course is to familiarize students with the multi-disciplinary aspect of the remote sensing and to help them gain knowledge in different disciplines related to the remote sensing subject area. Course will cover subject areas such as analysis of the aerial and space-born images where images might be acquired by either Multi-spectral, RADAR or LIDAR-based imaging systems. Features of the different spectral bands with respect to the earth's atmosphere and the nature of the ground targets are studied. Goal is to analyze the images and to extract useful features from them. This course will be followed by a seminar and an optional course project.

Syllabus:
1. Introduction to remote sensing and its applications.
2. Components of a remote sensing system.
3. Aerial imaging devices and photography films.
4. Spectral imaging, related features and relative imaging devices (imaging sensors and scanners).
5. Pre-processes on remotely sensed data.
6. Image transforms and filtering techniques for remotely sensed images.
7. Classification Techniques.
8. Multi-dimensional data analysis on the remotely sensed data.
9. 3D laser scanning principles and point cloud data manipulation.

Recommended References

1. Sohowengerdt, R.A., *Remote Sensing Models and Methods for Image processing 2nd ed.*, Academic Press 1997.
2. Lo, C.P., *Applied Remote Sensing*, Longman Scientific & Technical, 1986.
3. Holtz, R.K., *The Surveillant Science: Remote Sensing of The Environment*, Wiley, 1984.
4. Swain, P.H. & Davis, S.M., *Remote Sensing: The Quantitative Approach*, McGraw-Hill, New York, 1978.
5. Paul M. Mather, *Computer Processing of Remotely Sensed Images- An Introduction*, John Wiley & Sons, 1993.
6. Paul J.Carran, *Principles of Remote Sensing*, Longman Scientific & Technical, 1989.
7. Paul M. Mather, *Computer Processing of Remotely-Sensed Images- An Introduction (Third Edition)*, John Wiley & Sons, July 2005.
8. James B. Campbell, *Introduction to Remote Sensing (Third Edition)*, Taylor and Francis, 2002.

Course Title: Robotics

Course Type: Main Course (Group 2)	**Prerequisites:** None
Unit Type: Theoretical	**Project:** Optional
Units: 3	**Teaching Hours:** 48

Objectives:
The aim of this course is to equip students with an integrated view of a robotic system. This course will focus on robotics arm only. Different types of robotics arms and their forward and inverse control equations will be discussed in this course. Error sources in the systems, motion control, sensors and their applications are also explained. Students will be guided to build/improve a simulation environment for the manipulators. The main objectives of the course include ability to evaluate the quality of a robotic system and to design a motion control system for a robotic arm manipulator. Course will have an optional project as its course work.

Syllabus:

1. Basic definitions and introduction to different types of robotic arms and their applications.
2. Introducing error sources in a robotic arm and ways to compensate for them.
3. Introduction to the coordinate systems and transfer and rotation matrices.
4. Direct Kinematics: The Arm Equation.
5. Inverse Kinematics: Solving the Arm Equation.
6. Workspace Analysis and Trajectory Planning.
7. Arm equations and some examples for solving the arm equations for different models of manipulators.
8. Studying the pick and place operations, moving on a straight line.
9. Motion control and it related issues, i.e. point to point motion and continuous path motion.
10. Introduction to the sensors useful for the robotic arm control and a brief study of the sensor fusion.
11. Uncertainties in Robotics.
12. Robot vision.
13. Laser scanning principles, methods and calculations.

Recommended References

1. Robert J. Schilling, *Fundamentals of Robotics – Analysis and Control*, Prentice-Hall International Editions, 2003.
2. Mongi A. Abidi, Rafael C. Gonzalez, *Data Fusion in Robotics and Machine Intelligence*, Academic Press, 1992.
3. K.S. Fu, R. C. Gonzalez, *Robotics: Control, Sensing, Vision and Intelligence*, McGraw-Hill, 1987.

Course Title: Microprocessors 1

Course Type: Main Course
Unit Type: Theoretical
Units: 3
Prerequisites: Computer Architecture
Project: Optional
Teaching Hours: 48

Objectives:
This course is aimed to introduce students to the microprocessor-based design. Intention is to teach students how to design circuits with 8 bit microprocessors (Z80 microprocessor), how to write a startup program (BIOS) and an assembly code to do some work. Course will cover serial and parallel data communications. Programming of some peripheral chips such as 8255, 8253, 8251 and 8259 are also explained. Course will have an optional project as its course work.

Syllabus:
1. Memory technologies and memory organization.
2. Introduction to Microprocessors and the way they work.
3. Concepts such as Reset, Clock, Wait state, …
4. Introduction to Z80 microprocessor, its architecture and its instruction set.
5. Design method to build a microprocessor (Z80) based minimum system and writing a startup program (BIOS) for it.
6. Designing an extended version of the minimum system, production of the Op-Code for the program and calculations related to the execution time of the code.
7. Polling and Interrupt concepts. Interrupts in Z80 and how to write interrupt service routines.
8. Introduction to the Parallel data transfer and 8255 PPI.
9. Extending the previous design to include the 8255 chip and an example to show the communication between a PC and a printer. In this example both the polling and interrupt approaches are implemented.
10. Introduction to 8253.
11. Introduction to the serial data transfer (both Synchronous and Asynchronous) and 8251 (USART).
12. Interrupt controllers and 8259.
13. Introduction to AVR technology and ATMEL's 8-bit micro-controllers.
14. Design methods such as Keyboard scanning, etc.

Recommended References

1. Kenneth L. Short, *Microprocessors and Programmed logic*, Prentice-Hall International Editions, 1981.
2. Muhammad Ali Mazidi and Janice Gillispie Mazidi, *The 80x86 IBM PC & Compatible Computes*, Prentice-Hall International Editions, 1993.
3. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, *AVR Microcontroller and Embedded Systems: Using Assembly and C*, Pearson Education, 2011.
4. Lecture notes provided by the lecturer and a list of data sheets for the devices introduced in the course all obtainable from the IUST publications.

Course Title: Intrusion Detection and Response Methods and Systems for Computer Networks

(Advanced Concepts in Computer Networks)

Course Type: Advanced Course	**Prerequisites:** None
Unit Type: Theoretical	**Project and Seminar:** Yes
Units: 3	**Teaching Hours:** 48

Objectives:

This course intends to introduce the student to security treats in the computer networks and security mechanisms devised to improve the security of the network operation. The approach for this course is both theoretical approach and study of the reported works in this area. As required, in each part of the course students will be introduced to the theories related to the subject area and the applied theories in the current reported works. Students will become familiar with the intrusion detection methods their pre and post processes, intrusion prevention and response systems and honeypots. In addition course will introduce the students to the concepts of Security Operation Center (SOC), operation of the related network security organizations and security standards.

Syllabus:

1. Introduction to the problems caused by the security treats and intrusions on the networks and some of their methods.
2. Intrusion detection methods such as signature-based and anomaly-based intrusion detection.
3. Introduction to the structure of the Intrusion Detection Systems (IDS), alert aggregation and alert correlation methods.
4. Honeypots and Introduction to their duties and applications.
5. An overview on the theories and applicable to the intrusion detection in computer networks (Data mining, Principal Component Analysis (PCA), …).
6. Intrusion prevention and response systems.
7. Introduction to some intrusion detection systems, SOC and CERT centers and their responsibilities.
8. ISO standards related to the security of the network management centers and intrusion detection systems.

Recommended References

1- Current published research works in the area of interest in this course.

2- William Stallings, ***Network Security Essentials: Application and Standards,*** Prentice-Hall, 2000.

3- Stephen Northcutt, Judy Novak, ***Network Intrusion Detection 3ed,*** NewRiders, 2003.

4- W. Cheswick, Steven M. Bellovin, ***Firewalls and Internet Security,*** Addison-Wesley, 1994.

5- D. Marchette, ***Computer Intrusion Detection and Network Monitoring,*** Springer- Verlag, 2001.

6- Ryan Trost, ***Practical Intrusion Analysis: Prevention and Detection for the Twenty-First Century***, Addison-Wesley Professional, 2009.

7- Roberto Di Pietro and Luigi V. Mancini (Editors), ***Intrusion Detection Systems (Advances in Information Security)***, Springer, 2008.

8- Ronald D. Hopkins and Wesley P. Tokere (Editors), ***Computer Security: Intrusion, Detection and Prevention***, Nova Science Publishers, 2009.

9- Niels Provos and Thorsten Holz, ***Virtual Honeypots: From Botnet Tracking to Intrusion Detection***, Addison-Wesley Professional, 2007.

10- Lance Spitzner, ***Honeypots: Tracking Hackers***, Addison-Wesley Professional, 2002.

11- Jeffrey J. P. Tsai, ***Intrusion Detection: A Machine Learning Approach (Electrical and Computer Engineering***), Imperial College Press, 2010.

12- Luca Foschini, ***Stateful intrusion detection in high-speed networks: A formalization and analysis of high-speed stateful signature matching for intrusion detection***, VDM Verlag, 2009.