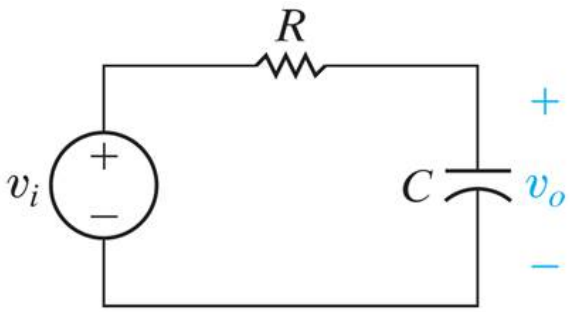
Started on	Monday, 13 May 2019, 10:10 AM
State	Finished
Completed on	Monday, 13 May 2019, 11:42 AM
Time taken	1 hour 32 mins
Grade	**92.00** out of 100.00

Question 1

Correct

Mark 9.00 out of 9.00



Q1a

Given: C = 250 nF (nano F) R = 5 kΩ (kilo Ohm)

a) Write the parameters of the transfer function H(s).

H(s) = V_0 / V_i = 800 ✓ / (s + 800 ✓)

b) Calculate the cutoff frequency ω_c in rad/sec and f_c in Hz.

ω_c = 800 ✓ rad/sec f_c = 127.3 ✓ Hz

c) State the phase angle of the output voltage when fully in the passband region where $\omega << \omega_c$.

θ(pass band) = 0 ✓ ° (Degrees)

d) State the phase angle of the output voltage at the corner frequency ω_c.

θ(ω_c) = -45 ✓ ° (Degrees)

e) State the phase angle of the output voltage when fully in the stopband region where $\omega >> \omega_c$.

θ(stop band) = -90 ✓ ° (Degrees)

f) Identify the filter type of this circuit.

Filter Type = Low Pass ▼ ✓

Numeric Answer

a) H(s) = 800 / (s + 800)

b) ω_c = 800 rad/sec f_c = 127.3240 Hz

c) θ(pass band) = 0°

d) θ(ω_c) = -45°

e) θ(stop band) = -90°

f) Filter Type = Low Pass

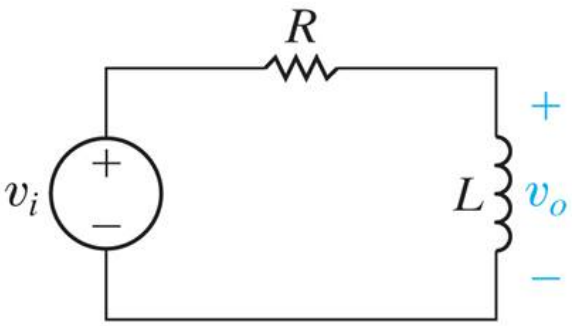
Correct

Marks for this submission: 9.00/9.00.

Question 2

Correct

Mark 9.00 out of 9.00



Q2e

Given: L = 67 mH (milli H) R = 353 Ω (Ohm)

a) Write the parameters of the transfer function H(s).

H(s) = V_0 / V_i = s / (s + 5268.7 ✓)

b) Calculate the cutoff frequency ω_c in rad/sec and f_c in Hz.

ω_c = 5268.7 ✓ rad/sec f_c = 838.54 ✓ Hz

c) State the phase angle of the output voltage when fully in the passband region where $\omega >> \omega_c$.

θ(pass band) = 0 ✓ ° (Degrees)

d) State the phase angle of the output voltage at the corner frequency ωw_c.

θ(ω_c) = 45 ✓ ° (Degrees)

e) State the phase angle of the output voltage when fully in the stopband region where $\omega << \omega_c$.

θ(stop band) = 90 ✓ ° (Degrees)

f) Identify the filter type of this circuit.

Filter Type = High Pass ▼ ✓

Numeric Answer

a) H(s) = s / (s + 5,268.6567)

b) ω_c = 5,268.6567 rad/sec f_c = 838.5328 Hz

c) θ(pass band) = 0°

d) θ(ω_c) = 45°

e) θ(stop band) = 90°

f) Filter Type = High Pass

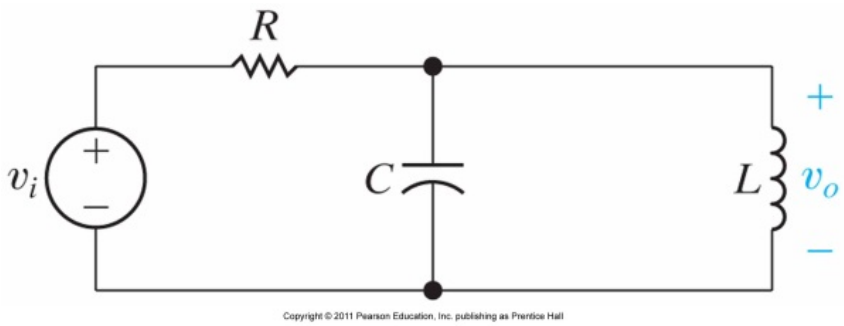
Correct

Marks for this submission: 9.00/9.00.

Question 3

Correct

Mark 9.00 out of 9.00



Q3Pb

Given: R = 160 Ω (Ohm) C = 5 µF (micro F) L = 100 µH (micro H)

a) Find the resonant frequency ω_0.

ω_0 = 44721.36 ✓ rad/sec

b) Find the lower half-power frequency w_{c1}.

ω_{c1} = 44096 ✓ rad/sec

c) Find the upper half-power frequency w_{c2}.

ω_{c2} = 45346 ✓ rad/sec

d) Find the bandwidth β (Beta).

β = 1250 ✓ rad/sec

e) Find the quality factor Q.

Q = 35.77 ✓

f) Identify the filter type of this circuit.

Filter Type = Band Pass ▼ ✓

Numeric Answer

a) ω_0 = 44,721.3595 rad/sec

b) ω_{c1} = 44,100.7267 rad/sec

c) ω_{c2} = 45,350.7267 rad/sec

d) β = 1,250 rad/sec

e) Q = 35.7771

f) Filter Type = Band Pass

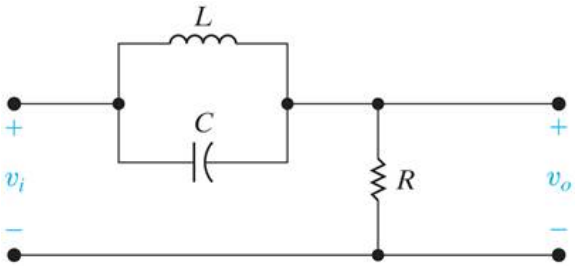
Correct

Marks for this submission: 9.00/9.00.

Question 4

Correct

Mark 9.00 out of 9.00



Q4Pb

Given: R = 750 Ω (Ohm) C = 20 nF (nano F) L = 150 µH (micro H)

a) Calculate ω_0.

ω_0 = 577.35 ✓ krad/sec (kilo rad/sec)

b) Calculate f_0.

f_0 = 91.888 ✓ kHz (kilo Hz)

c) Find ω_{c1}.

ω_{c1} = 544.997 ✓ krad/sec (kilo rad/sec)

d) Find ω_{c2}.

ω_{c2} = 611.645 ✓ krad/sec (kilo rad/sec)

e) Find β (Beta).

β = 66.66 ✓ krad/sec (kilo rad/sec)

f) Find Q.

Q = 8.66 ✓

g) Identify the filter type of this circuit.

Filter Type = Band Reject ▼ ✓

Numeric Answer

a) ω_0 = 577.3503 krad/sec

b) f_0 = 91.8881 kHz

c) ω_{c1} = 544.9784 krad/sec

d) ω_{c2} = 611.6451 krad/sec

e) b = 66.6667 krad/sec

f) β = 8.6603

g) Filter Type = Band Reject

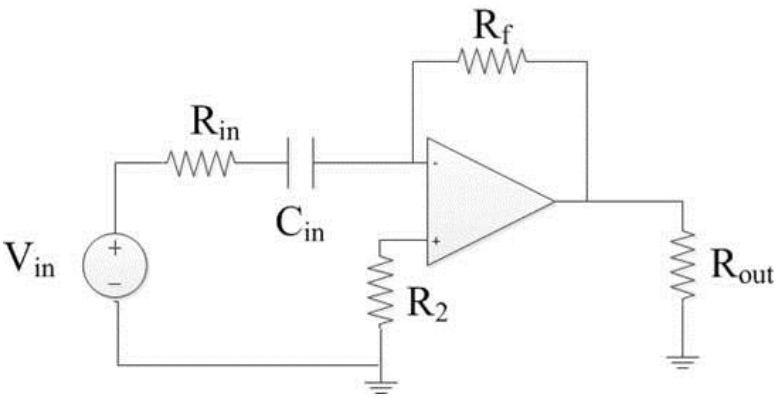
Correct

Marks for this submission: 9.00/9.00.

Question 5

Correct

Mark 9.00 out of 9.00



Q5a

Given: Vin = 15 cos(2,000t) Volts

R_{in} = 10 kΩ (kilo Ohm) C_{in} = 0.1 μF (micro F) Rf = 10 kΩ (kilo Ohm)

R_{out} = 1 kΩ (kilo Ohm) R2 = 10 Ω (Ohm)

The opamp has power input rails at +15V and -15V.

Find the steady-state output voltage v_{out} which is the voltage across the resistor R_{out}.

v_{out} = 13.41 ✓ cos (2,000 t + 210 ✓ ° (Degrees) Volts

State the voltage magnitude as positive and state the phase angle as a positive angle (counterclockwise from the origin) in the correct quadrant.

Numeric Answer

v_{out} = 13.4164 cos (2,000 t + 206.57°) Volts

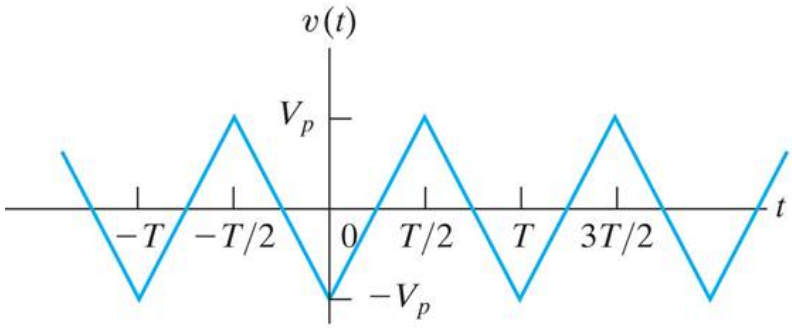
Correct

Marks for this submission: 9.00/9.00.

Question 6

Correct

Mark 9.00 out of 9.00



Q6b

Given: The Fourier coefficients for this waveform are

$a_v = 0$ V $a_n = -8V_p/(n\pi)^2$ Volts for k odd $b_n = 0$ V

$V_p = 50$ V T = 5 ms (milli sec)

Write the following terms of this waveform's Fourier series.

a) What is the average value?

Avg = 0 ✓ Volts

Answers for the next two questions are in the order of magnitude, identify cosine or sine and the frequency of the sinusoid in radians/sec.

b) Write the expression for n = 1.

$v_1(t)$ = -40.53 ✓ cosine ✓ (1256.64 ✓ t) Volts

c) Write the expression for n = 5.

$v_5(t)$ = -1.62 ✓ cosine ✓ (6283 ✓ t) Volts

Numeric Answer

a) $a_v = 0$ Volts

b) For n = 1, $v(t) = -400/(1*\pi)^2 \sin(1*400p) = -40.5284 \cos(1{,}256.6371\ t)$ V

c) For n = 5, $v_5(t) = -400/(5*\pi)^2 \sin(5*400p) = -1.6211 \cos(6{,}283.1853\ t)$ V

Correct

Marks for this submission: 9.00/9.00.

Question 7

Correct

Mark 9.00 out of 9.00

Q7b

Given the "normal" trigonometric form of the Fourier series coefficients for a waveform are

a_{avg} = zero $a_n = -5/n^2$ $b_n = 15/n$

Determine the coefficients for the Alternative trigonometric form of the Fourier series in the polar form

$a_n - jb_n = A_n \angle -\theta_n$ (Magnitude A_n at angle $-\theta_n$)

a) For the first term in the summation where n = 1:

A_1 = 15.81 ✓ Volts

$-\theta_1$ (Theta 1) = -108.5 ✓ ° (Degrees, angle CW from origin)

b) For the second term in the summation where n = 2:

A_2 = 7.6 ✓ Volts

$-\theta_2$ (Theta 2) = -99.47 ✓ ° (Degrees, angle CW from origin)

c) For the third term in the summation where n = 3:

A_3 = 5.02 ✓ Volts

$-\theta_3$ (Theta 3) = -96.35 ✓ ° (Degrees, angle CW from origin)

CW = Clock-wise

Note that the angle also includes the "-" sign as shown in the polar form.

Numeric Answer

a) A_1 = 15.8114 Volts $-\theta_1$ = -108.4349°

b) A_2 = 7.6035 Volts $-\theta_2$ = -99.4623°

c) A_3 = 5.0308 Volts $-\theta_3$ = -96.3402°

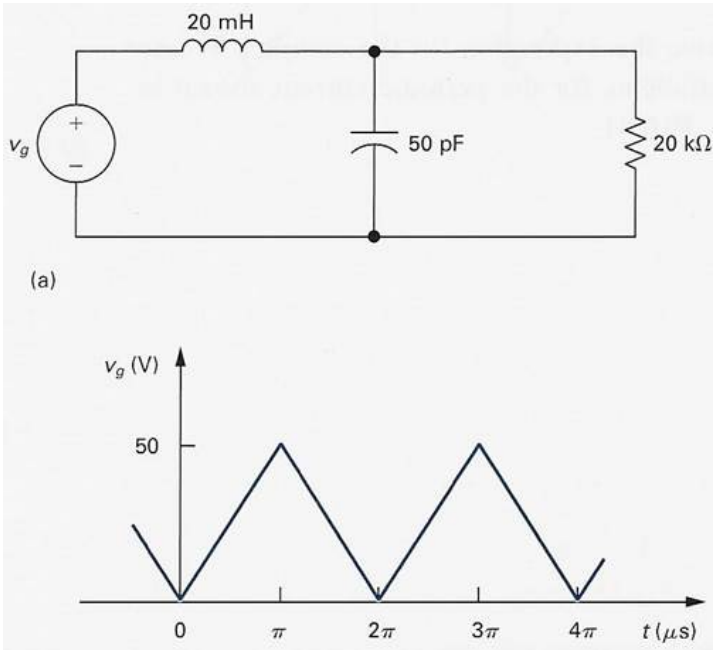
Correct

Marks for this submission: 9.00/9.00.

Question 8

Correct

Mark 9.00 out of 9.00



Q8

The triangular-wave voltage source is applied to this circuit.

The Fourier series of this input waveform is

$$v(t) = 25 - \frac{200}{\pi^2} \sum_{n=1,3,5,\ldots}^{\infty} \frac{1}{n} \cos(n\omega_0 t)$$

The s domain transfer function of the circuit is

$$H(s) = \frac{10^{12}}{s^2 + s10^6 + 10^{12}}$$

The desired output is the voltage across the 20 kΩ (kilo Ohm) resistor.

a) Determine the steady-state output voltage for n = 1 written as polar phasor.

$v_{1,20W,steady\text{-}state}(t)$ = Magnitude -20.26 ✓ at angle -90 ✓ ° (Degrees) Volts (negative magnitude and negative angle)

b) Determine the steady-state output voltage for n = 5 written as polar phasor.

$v_{5,20W,steady\text{-}state}(t)$ = Magnitude -0.165 ✓ at angle 11.77 ✓ ° (Degrees) Volts (negative magnitude and positive angle)

c) Determine an estimate of the time varying power across the 20 kΩ (kilo Ohm) resistor based on the voltage from n = 1 term only.

$P_{20W,steady\text{-}state}$ = 10.26 ✓ mW (milli W)

Numeric Answer

a) $v_{1'20W'steady\text{-}state}(t)$ = -20.2642 at angle -90° V

b) $v_{5'20W'steady\text{-}state}(t)$ = -0.1654 at angle 11.77° V

c) P_{20W},steady-state = 10.266 mW

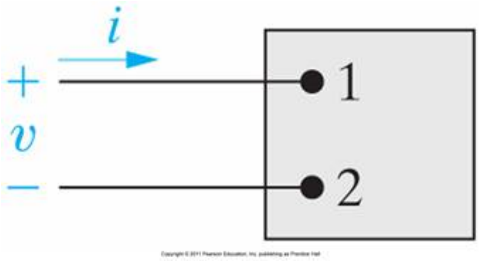
Correct

Marks for this submission: 9.00/9.00.

Question 9

Correct

Mark 9.00 out of 9.00



Q9e

The voltage and current at terminals of this network are

$v(t) = 55 + 120 \cos(300\,t + 45°) + 40 \sin(900\,t)$ Volts

$i(t) = 35 + 18 \sin(300\,t + 75°) + 8 \cos(900\,t - 15°)$ Amps

a) What is the average power at terminals?

P = 2506 ✓ W

b) What is the rms value of the voltage of this truncated series?

V_{rms} = 105 ✓ V_{rms}

c) What is the rms value of the current of this truncated series?

I_{rms} = 37.67 ✓ A_{rms}

Numeric Answer

a) P = 2,506.4110 W

b) V_{rms} = 105.00 V_{rms}

c) I_{rms} = 37.6696 I_{rms}

Correct

Marks for this submission: 9.00/9.00.

Question 10

Correct

Mark 9.00 out of 9.00

Q10c

Given $H(s)=\frac{(45{,}000)(s+200)}{(s+2{,}000)(s+9{,}000)}$

a) What is the zero of this function in the form s + z_1?

z_1 = 200 ✓

b) What are the two poles of this function in the form s + $p_{1,2}$?

p_1 = 2000 ✓ (positive lower value)

p_2 = 9000 ✓ (positive higher value)

c) What is the *gain K* in dB after putting this function in *Standard Form*?

K = -6 ✓ dB

For the following use the Bode diagram straight-line approximation conventions (do not plot the function)

d) Find the magnitude of this transfer function at ω = 2,000 rad/sec.

| H(jω = 2,000 rad/sec) | = 13.87 ✓ dB

e) Find the phase angle at ω = 2,000 rad/sec

θ(jω = 2,000 rad/sec) = 45 ✓ ° (Degrees)

a) z_1 = 200

b) p_1 = 2,000 p_2 = 9,000

c) K in dB = -6.0206 dB

d) | H(jω = 2,000 rad/sec) | = 14 dB

e) θ(jω = 200 rad/sec) = 45°

Correct

Marks for this submission: 9.00/9.00.

Question 11

Complete

Mark 2.00 out of 10.00

You created a hand-drawn Bode Diagram of a given transfer function in-class on May 6th. That in-class work has been manually graded. The instructor will enter your score here after you have completed this online exam.

Comment:

◄ Quiz 12 - Chapter 16

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