Here is an explanation of the key functions, formulas, and MATLAB syntax used in the ECG signal processing code:

1. load() - Used to load ECG data from a .mat file into the workspace. 'ecgdata' will contain the ECG signal.
2. t = 0:1/500:10 - Generates a time vector from 0 to 10 seconds in steps of 1/500 (sampling rate of 500 Hz).
3. plot() - Plots the ECG signal (ecgdata) vs time (t). Sets labels and title.
4. annotation() - Creates a text box annotation on the plot at specified position.
5. lowpass() - Applies a lowpass filter to the ECG signal to remove high frequency noise. Cutoff of 40 Hz.
6. findpeaks() - Detects peaks in the filtered ECG that exceed a certain peak prominence. Returns peak values and locations.
7. pks, locs = findpeaks(...) - Outputs of findpeaks assigned to pks (peak values) and locs (peak locations).
8. mean(60./(diff(locs))) - Calculates heart rate from peak locations:
    - diff(locs) gives interval between peaks
    - 60./diff(locs) gives instantaneous heart rate in BPM
    - mean() calculates average heart rate
9. num2str() - Converts number to string for display.
10. scatter() - Plots markers at peak locations on ECG signal.
11. 'r*' - Red color asterisk marker.

Here are the details explaining the MATLAB code that generates simulated ECG data:

1. fs = 500; - Samples the ECG at 500 Hz
2. t = 0:1/fs:10; - Generates a 10 second time vector at the sampling rate fs
3. ecg = 2*sin(2*pi*1.2*t) - Generates first ECG component using sine function at 1.2 Hz
4.
    - 1.2*sin(2*pi*7*t) - Adds second component at 7 Hz
5.
    - 0.75*sin(2*pi*12*t) - Adds third component at 12 Hz
6. 2*sin(2*pi*f*t) - Amplitude 2, sine function with frequency f (in Hz), time t
7. The sine waves at different frequencies model the shape of a real ECG signal
8. ecg = ecg + 0.2*randn(size(t)) - Adds Gaussian white noise with standard deviation 0.2
9. randn(size(t)) - Generates random noise of same size as t
10. figure; - Opens a new figure window
11. plot(t,ecg) - Plots the ECG signal vs time
12. title, xlabel, ylabel - Sets labels for the plot
13. save('ecgdata.mat','ecg') - Saves ECG data to a .mat file called 'ecgdata'