**EECE 290 Analog Signal Processing**

**Final Exam – May 8, 2017**

1. Draw the circuit diagram of a third order, lowpass, Butterworth filter as a cascade of a second-order lowpass filter (first stage) and a first-order lowpass filter (second stage). The filter is to have a passband voltage gain of 20 dB, and a 3 dB cutoff frequency of 10 krad/s, using 100 nF capacitors.

**Ans.**



1. (a) Determine the third harmonic component of *vO*(*t*), given that *vI*(*t*) is the periodic function shown

having a period of 6 s, with *A* = 1 V, applied to the op

amp circuit shown.

(b) Determine the value and polarity of the average voltage across the capacitor.

**Ans.** (a)  V.

(b) 0.5 V, polarity is + on the left capacitor plate and – on the right capacitor plate.



1. Assuming *VSRC* = 15 V, determine: (a) *RLm* for maximum power transfer to *RL*, (b) the maximum power transferred, and (c) the complex power delivered under these conditions by the ideal voltage source.

**Ans.** (a) *RLm* = 24 Ω; (b) 5/3 W; (c)  VA.

**4.** The switch is opened at *t* = 0 after being closed for a long time. Determine *VC*(*s*) and *vC*(*t*), assuming *VSRC* = 1.5 V.

**Ans.** ,  V.

1. A current *i*(*t*) =  is applied to a resistor of 2 Ω. Determine the energy dissipated in the resistor over all time using Parseval’s theorem. Note that:



**Ans.** 1/4 J.

1. The input impedance of a symmetric two-port circuit is (1 + *j*) Ω when the other port is open circuited, and is  Ω when the other port is short circuited. Determine the *z* parameters of the circuit.

**Ans.** *z*11 =  Ω, *z*12 = 1 Ω.