Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

I SEMESTER M.TECH (INDUSTRIAL AUTOMATION AND ROBOTICS, MECHATRONICS ENGINEERING) END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: SIGNAL PROCESSING AND APPLICATIONS [MTE 509]

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Transform Tables to be provided
- Missing data may be suitably assumed.

1A. A Digital signal processor kit is programmed to obtain the following list of manipulations on the signal. X(n) = {-2, -1 , 0 , 1 ,0 ,1 ,2,1}. Output of the kit is connected to a digital oscilloscope. Sketch the output displayed on scope after each operation. **(8m)**

i. f(2n)
ii. 2f(n/2)
iii. f(-n)
iv. f(n+4) – f(n+2)

1B. Define dynamic and linear systems? Give examples. **(2m)**

2A. Find the transfer function of a DSP kit in Fourier which produces following output f2(t) to input f1(t). **(3m)**

2B. If the Fourier transform of a time domain function f(t) is F(f(t)) = $\frac{a}{a^2+\omega^2}$ .Then find the following **(3m)**

i. $F(f(t)e^{jkt})$ *ii.* $F(4\frac{df(t)}{dt})$ *iii.* $F(f(t- t_0))$

2C. Write a short note on any one applications of signal processing with neat block diagram representation. **(4m)**

3A. Design a second order digital IIR filter that allows signals to pass beyond analog **(7m)**

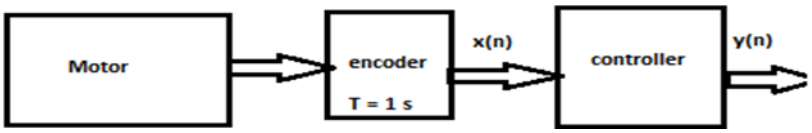
frequency Ωc = 5 rad/sec.

3B. Find y(n) = x(n)*h(n) if x(n) ={[1],2,−1,1} and h(n) = {1,[0],1,1,}. **(3m)**

4A. A surveillance camera is mounted on a moving cart with suspension system. The highly frequent occurrence of irregularities on the tracking surface should be effectively removed by the suspension system. The amplitude of vibrations, above 500 Hz, has to be kept as low as 0.2 db. The suspension gets active around vibrations that exceed 100Hz with amplitude of 3db. Design a digital filter to serve the purpose. Apply bilinear transformation and T = 1 sec. **(8m)**

4B. Find the z transforms of the $x(n) = 2^n u(n-5)$. Also mention the region of convergence. **(2m)**

5A. An armature controlled dc servo motor is connected to a robotic arm, represented by the transfer function, $\frac{\theta(s)}{V(s)} = \frac{2}{s+2}$. The speed of the rotational arm movement is measured using an encoder system that gives out discrete signals with sampling time T = 1sec. The signal is then processed with the controller block with system transfer function $h(n) = 2^n u(n)$. Obtain the final equivalent discrete time response y(n) of the entire set up. Assume the input to the motor is 1 V dc battery source. **(6m)**



5B. Prove the Parseval's theorem of Fourier transforms for the causal signal X(t) = $e^{-at}u(t)$ **(4m)**

6A. Design and realize an FIR digital filter with n = {0,1,2,…4} whose magnitude response is $H(e^{jw}) = e^{-5jw}$ for $-\frac{5\pi}{2} \leq w \leq \frac{5\pi}{2}$, and zero elsewhere. **(10m)**

Also the weighting factor is a sinusoidal function.