F. Y. M. TECH. (E&TC) (SEMESTER -I)

COURSE NAME: Biomedical Signal Processing
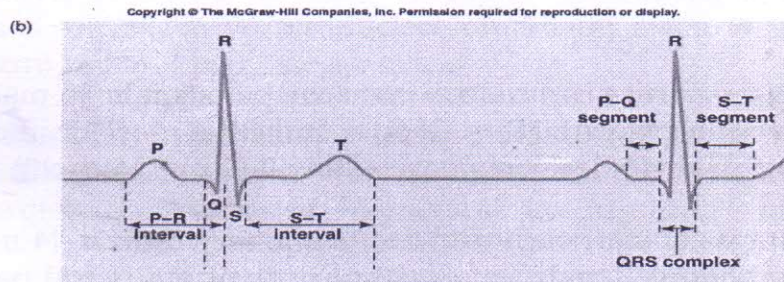
COURSE CODE: ETPA11183C

(PATTERN 2018)

Solution and Marking Scheme Set3

Q.1) i) Draw a neat labeled diagram of ECG signal and write the diagnostically important feature points with their time and amplitude

[3 marks]

Diagram – 1 mark, time interval 1 mark, amplitudes 1 mark

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OR

ii) List the various frequency ranges in EEG waveforms and explain their significance in diagnosing brain disorders.   [3 marks]

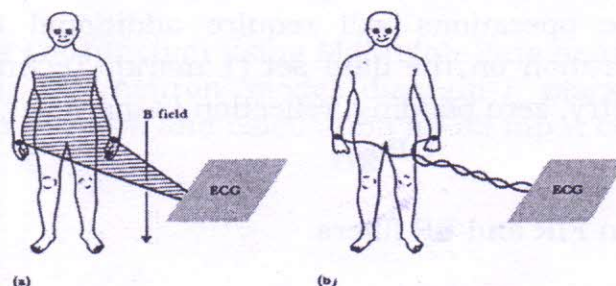Solution: List: Delta, theta, beta, alpha and gamma waves .(1 mark) explanation (2 marks)

Q.2) i) Explain shielding techniques implemented for electrical safety of Medical Instruments.   [3 marks]

Solution: need of shielding-1 mark, techniques- 2 marks

OR

ii) Explain the benefits of using digital filters in biomedical signal processing
[3 marks]
Solution: Any three benefits 1 mark each (de-noising, any order filter, no need of active or passive components, computational accuracy)

Q.3) i) Explain STFT. Discuss its short comings   [2 marks]
STFT definition and equation- 1 mark
Short comings: window selection and time frequency trade off- 1 mark

OR

ii) List the various features in frequency domain that can be useful in biomedical signal processing.   [2 marks]
Entropy, autocorrelation function, Energy, Periodogram, Power spectral density (any four 2 marks)

Q.4) i) What type of noise sources can contaminate the bio-signals. [6 marks]
Solution: (1)physiological variability (2) environmental noise or interference (3) transducer artifact (4) electronic noise (any 3 (2 marks each))

ii) Discuss advantages of stationary and non-stationary signals. [4 marks]
Explantion: Stationary signals are constant in their statistical parameters over time. Stationary signals are further divided into deterministic and random signals. Random signals are unpredictable in their frequency content and their amplitude level, but they still have relatively uniform statistical characteristics over time. A signal is said to be non-stationary if one of these fundamental assumptions is no longer valid. (1 mark), advantages and dis advantges (3 marks)

iii) What are edge effects? How can they be eliminated? [4 marks]
Edge effects: Finite data consist of numerical sequences having a fixed length with fixed end points at the beginning and end of the sequence
Some operations, such as convolution, may produce additional data points while some operations will require additional data points to complete their operation on the data set (1 mark). Technique to remove edge effects symmetry, zero padding, reflection (3 marks)

OR

Q.5) i) Differentiate between FIR and IIR filters   [6 marks]

Comment on phase, stability, order of design, computational complexity, feedback and poles and zeroes (1mark each)

ii) How adaptive noise cancellation technique can be implemented in removal of noise [8 marks]
Solution: Diagram 2 marks, Explanation 6 marks.

Q.6) i) Explain application of Wavelet Transform in Biomedical signal analysis [6 marks]
Solution: De-noising and feature extraction in Bio-signal analysis
Explanation 3 marks and equation 3 marks

ii) Compare PCA and ICA [8 marks]
Solution: Any four points of difference

OR

Q.7) i) Explain PCA algorithm with suitable example. [6 marks]
Following steps should be mentioned: Consider dataset, Subratct mean to generate adjusted dataset, Calculate covariance matrix, calculate eigen values and eigen vectors, select prominent eigen vectors to generate new feature vector. [each step 1 mark]

ii) Write a note on application areas of Bio-signal analysis [8 marks]
Solution: ECG analysis for arrythmia detection, EEG analysis for brain disorders, EMG analysis, Biomedical imaging, etc.(2 marks each)

Q.8) i) Draw and explain the steps involved in Biomedical signal processing [6 marks]
Solution : Diagram 2 marks, Explanation 4 marks

Fig. 13.53 Block Diagram of Pattern Recognition Procedure
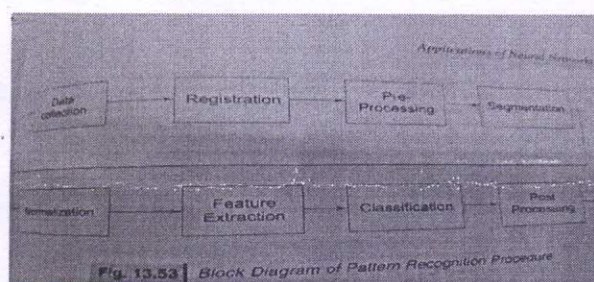
ii) Generate OR function using McCulloh-Pitts neuron model [8 marks]
Solution; MP neuron model diagram-1 mark, truth table -1 mark, equation – 1mark and calculation for all input conditions

OR

Q.9) i) What do you understand by supervised and unsupervised learning

[6 marks]

Solution: Explain each 3marks [6 marks]

ii) State the methods for detection of QRS complex. Draw flowchart for Pan Tomkins Algorithm technique

[8 marks]

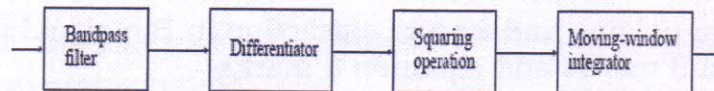Solution: Diagram 2 marks. Explanation 6 marks

Figure 4.4: Block diagram of the Pan-Tompkins algorithm for QRS detection.