Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**ME – SEMESTER – II • EXAMINATION – SUMMER - 2016**

**Subject Code: Biomedical Signal Processing** **Date: 31/05/2016**

**Subject Name: 2724107**

**Time: 10:30 am to 1:00 pm** **Total Marks: 70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

**Q.1** **(a)** Enlist different types of biomedical signals that can be acquired from the human body and briefly explain each signal. **07**

**(b)** Draw the structure of the human heart and explain the correlation between cardiovascular circulation and generation of ECG signal. **07**

**Q.2** **(a)** What are the noise and artifact present in the ECG signal? Explain any two in detail. **07**

**(b)** Two filters are cascaded. The first has the transfer function: **07**

$$H_1(z) = 1 + 2z^{-1} - 3z^{-2}$$

The second has the transfer function:

$$H_2(z) = 1 - 2\,z^{-1}$$

A *unit impulse* is applied to the input of the cascaded filters. (a) What is the output sequence? (b) Draw signal flow graph and pole zero diagram.

**OR**

**(b)** A digital filter has the following transfer function. What traditional filter type best describes this filter? What is the difference equation? **07**

$$H(z) = \frac{1 - z^{-10}}{1 - z^{-1}}$$

Draw its pole – zero plot, amplitude and phase response.

**Q.3** **(a)** Explain linear filtering approach for removal of Power line interference from an ECG signal. Discuss limitation of this technique. **07**

**(b)** What is an arrhythmia? Describe various atrial arrhythmias with neat diagram. **07**

**OR**

**Q.3** **(a)** Write an algorithm of Pan Tompkins for detection of QRS complex in ECG signal and explain each step mathematically. **07**

**(b)** Draw and explain 12 lead ECG recording system. **07**

**Q.4** **(a)** What are the various sleep disorders observed during sleep in EEG signal? Explain each one in detail. **07**

**(b)** Define the following terms in brief:

i) Epilepsy **04**

ii) Dendrites **03**

**OR**

**Q.4** **(a)** Draw and explain block diagram of Brain Computer Interface. **07**

**(b)** With appropriate diagram, explain artifact cancellation using reference signals. **07**

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|---|---|---|---|
| **Q.5** | **(a)** | Write an algorithm of Principal Component Analysis (PCA) with suitable equations. | **07** |
| | **(b)** | Define the following terms in brief: | |
| | | i) Myocardial infarction | **04** |
| | | ii) Premature beats | **03** |

**OR**

| | | | |
|---|---|---|---|
| **Q.5** | **(a)** | Explain the concept of blind source separation. Discuss the method Independent Component Analysis (ICA) with all the required steps. | **07** |
| | **(b)** | How Support Vector Machines can classify the biomedical signal features? Explain in brief. | **07** |

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