Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
(A Constituent Institute of Manipal University)
Manipal – 576 104

FIRST SEMESTER M.Tech (BME) DEGREE MAKE-UP EXAMINATIONS , DEC/JAN 2015-16
SUBJECT: BIOMEDICAL SIGNAL PROCESSING (BME 505)
Thursday, 7th January 2016 : 2.00 to 5.00 p.m.

TIME: 3 HOURS **MAX. MARKS: 100**

Instruction to Candidates:

Answer any FIVE full questions.
Assume relevant data if missing.
Give diagrams wherever necessary.

1. (A) For the systems described by the following input output relation, determine whether the system is stable, causal, linear and time invariant. 8

i) $T\{x(n)\} = (\cos \pi n)x(n)$ ii) $T\{x(n)\} = x(n^2)$

iii) $T\{x(n)\} = x(n)\sum_{k=0}^{\infty}\delta(n-k)$ iv) $T\{x(n)\} = \sum_{k=n-1}^{\infty}x(k)$

(B) How do you estimate the power spectrum density (PSD) of a given signal based on modified periodogram method? Discuss the advantages of modified periodogram method over the periodogram method in estimating the PSD of a given signal. 6

(C) Explain the technique for extracting QRS complex, based on real time QRS detection algorithm. 6

2. (A) i) Derive a closed form expression for the convolution of 8

$$x(n) = \left(\frac{1}{6}\right)^{n-6} u(n) \;\&\; h(n) = \left(\frac{1}{3}\right)^{n} u(n-3)$$

ii) Determine the fourier transform of $x(n) = \left(\frac{1}{2}\right)^{n} u(n+3)$

(B) Auditory evoked responses are recorded from patients with different levels of hearing impaired-ness. How do you identify the segments corresponding to different stages of hearing impaired-ness from the normal ones? Describe the method. 6

(C) Consider speech samples from a male uttering the vowels. Use complex cepstrum followed by a suitable homomorphic filter to separate at least two constituents of the samples. 6

3. (A) Consider two four point sequences $x(n)$ & $h(n)$. Calculate the 4-point DFT's of $x(n)$ & $h(n)$. Find circular convolution of the sequences $x(n)$ & $h(n)$. Also determine $y(n)$ by multiplying the DFT's of $x(n)$ & $h(n)$ and performing an inverse DFT. 8

$$x[n] = \cos\left(\frac{\pi n}{2}\right), \quad n = 0, 1, 2, 3,$$
$$h[n] = 2^n, \quad n = 0, 1, 2, 3.$$

(B) What role does adaptive noise canceler play in the enhancement of ECG signal of a patient implanted with a donor heart? Justify with a suitable adaptive scheme. 6

(C) How Weiner filter helps in eliminating noise from a corrupted signal? Explain with mathematical terms. 6

4. (A) When the input to a causal LSI system is: 8

$$x[n] = -\frac{1}{3}\left(\frac{1}{2}\right)^n u[n] - \frac{4}{3}2^n u[-n-1],$$

the z-transform of the output is:

$$Y(z) = \frac{1 + z^{-1}}{\left(1 - z^{-1}\right)\left(1 + \frac{1}{2}z^{-1}\right)\left(1 - 2z^{-1}\right)}.$$

Find z-transform of $x(n)$. Determine the ROC of $Y(z)$. Find the impulse response of the system.

(B) What are the differences between adaptive noise canceler and adaptive line enhancer? Justify your answer with suitable description. 6

(C) How recursive least square algorithm is different from least mean square algorithm? Justify the answer with mathematical description regarding recursive least square method. 6

5. (A) Compute $y(n) = v(n) * w(n)$, where 8

$$v[n] = u[n] - u[n-6],$$

$$w[n] = \delta[n] + 2\delta[n-2] + \delta[n-4],$$

(B) How do you estimate the autoregressive parameters, when there are slow changes in the spectra of an ECG signal? Explain with mathematical terms. 6

(C) Explain the auto regressive method employed in the analysis of diastolic heart sounds to detect coronary artery disease non-invasively? Give suitable explanation. Draw the spectrum for patients and normal subjects. Interpret the results. 6

6. (A) Derive various time series models based on the transfer function of a linear prediction model. 8

(B) How do you interpret the ST segment of an ECG signal using a ST segment analyzer? Explain in detail. 6

(C) Discuss the various features of the following bio-electric signals: 6
i) Phonocardiogram, ii) Electrocardiogram and iii) Vibromyogram

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