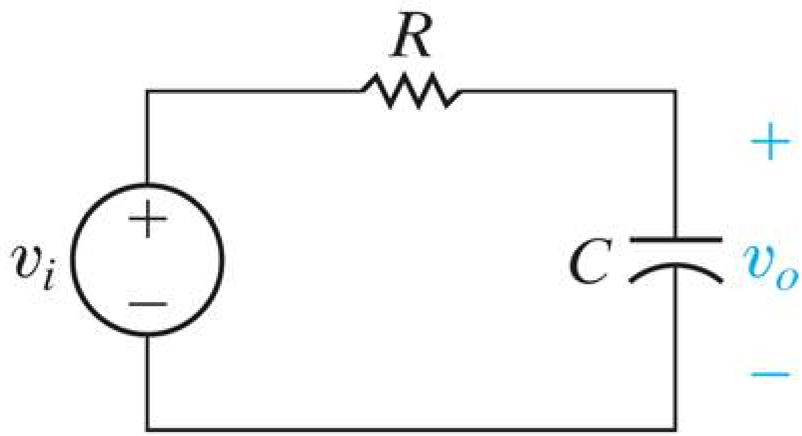
Started on	Monday, 13 May 2019, 10:10 AM
State	Finished
Completed on	Monday, 13 May 2019, 11:13 AM
Time taken	1 hour 3 mins
Grade	**98.00** out of 100.00

Question 1

Correct

Mark 9.00 out of 9.00



Q1e

Given: C = 100 nF (nano F)   R = 99.5 Ω (Ohm)

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

$H(s) = V_0 / V_i =$ 100502.513 / (s + 100502.513)

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

$\omega_c =$ 100502.513 rad/sec $f_c =$ 15995.47 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.

$\theta(\omega_c) =$ -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) = 100,502.5126 / (s + 100,502.5126)

b) ω_c = 100,502.5126 rad/sec f_c = 15,9995.4717 Hz

c) θ(pass band) = 0°

d) $\theta(\omega_c)$ = -45°

e) θ(stop band) = -90°

f) Filter Type = Low Pass

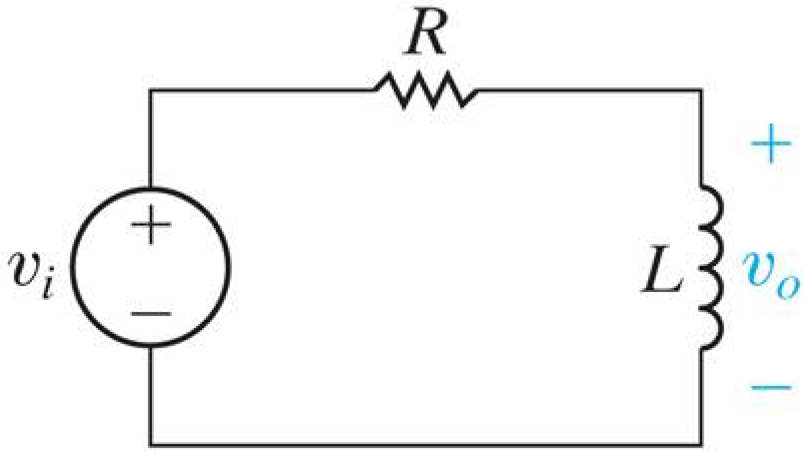
Correct

Marks for this submission: 9.00/9.00.

Question 2

Correct

Mark 9.00 out of 9.00



Q2d

Given: L = 570 mH (milli H) R = 3.5 kΩ (kilo Ohm)

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

$H(s) = V_0 / V_i = s / (s +$ 6140.35 $)$

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

$\omega_c =$ 6140.35 rad/sec $f_c =$ 977.27 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.

$\theta(\omega_c) =$ 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 + 6,140.3509)

b) ω_c = 6,140.3509 rad/sec f_c = 977.2672 Hz

c) θ(pass band) = 0°

d) $\theta(\omega_c)$ = 45°

e) θ(stop band) = 90°

f) Filter Type = High Pass

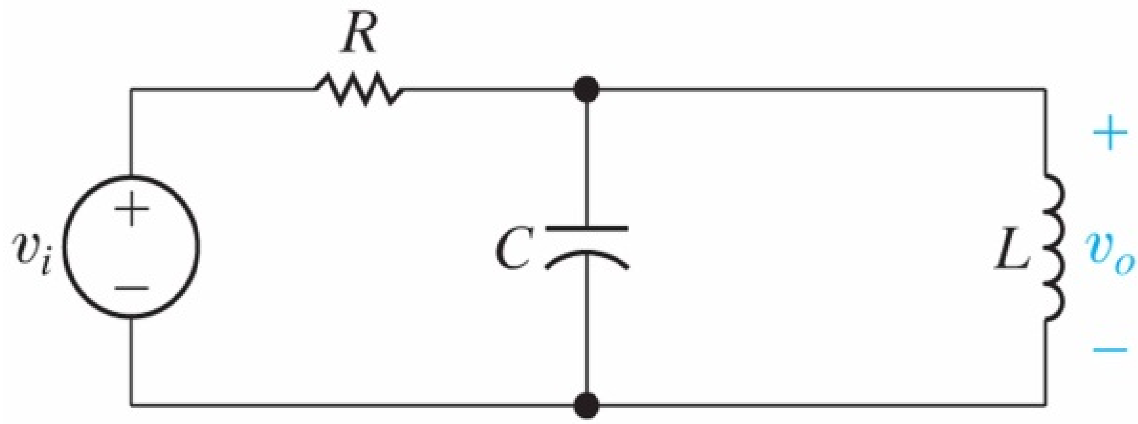
Correct

Marks for this submission: 9.00/9.00.

Question 3

Correct

Mark 9.00 out of 9.00



Q3Pc

Given: R = 80 Ω (Ohm) C = 5 μF (micro F) L = 180 μH (micro H)

a) Find the resonant frequency ω_0.

ω_0 = 33332 rad/sec

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

ω_{c1} = 32106 rad/sec

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

ω_{c2} = 34607.083 rad/sec

d) Find the bandwidth β (Beta).

β = 2500.62 rad/sec

e) Find the quality factor Q.

Q = 13.33

f) Identify the filter type of this circuit.

Filter Type = Band Pass

Numeric Answer

a) ω_0 = 33,333.3333 rad/sec

b) ω_{c1} = 32,106.7626 rad/sec

c) ω_{c2} = 34,606.7626 rad/sec

d) β = 2,500 rad/sec

e) Q = 13.3333

f) Filter Type = Band Pass

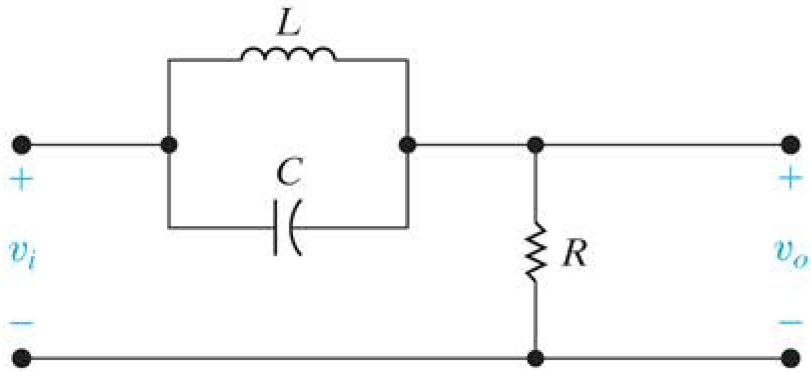
Correct

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 = 91.88 kHz (kilo Hz)

c) Find ω_{c1}.

ω_{c1} = 544.977 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

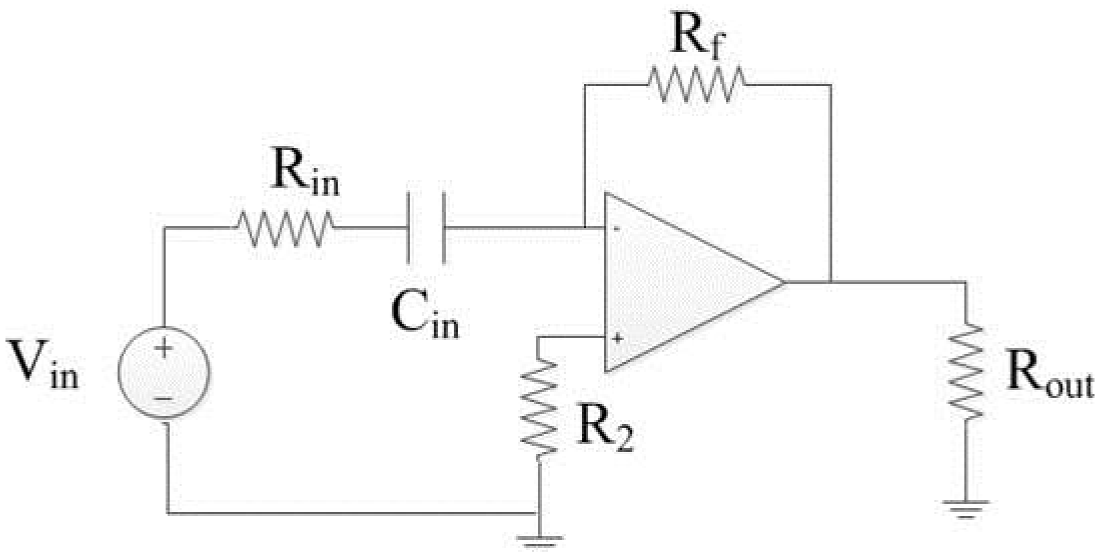
Correct

Marks for this submission: 9.00/9.00.

Question **5**

Correct

Mark 9.00 out of 9.00



Q5e

Given: Vin = 25 cos(4,000t) Volts

R_{in} = 40 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} = 6.2 cos (4,000 t + 183.6 ° (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} = 6.2378 cos (4,000 t + 183.5763°) Volts

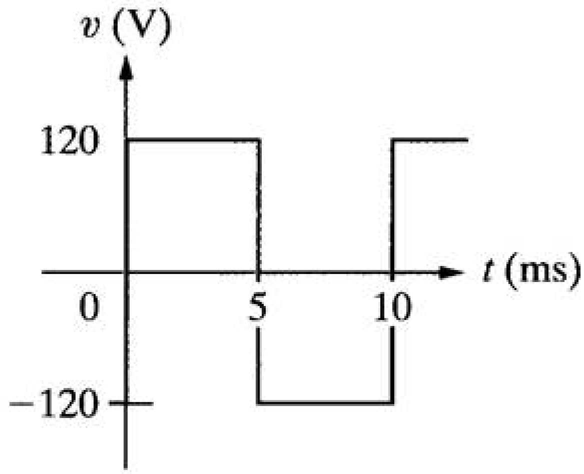
Correct

Marks for this submission: 9.00/9.00.

Question **6**

Correct

Mark 9.00 out of 9.00



Q6a

Given: The Fourier coefficients for this waveform are

$a_v = 0$ V $\quad a_n = 0$ V $\quad b_n = 480 / (n\pi)$ for n odd

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) Find the Fourier Series term for n = 1.

$v_1(t) =$ 152 sine (628.31 t) Volts

c) Find the Fourier Series term for n = 5.

$v_5(t) =$ 30.56 sine (3141.59 t) Volts

Numeric Answer

a) $a_v = 0$ Volts

b) For n = 1, $v_1(t) =$ 480/p sin $(1*200\pi)$ = 152.7887 sin(623.3185 t) V

c) For n = 5, $v_5(t) =$ 96/p sin $(5*200\pi)$ = 30.5577 sin(3,141.5927 t) V

Correct

Marks for this submission: 9.00/9.00.

Question 7

Correct

Mark 9.00 out of 9.00

Q7a

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

a_{avg} = zero $a_n = -10/n^2$ $b_n = 20/n$

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

$$a_n - j b_n = A_n \measuredangle -\theta_n$$ (Magnitude A_n at angle $-\theta_n$)

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

A_1 = 22.36 Volts

$-\theta_1$ (Theta 1) = 116.565 ° (Degrees, angle CW from origin)

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

A_2 = 10.31 Volts

$-\theta_2$ (Theta 2) = 104.036 ° (Degrees, angle CW from origin)

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

A_3 = 6.67 Volts

$-\theta_3$ (Theta 3) = 99.46 ° (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 = 22.3607 Volts $-\theta_1$ = 116.5651°

b) A_2 = 10.3078 Volts $-\theta_2$ = 104.0362°

c) A_3 = 6.7586 Volts $-\theta_3$ = 99.4623°

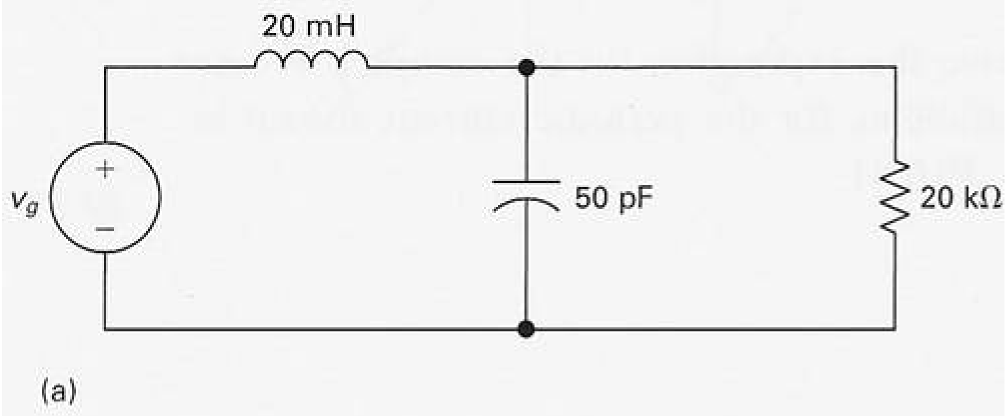
Correct

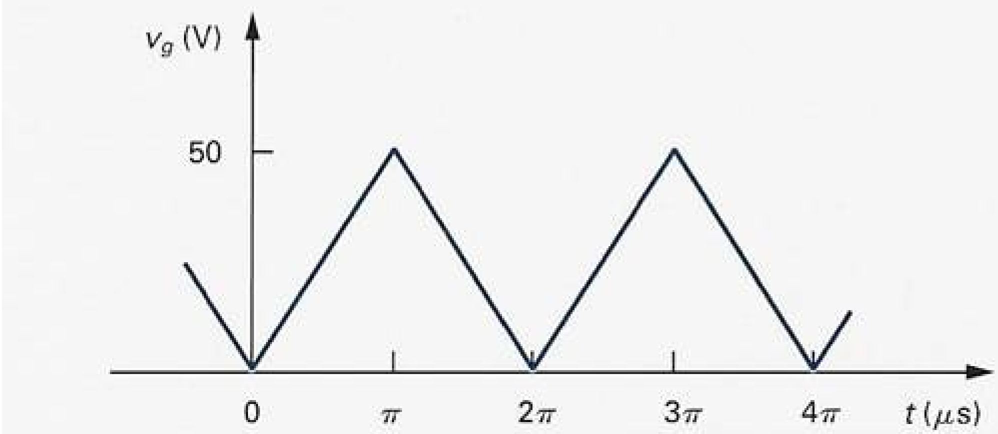
Marks for this submission: 9.00/9.00.

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 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 -0.1655 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.

$P_{20W,steady\text{-}state}$ = 10.3 mW (milli W)

Numeric Answer

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

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

c) $P_{20W\text{'}}$,steady-state = 10.266 mW

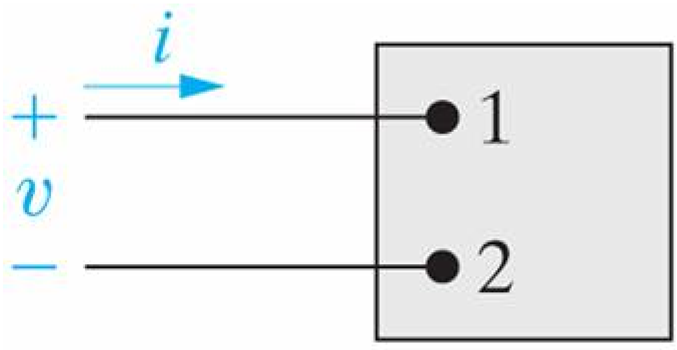
Correct

Marks for this submission: 9.00/9.00.

Question 9

Correct

Mark 9.00 out of 9.00



Q9a

The voltage and current at terminals of this network are

$v(t) = 60 + 170\cos(120\pi t + 15°) + 30\sin(360\pi t + 12°)$ Volts

$i(t) = 5 + 12\sin(120\pi t + 35°) + 3\cos(360\pi t - 30°)$ Amps

a) Estimate the average power at terminals?

P = 669.29 W

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

V_{rms} = 136.01 V_{rms}

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

I_{rms} = 10.07 A_{rms}

Numeric Answer

a) P = 678.9714 W

b) V_{rms} = 136.0147 V_{rms}

c) I_{rms} = 10.0747 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 8.00 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: