2021-EE-27-39

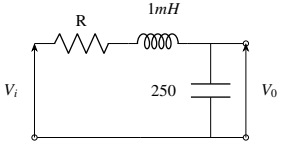
EE24BTECH11006 - Arnav Mahishi

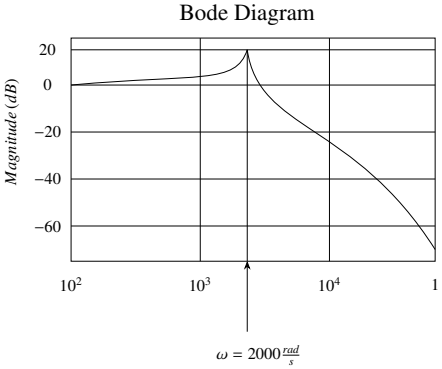
1) A $1\mu C$ point charge is held at the origin of a cartesian coordinate system. If a second point charge of $10\mu C$ is moved from $(0, 10, 0)$ to $(5, 5, 5)$ and subsequently to $(5, 0, 0)$, then the total work done is _____mJ.(Round off to 2 decimal places)
Take $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9$ in SI units. All coordinates are in meters.

2) The power input to a 500V, 50Hz, 6-pole, 3-phase induction motor running at 975 rpm is 40kW. The total stator losses are 1kW. If the total friction and windage losses are 2.025kW, then the efficiency is _____%

3) An alternator with internal voltage of $1\angle\delta_1$ p.u. and synchronous reactance of 0.4 p.u. is connected by a transmission line of reactance 0.1 p.u. to a synchronous motor having synchronous reactance 0.35 p.u. and internal voltage of $0.85\angle\delta_2$ p.u. If the real power supplied by the alternator is 0.866 p.u., then $(\delta_1 - \delta_2)$ is _____ degrees. (Round off to 2 decimal places.)
(Machines are of non-salient type. Neglect resistances.)

4) The Bode magnitude plot for the transfer function $\frac{V_0(S)}{V_i(S)}$ of the circuit is as shown. The value of R is _____Ω.(Round of to 2 decimal places)



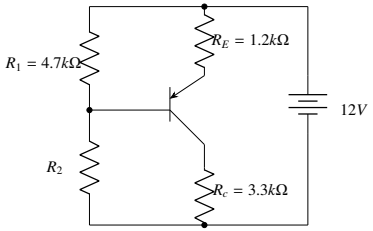


5) A signal generator having a source resistance of 50Ω is set to generate a $1kHz$ sinewave. Open circuit terminal voltage is $10V$ peak-to-peak. Connecting a capacitor across the terminals reduces the voltage to $8V$ peak-to-peak. The value of this capacitor is _____μF. (Round off to 2 decimal places.)

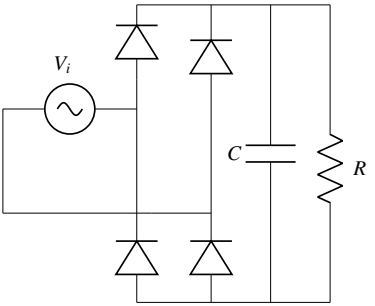
6) A 16-bit synchronous binary up-counter is clocked with a frequency f_{CLK}. The two most significant bits are OR-ed together to form an output Y. Measurements show

that Y is periodic, and the duration for which Y remains high in each period is 24 ms. The clock frequency f_{CLK} is _____MHz. (Round off to 2 decimal places.)

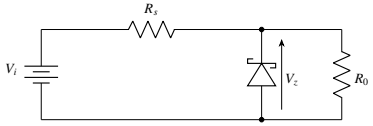
7) In the BJT diagram shown, beta of the PNP transistor is 100. Assume $V_{BE} = -0.7V$. The voltage across R_c will be 5V when R_2 is _____$k\Omega$. (Round off to 2 decimal places)



8) In the circuit shown, the input V_i is a sinusoidal AC voltage having an RMS value of $230V \pm 20\%$. The worst-case peak-inverse voltage seen across any diode is _____V.(Round off to 2 decimal places)



9) In the circuit shown, a 5 V Zener diode is used to regulate the voltage across load R_L. The input is an unregulated DC voltage with a minimum value of 6 V and a maximum value of 8 V. The value of R_S is 6 Ω. The Zener diode has a maximum rated power dissipation of 2.5 W. Assuming the Zener diode to be ideal, the minimum value of R_L is _____Ω.



10) In the open interval $(0, 1)$, the polynomial $p(x) = x^4 - 4x^3 + 2$ has

a) two real roots b) one real root c) three real roots d) no real roots

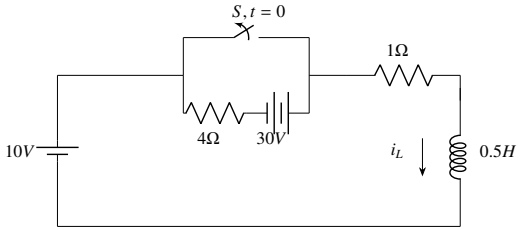
11) Suppose the probability that a coin toss shows "head" is p, where $0<p<1$. The coin is tossed repeatedly until the first "head" appears. The expected number of tosses required is

a) $\frac{p}{1-p}$ b) $\frac{1-p}{p}$ c) $\frac{1}{p}$ d) $\frac{1}{p^2}$

12) Let $(-1-j), (3-j), (3+j)$ and $(-1+j)$ be the vertices of a rectangle C in the complex plane. Assuming that C is traversed in counter-clockwise direction, the value of the contour integral $\oint_C \frac{dz}{z^2(z-4)}$ is

a) $\frac{j\pi}{2}$ b) 0 c) $\frac{-j\pi}{18}$ d) $\frac{j\pi}{16}$

13) In the circuit, switch 'S' is in the closed position for a very long time. If the switch is opened at time $t = 0$, then $i_L(t)$ in amperes, for $t \geq 0$ is



a) $8e^{-10t}$ b) 10 c) $8+2e^{-10t}$ d) $10\left(1-e^{-2t}\right)$