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 NPTEL (<https://swayam.gov.in/explorer?ncCode=NPTEL>) » Basic Electrical Circuits (course)

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Unit 13 - Week 11: Second order system response

Course outline

How does an NPTEL online course work?

Week 0

Week 1: Preliminaries; Current and voltage; Electrical elements and circuits; Kirchhoff's laws; Basic elements; Linearity

Week 2: Elements in series and parallel; Controlled sources

Week 3: Power and energy in electrical elements; Circuit analysis methods

Week 4: Nodal analysis

Week 5 : Mesh analysis; Circuit theorems

Week 6: More circuit theorems; Two port parameters

Week 7: Two port parameters continued; Reciprocity in resistive networks

Week 8: Opamp and negative feedback; Example circuits and additional topics

Week 9 :First Order Circuits

Week 10 : First order circuits with time-varying inputs

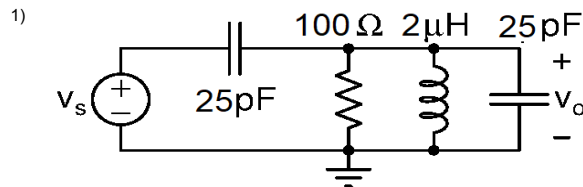
Week 11: Second order system response

- Second order system natural response (unit? unit=22&lesson=161)
- Second order system as a cascade of two first order systems (unit? unit=22&lesson=167)
- Second order system natural response-critically damped and underdamped (unit? unit=22&lesson=162)

Assignment 11

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2020-12-02, 23:59 IST.

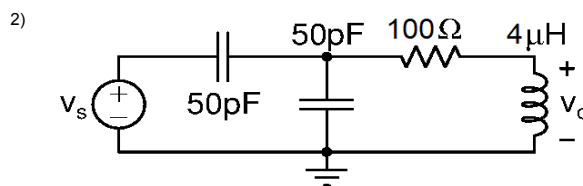


Determine the damping factor ζ of the circuit above.

(The answer must be the value of ζ . Round off fractional answers to 2 decimal places.)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 0.9,1.1

1 point



Determine the damping factor ζ of the circuit above.

(The answer must be the value of ζ . Round off fractional answers to 2 decimal places.)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 0.2,0.31

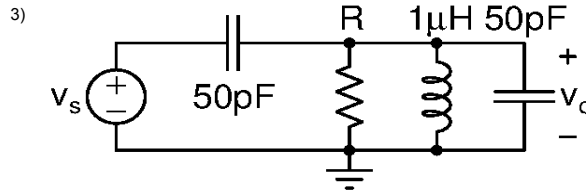
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- Generalized form of a second order system (unit?unit=22&lesson=163)
- Numerical example (unit?unit=22&lesson=166)
- Series and parallel RLC circuits (unit?unit=22&lesson=164)
- Forced response of a second order system (unit?unit=22&lesson=165)
- Basic Electrical Circuits : Week 11 Feedback Form (unit?unit=22&lesson=204)
- Week 11 Lecture materials (unit?unit=22&lesson=229)
- Quiz : Assignment 11 (assessment?name=232)
- Assignment 11 solutions (unit?unit=22&lesson=235)

Week 12: Direct calculation of steady state response from equivalent components

Text Transcripts

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In the circuit above, R is such that the damping factor $\zeta = 0.6$. $v_s(t) = 4u(t)$ V. $v_o(0^-) = 0$. The total response of the circuit is given by

$$v_o(t) = \underbrace{V_f}_{\text{Forced}} + \underbrace{V_p \exp(\sigma t) \cos(\omega t + \phi)}_{\text{Natural}}$$

Determine V_f , V_p , σ , ω , ϕ . (Think carefully and compute the forced and natural responses separately. For the natural response, you need to use v_o and dv_o/dt at $t = 0^+$. Again, these can be calculated by looking at the circuit and judging the voltages and currents, similar to how first order responses were calculated.)

Value of V_f :

(The answer must be in **volts (V)**. Round off fractional answers to 1 decimal place.)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Numeric) 0

1 point

4) Value of V_p :

(The answer must be in **volts (V)**. Round off fractional answers to 1 decimal place.)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 4.8,5

1 point

5) Value of σ :

(The answer must be in **megaradians per second (Mrad/s)**. Round off fractional answers to 1 decimal place.)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) -61,-59

1 point

6) Value of ω :

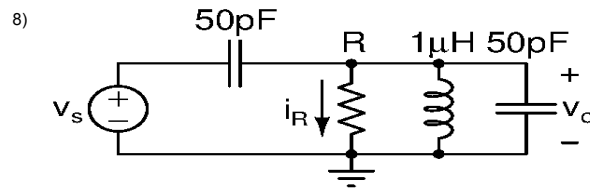
(The answer must be in **megaradians per second (Mrad/s)**. Round off fractional answers to 1 decimal place.)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 78.9,81.1

7) Value of ϕ :

(The answer must be in degrees ($^{\circ}$). Round off fractional answers to 1 decimal place.)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 65,67

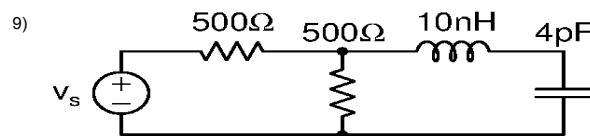


In the circuit above, R is such that the damping factor $\zeta = 0.8$. $v_s(t) = 4 \cos(10^8 t)$ V. What is the amplitude of $i_R(t)$ in steady state? (Hint: Use the methods outlined in Unit 10 for directly calculating the sinusoidal steady state response).

Amplitude of $i_R(t)$:

(The answer must be milliamperes (mA). Round off fractional answers to 1 decimal place.)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 19,21



Determine the damping factor ζ and the natural frequency ω_n of the circuit above.

Value of ζ :

(The answer must be the value of ζ . Round off fractional answers to 2 decimal places.)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 2.4,2.6

1 point

1 point

1 point

1 point

10) Value of ω_n :

(The answer must be in **gigaradians per second (Grad/s)**. Round off fractional answers to 1 decimal place.)

No, the answer is incorrect.

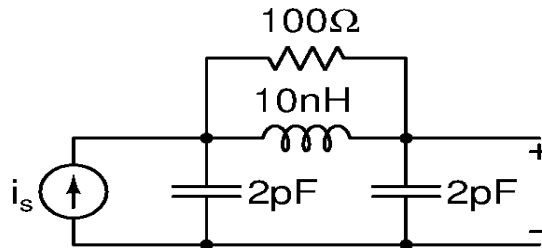
Score: 0

Accepted Answers:

(Type: Range) 4.9,5.1

1 point

11)



Determine the damping factor ζ and the natural frequency ω_n of the circuit above.

Value of ζ :

(The answer must be the value of ζ . Round off fractional answers to 2 decimal places.)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Range) 0.45,0.55

1 point

12) Value of ω_n :

(The answer must be in **gigaradians per second (Grad/s)**. Round off fractional answers to 1 decimal place.)

No, the answer is incorrect.

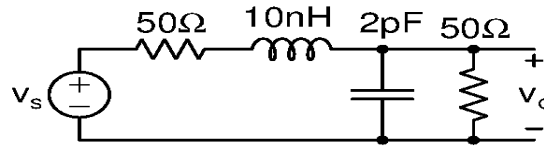
Score: 0

Accepted Answers:

(Type: Range) 9.9,10.1

1 point

13)



The above circuit is governed by the second order differential equation

$$\frac{d^2 v_o}{dt^2} + 2\zeta\omega_n \frac{dv_o}{dt} + \omega_n^2 v_o = b_2 \frac{d^2 v_s}{dt^2} + b_1 \frac{dv_s}{dt} + b_0 v_s$$

Derive the governing differential equation, put it in the standard form, and determine the damping factor ζ and the natural frequency ω_n .

Value of ζ :

(The answer must be the value of ζ . Round off fractional answers to 2 decimal places.)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 0.7,0.81

1 point

14) Value of ω_n :

(The answer must be in **gigaradians per second (Grad/s)**. Round off fractional answers to 1 decimal place.)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 9.9,10.1

1 point