FACULTY OF ECT
Computing Security Program

SAXONY EGYPT UNIVERSITY
FOR APPLIED SCIENCE AND TECHNOLOGY

Academic Year **2024/2025**
Semester **Spring**
Academic Level: **Level 1**
Sheet No.: **4**

Subject: (ECT 141) Networks and Communication Technologies

Question 1: Signal Generation
Write a MATLAB script to generate a 1-second sinusoidal signal with a frequency of 8 Hz, amplitude of 2, and sampling rate of 1000 Hz. Plot the signal with appropriate labels for time (seconds) and amplitude. Provide the MATLAB code.

Question 2: Signal Addition
Generate two sinusoidal signals: one with a frequency of 5 Hz and amplitude 1, and another with a frequency of 15 Hz and amplitude 1, both sampled at 1000 Hz for 1 second. Add the two signals and plot the result. Provide the MATLAB code and explain how the combined signal differs from the individual signals in the time domain.

Question 3: Scaling Application
Write a MATLAB script to generate a 5 Hz sinusoidal signal with amplitude 1, sampled at 1000 Hz for 1 second. Scale the signal by a factor of 4 and plot both the original and scaled signals on separate subplots. Provide the MATLAB code and explain how scaling affects the signal's appearance.

Question 4: Filtering Task
Write a MATLAB script to generate a 10 Hz sinusoidal signal with amplitude 1, sampled at 1000 Hz for 1 second. Add random noise with amplitude 0.5 to the signal. Apply a moving average filter with a window size of 25 and plot the noisy and filtered signals on separate subplots. Provide the MATLAB code and describe how the filter affects the noise.

Question 5: Frequency Analysis
Write a MATLAB script to generate a signal that is the sum of two sine waves (frequencies 6 Hz and 12 Hz, amplitude 1 each), sampled at 1000 Hz for 1 second. Compute and plot the single-sided FFT of the signal, showing frequencies up to 20 Hz. Provide the MATLAB code and identify the expected frequency peaks in the FFT plot.

Question 6: Signal Design and Analysis
Design a MATLAB script to generate a signal that is the sum of three sinusoidal components with frequencies 4 Hz, 10 Hz, and 16 Hz, each with amplitude 1.5, sampled at 2000 Hz for 1 second. Add random noise with amplitude 0.4. Plot the clean signal, noisy signal, and the FFT of the noisy signal. Provide the complete MATLAB code and explain how the FFT plot helps identify the signal's frequency components.

Question 7: Filtering Comparison
Write a MATLAB script to generate a 7 Hz sinusoidal signal with amplitude 1, sampled at 1000 Hz for 1 second, and add random noise with amplitude 0.6. Apply a moving average filter with window size 20. Plot the noisy signal and both filtered signals. Provide the complete MATLAB code.

Question 8: Frequency Domain Filtering
Write a MATLAB script to generate a signal that is the sum of three sine waves with frequencies 5 Hz, 10 Hz, and 20 Hz (amplitude 1 each), sampled at 1000 Hz for 1 second. Compute the FFT, set the frequency components above 15 Hz to zero, and use the inverse FFT to reconstruct the filtered signal. Plot the original and filtered signals in the time domain. Provide the complete MATLAB code.

Question 9: Optimization Task
Write a MATLAB script to generate a 6 Hz sinusoidal signal with amplitude 1, sampled at 1000 Hz for 1 second, and add random noise with amplitude 0.5. Apply a moving average filter with window sizes of 10, 20, 30, and 40. Plot the filtered signals and provide the complete MATLAB code. Recommend the best window size.