Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

I SEMESTER M.Tech. (BME) DEGREE MAKE UP EXAMINATIONS DEC/JAN 2016-17
SUBJECT: BIOMEDICAL SIGNAL PROCESSING (BME 5103)
(REVISED CREDIT SYSTEM)
Saturday, 31st December 2016, 9 AM to 12 NOON

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

Instructions to Candidates:

1. **Answer full questions.**
2. **Draw labeled diagram wherever necessary**

1. (a) Let $h(n)$ be the unit sample response of a linear shift invariant system. Find the frequency response when: **8**

i) $h(n) = \delta(n) + 6\delta(n+1) + 3\delta(n-2)$ ii) $h(n) = \left(\frac{1}{3}\right)^{n+2} u(n-2)$

(b) How do you estimate the Welch power spectral density? Justify your answer with mathematical explanation. **6**

(c) Explain how the power spectrum estimation method may be used in the analysis of auditory evoked potentials to diagnose neural hearing loss and also to understand the neurophysiology of the auditory system. **6**

2. (a) Find whether or not each of the following systems is stable: **8**

i) $y(n) = x^2(n)$ ii) $y(n) = \frac{e^{x(n)}}{x(n)-1}$ iii) $y(n) = Cos[x(n)]$ iv) $y(n) = \sum_{k=-\infty}^{\infty} x(k)x(n+k)$

(b) Compare multiplicative homomorphic filtering with homomorphic deconvolution. What do you understand by phase unwrapping technique? Explain. **6**

(c) Explain how the ST-segment analyzer may be used for the interpretation of an ECG, to determine whether a patient is normal or diseased. **6**

3. (a) i) Find the correlation between the sequences: $x(n) = u(n) - u(n-6)$ & $h(n) = u(n-2) - u(n-5)$ **4+4**

ii) Determine $N-$point circular convolution of $x_1(n)$ & $x_2(n)$.
$x_1(n) = x_2(n) = 1$; $0 \le n \le N-1$

(b) How do adaptive line enhancer and adaptive noise canceler help in enhancing electro-gastric signal? Explain with a neat adaptive scheme. **6**

(c) What is the role played by the adaptive line enhancer adopted in the modified adaptive filter scheme to enhance visually evoked potentials? What are the advantages and disadvantages associated with the modified filter scheme? Provide the exact structure with description. **6**

4. (a) A causal LSI system has the impulse response $h(n)$, for which the z-transform is $H(z) = \frac{1+z^{-1}}{(1-\frac{1}{2}z^{-1})(1+\frac{1}{4}z^{-1})}$ Determine the impulse response of the system. Is the system stable **8**

(b) Explain with a conventional FIR filter structure, the wiener filter that can eliminate the background noise from a biomedical signal. **6**

(c) What is the role played by autoregressive model to analyze lung sounds in order to estimate the source and transmission characteristics? Explain with a neat sketch. **6**

5. (a) Find the $N-$point discrete fourier transform of the sequence **8**

$x(n) = Cos(n\omega_o)\ ;\ 0 \le n \le N-1$

(b) How can we obtain the linear prediction model when the input to the system that caused the EEG signal as its output is unknown? Interpret the model by formulations in the time domain. **6**

(c) Why is adaptive autoregressive method based on recursive least square algorithm used to track changes in biomedical signals? Provide mathematical explanation. **6**