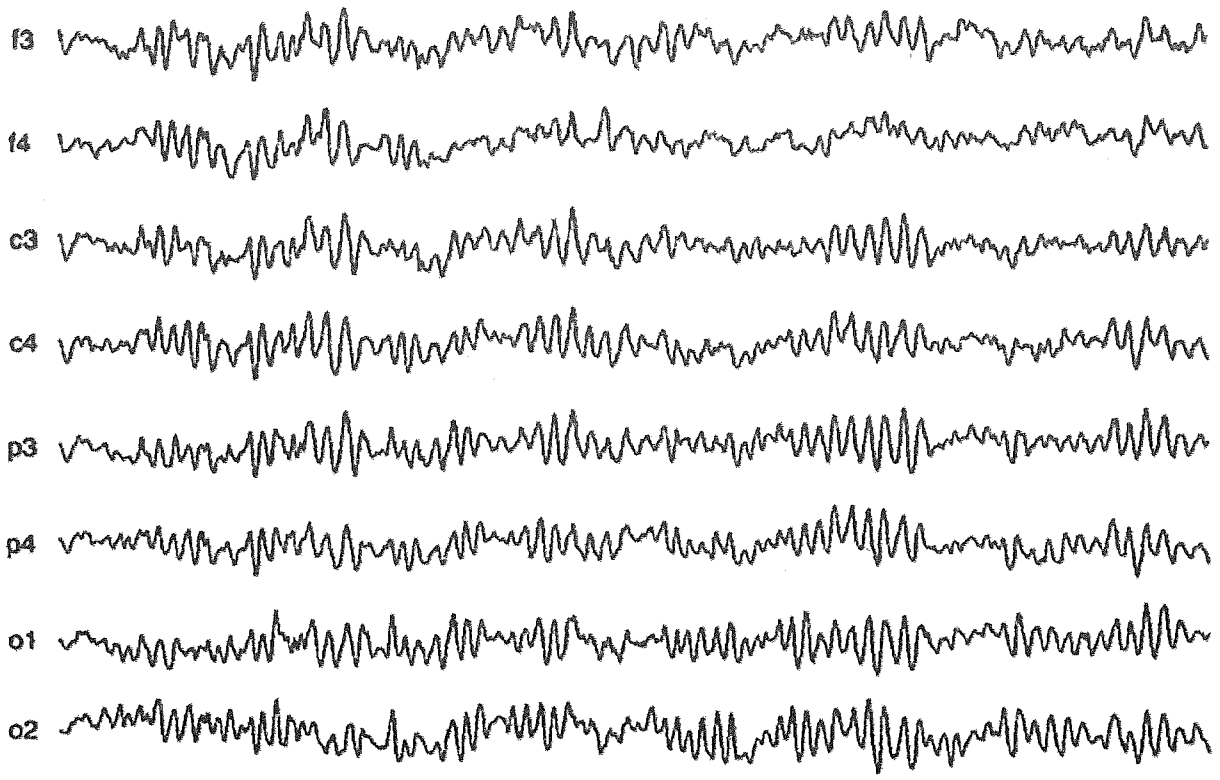
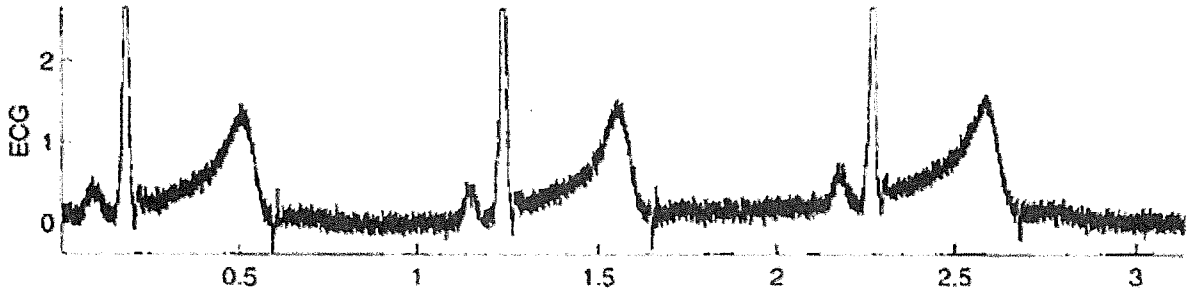
August 2017 QE

1. The figure below shows brainwave (EEG) signals recorded from eight channels on the head surface. The time courses of these signals suggest some periodicity – an oscillation at a specific frequency. Please describe a method to precisely measure the frequency of the observed oscillation (20 points).

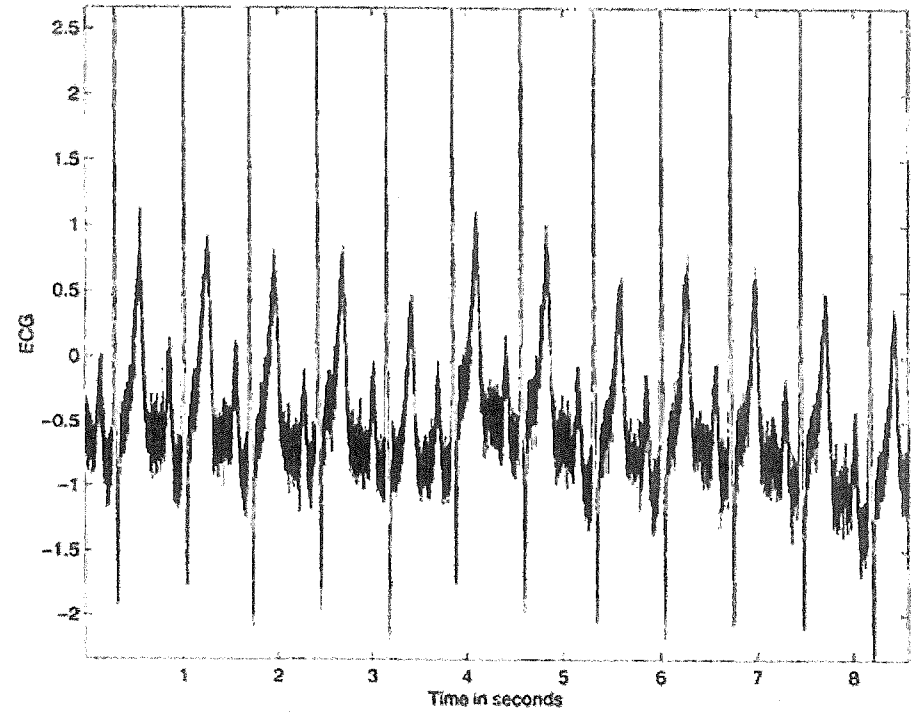


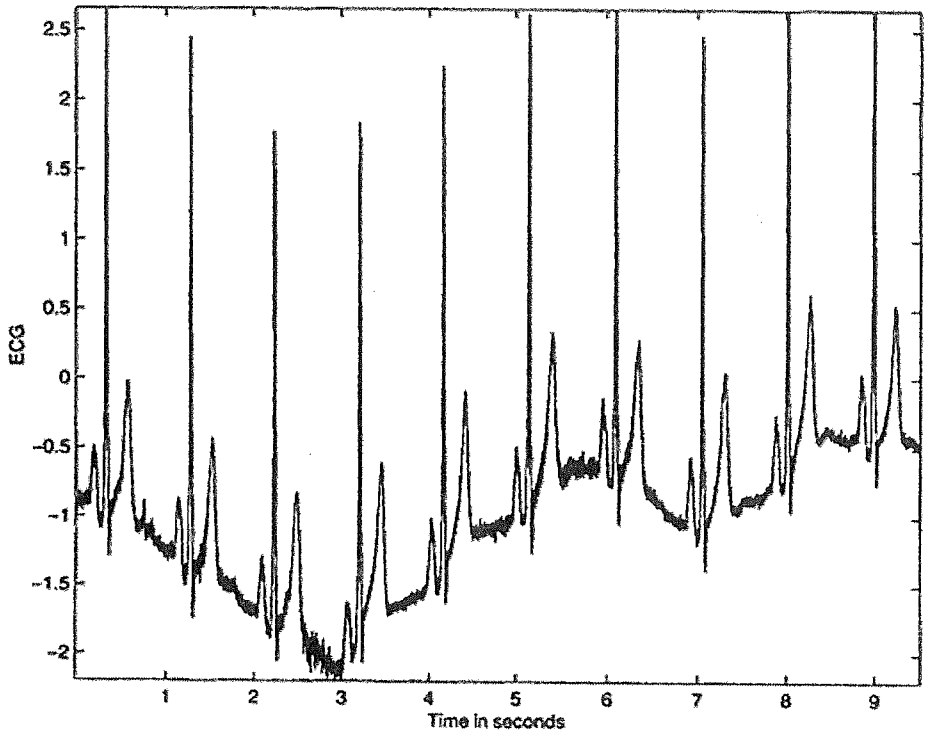
2. The figure below shows the electrocardiogram (ECG) – a recording of electrical activity from the heart. Please describe a method to automatically measure the heart rate given the recorded ECG time series (20 points).



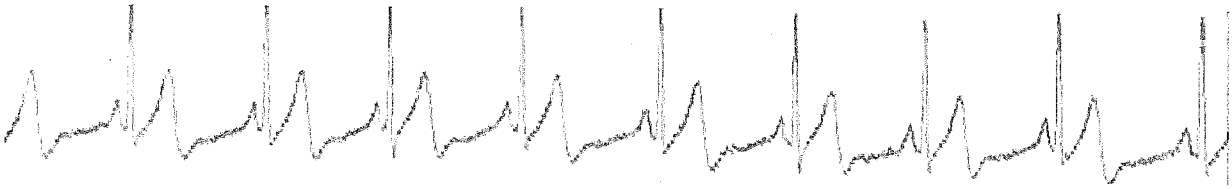
Write in Exam Book Only

3. The figure below shows the ECG signals recorded from the same source but with two different amplifiers. Both recordings include noise: the top has high-frequency noise, and the bottom has a slow drift. Please describe a method to denoise these recordings (20 points).





4. The figure below shows a segment of 10-minute ECG recording. Please describe a solution to detection of the R peaks in the ECG trace (20 points). Hint: the R peak is the sharpest positive peak in a cardiac cycle.



5. The biomedical signal is often a time series signal. Please describe a method to describe the time-series signal as a function of both time and frequency (20 points).