#### SEMESTER 1 EXAMINATION – 20012/2013

**Module Code: EEEN30110 , Module Title: Signals and Systems**

**Time Allowed: 2 hours**

### Answer all questions. The percentages in the right margin give an approximate indication of the relative importance of each part of a question. All rough work should be entered in your answer books

1. A signal is periodic of period 1 sec. Over the time-interval -0.2 sec to 0 sec the signal is constant at -1. Over the time-interval 0 sec to 0.8 sec the signal ramps, (i.e. rise linearly) from -1 to 10. At time 0.8 sec the signal resets back to -1.

Plot three cycles of the signal vs time. **10**

Determine whether or not the signal has discontinuities and hence select a suitable value for the number of samples per cycle, *N* , arising in the approximate evaluation of the Fourier coefficients. Find the first eight non-zero terms of the trigonometric Fourier series of. **80**

Determine the DC component, the fundamental, the second harmonic and the third harmonic of. **10**

2. A plotter with input , a voltage, and output , the position of a pen, is described by the linear, constant-coefficient, ordinary differential equation:

**** .

Determine the transfer function  of the system from input  to output.

Plot the magnitude of the frequency response vs frequency and hence or otherwise discuss the filtering properties of the system. **10**

If the input voltage is a unit step and the initial position is constant at 1 cm, find a formula for subsequent position of the pen as a function of time. Identify the forced response and the free response. Identify also the transient and the steady-state response. **70**

Given that the input voltage to the plotter system is the signal  of the first part of question 1 find the first eight non-zero terms of the trigonometric Fourier series of the steady-state output of the system. **20**

3. An LTI, SISO, causal, discrete-time system with input *x*(*n*) and output *y*(*n*) is governed by the recursion/difference equation:

 for 

subject to the initial conditions , , . Given an input *x*(*n*) which is zero for *n* not equal to 0 or 1 and 0.5 for *n* equal to 0 or 1, find a formula for the resulting output of the system for . **50**

Let the input to the system be a periodic signal of period 9. For *n* = 0 and 1 this signal equals 0.5. For *n* = 2, 3, … , 8 this signal is equal to 0. Find the resulting steady-state output of the system. **50**

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