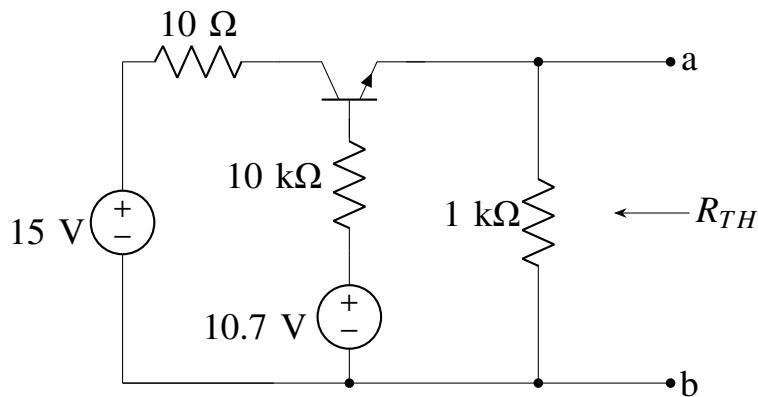


Assignment-9

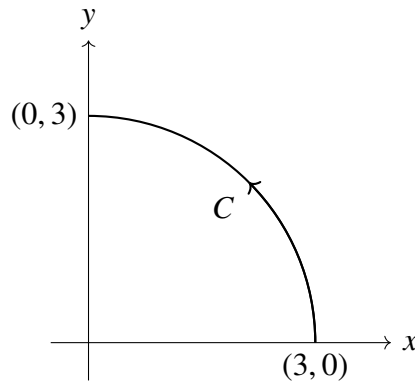
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- 40) The Fourier transform of a continuous-time signal $x(t)$ is given by $X(\omega) = \frac{1}{(10+j\omega)^2}$, $-\infty < \omega < \infty$, where $j = \sqrt{-1}$ and ω denotes frequency. Then the value of $|\ln x(t)|$ at $t = 1$ is _____ (up to 1 decimal place). (ln denotes the logarithm to base e)
- 41) In the circuit shown in the figure, the bipolar junction transistor (BJT) has a current gain $\beta = 100$. The base-emitter voltage drop is a constant, $V_{BE} = 0.7V$. The value of the Thevenin equivalent resistance R_{Th} (in Ω) as shown in the figure is _____ (up to 2 decimal places).

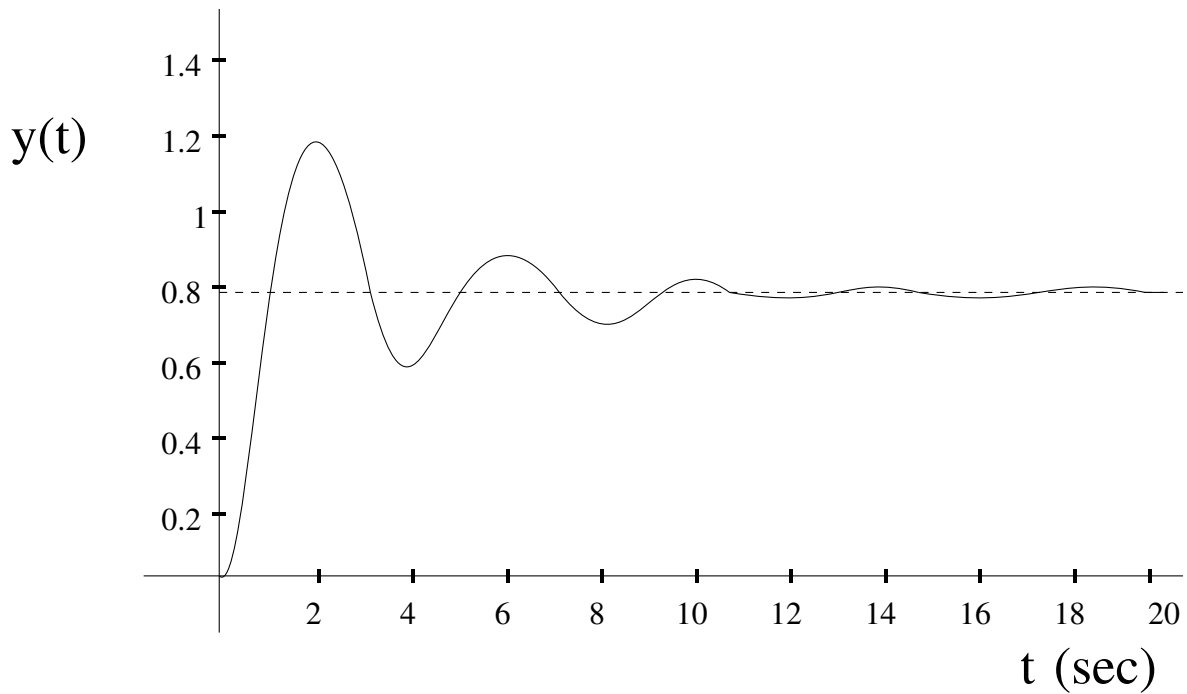


- 42) As shown in the figure, C is the arc from the point $(3, 0)$ to the point $(0, 3)$ on the circle $x^2 + y^2 = 9$. The value of the integral $\int_C (y^2 + 2yx) dx + (2xy + x^2) dy$ is _____ (up to 2 decimal places).

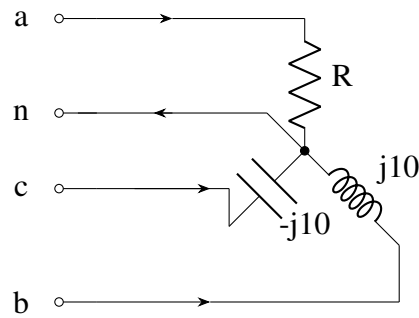


- 43) Let $f(x) = 3x^3 - 7x^2 + 5x + 6$. The maximum value of $f(x)$ over the interval $[0, 2]$ is _____ (up to 1 decimal place).

- 44) Let $A = \begin{bmatrix} 1 & 0 & -1 \\ -1 & 2 & 0 \\ 0 & 0 & -2 \end{bmatrix}$ and $B = A^3 - A^2 - 4A + 5I$, where I is the 3×3 identity matrix. The determinant of B is _____ (up to 1 decimal place).
- 45) The capacitance of an air-filled parallel-plate capacitor is 60 pF. When a dielectric slab whose thickness is half the distance between the plates, is placed on one of the plates covering it entirely, the capacitance becomes 86 pF. Neglecting the fringing effects, the relative permittivity of the dielectric is _____ (up to 2 decimal places).
- 46) The unit step response $y(t)$ of a unity feedback system with open loop transfer function $G(s)H(s) = \frac{K}{(s+1)^2(s+2)}$ is shown in the figure. The value of K is _____ (up to 2 decimal places).



- 47) A three-phase load is connected to a three-phase balanced supply as shown in the figure. If $V_{an} = 100\angle 0^\circ$, $V_{bn} = 100\angle -120^\circ$ and $V_{cn} = 100\angle -240^\circ$ (angles are considered positive in the anti-clockwise direction) the value of R for zero current in the neutral wire is _____ (up to 2 decimal places).

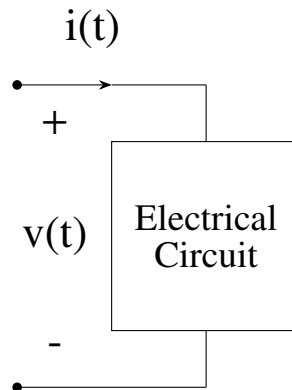


- 48) The voltage across the circuit in the figure, and the current through it, are given by the following expressions:

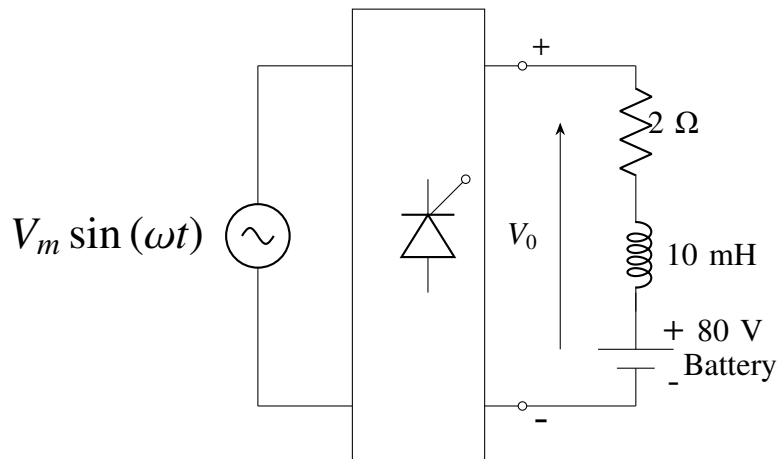
$$v(t) = 5 - 10 \cos(\omega t + 60^\circ) V$$

$$i(t) = 5 + X \cos(\omega t) A$$

where $\omega = 100\pi$ radian/s. If the average power delivered to the circuit is zero, then the value of X (in Ampere) is _____ (up to 2 decimal places).

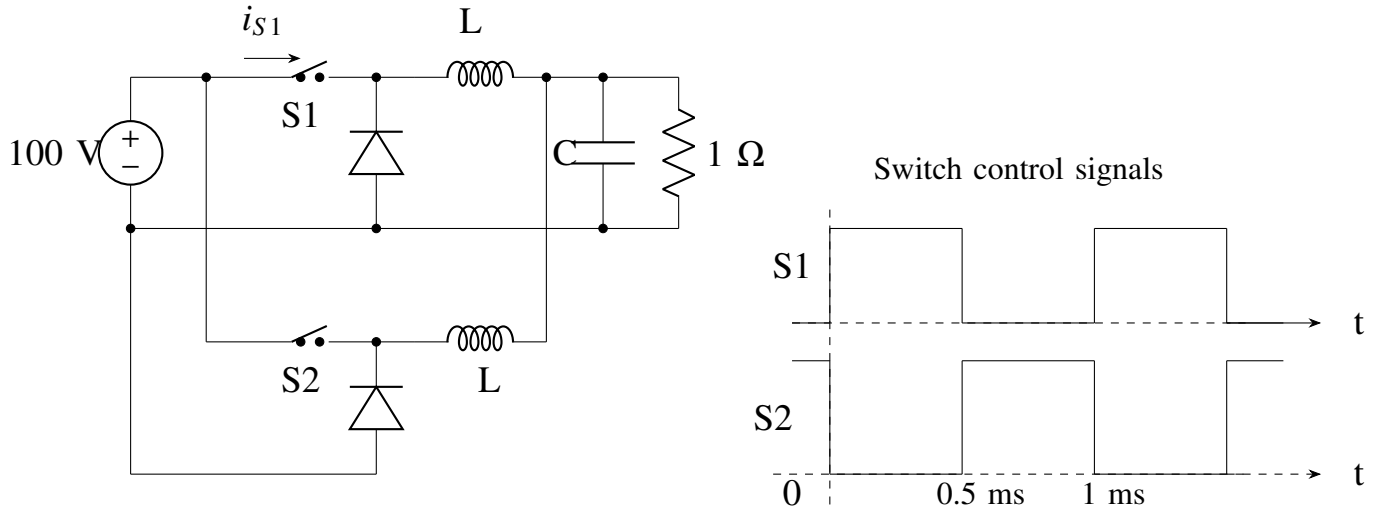


- 49) A phase controlled single phase rectifier, supplied by an AC source, feeds power to an R-L-E load as shown in the figure. The rectifier output voltage has an average value given by $V_0 = \frac{V_m}{2\pi} (3 + \cos \alpha)$, where $V_m = 80\pi$ volts and α is the firing angle. If the power delivered to the lossless battery is 1600 W, α in degree is _____ (up to 2 decimal places).



- 50) The figure shows two buck converters connected in parallel. The common input dc voltage for the converters has a value of 100 V. The converters have inductors of identical value. The load resistance is

1Ω The capacitor voltage has negligible ripple. Both converters operate in the continuous conduction mode. The switching frequency is 1 kHz, and the switch control signals are as shown. The circuit operates in the steady state. Assuming that the converters share the load equally, the average value of i_{S1} , the current of switch S1 (in Ampere), is _____ (up to 2 decimal places).



- 51) A 3-phase 900 kVA, 3 kV / $\sqrt{3}$ kV (Δ/Y), 50 Hz transformer has primary (high voltage side) resistance per phase of 0.3Ω and secondary (low voltage side) resistance per phase of 0.02Ω . Iron loss of the transformer is 10 kW. The full load % efficiency of the transformer operated at unity power factor is _____ (up to 2 decimal places).
- 52) A 200 V DC series motor, when operating from rated voltage while driving a certain load, draws 10 A current and runs at 1000 r.p.m. The total series resistance is 1Ω . The magnetic circuit is assumed to be linear. At the same supply voltage, the load torque is increased by 44%. The speed of the motor in r.p.m. (rounded to the nearest integer) is _____ .