2021-EE- 53-65

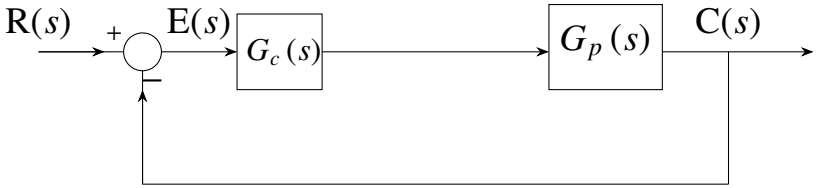
EE24BTECH11021 - Eshan Ray

53) Consider a continuous-time signal $x(t)$ defined by $x(t) = 0$ for $|t| > 1$, and $x(t) = 1 - |t|$ for $|t| \leq 1$. Let the Fourier transform of $x(t)$ be defined as $X(\omega) = \int_{-\infty}^{\infty} x(t)\, e^{-j\omega t}\, dt$. The maximum magnitude of $X(\omega)$ is ...

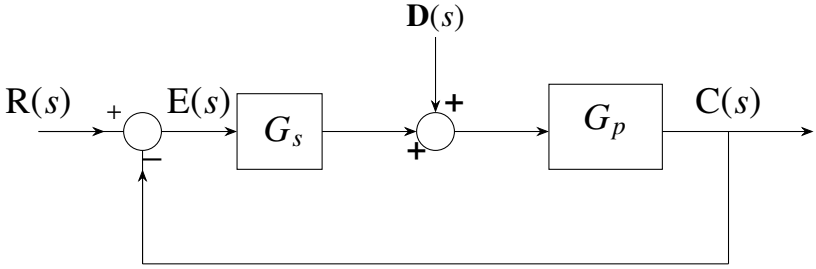
54) A belt-driven DC shunt generator running at $300\,RPM$ delivers $100\,kW$ to a $200\,V$ DC grid. It continues to run as a motor when the belt breaks, taking $10\,kW$ from the DC grid. The armature resistance is $0.025\,\Omega$, field resistance is $50\,\Omega$, and brush drop is $2\,V$. Ignoring armature reaction, the speed of the motor is ... RPM. (Round off to 2 decimal places.)

55) An $8-pole$, $50\,Hz$, three-phase, slip-ring induction motor has an effective rotor resistance of $0.08\,\Omega$ per phase. Its speed at maximum torque is $650\,RPM$. The additional resistance per phase that must be inserted in the rotor to achieve maximum torque at start is ... Ω. (Round off to 2 decimal places.) Neglect magnetizing current and stator leakage impedance. Consider equivalent circuit parameters referred to stator

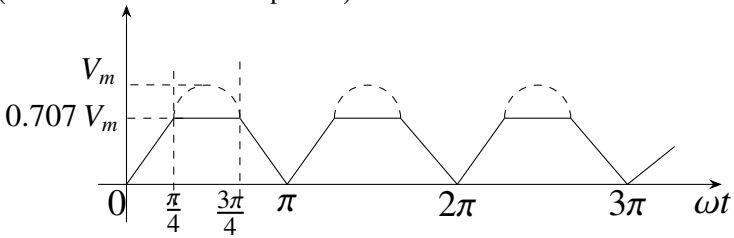
56) Consider a closed-loop system as shown. $G_p(s) = \frac{14.4}{s(1+0.1s)}$ is the plant transfer function and $G_c(s) = 1$ is the compensator. For a unit-step input , the output response has damped oscillations. The damped natural frequency is ... $\frac{rad}{s}$. (Round off to 2 decimal places.)



57) In the given figure, plant $G_p(s) = \frac{2.2}{(1+0.1s)(1+0.4s)(1+1.2s)}$ and compensator $G_c(s) = K\left(\frac{1+T_1 s}{1+T_2 s}\right)$. The external disturbance input is $D(s)$. It is desired that when the disturbance is a unit step, the steady-state error should not exceed 0.1 unit. The minimum value of K is ....
(Round off to 2 decimal places.)

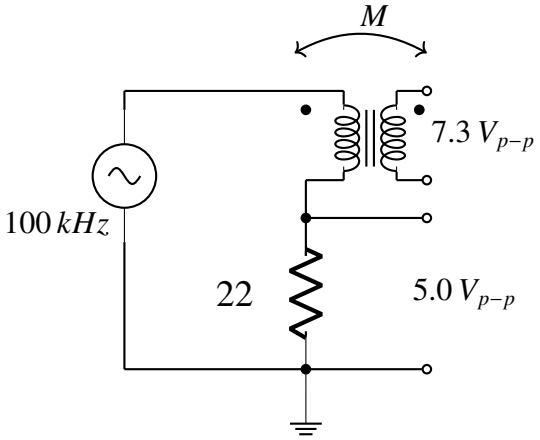


58) The waveform shown in solid line is obtained by clipping a full-wave rectified sinusoid (shown dashed). The ratio of RMS value of the full-wave rectified waveform to the RMS value of the clipped waveform is ....
(Round off to 2 decimal places.)

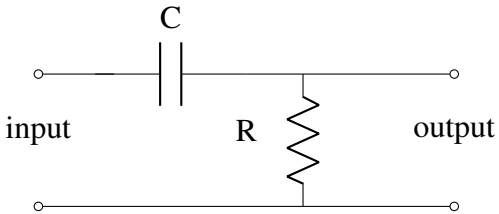


59) The state space representation of a first-order system is given by
$\dot{x} = -x + u$
$y = x$
where, x is the state variable, u is the control input and y is the controlled output. Let $u = -Kx$ be the control law, where K is the controller gain. To place a closed-loop pole at -2, the value of K is ...

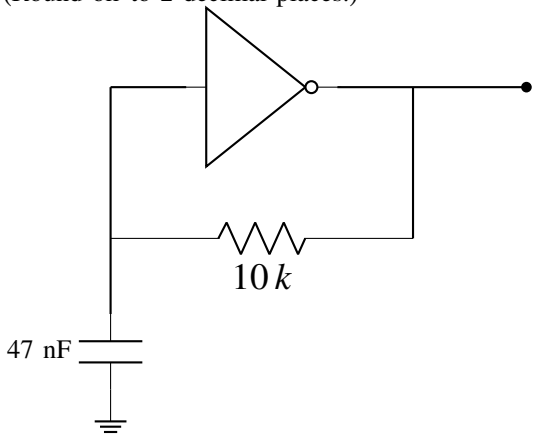
60) An air-core radio-frequency transformer as shown has a primary winding and a secondary winding. The mutual inductance M between the windings of the transformer is $\ldots \mu H$.
(Round off to 2 decimal places.)



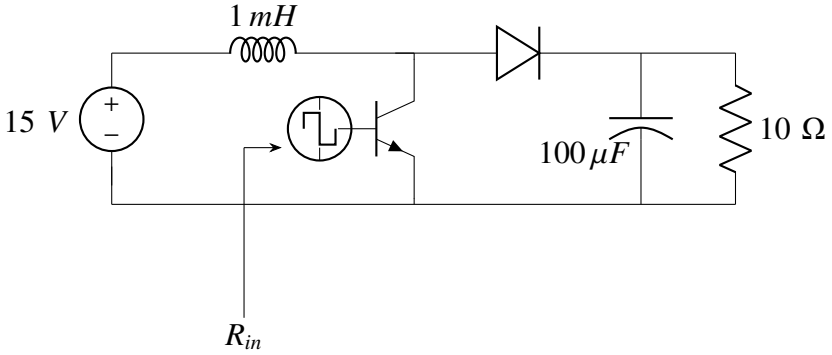
61) A $100\,Hz$ square wave, switching between $0\,V$ and $5\,V$, is applied to a CR high-pass filter circuit as shown. The output voltage waveform across the resistor is $6.2\,V$ peak-to-peak. If the resistance R is $820\,\Omega$, then the value C is $\ldots \mu F$.
(Round off to 2 decimal places.)



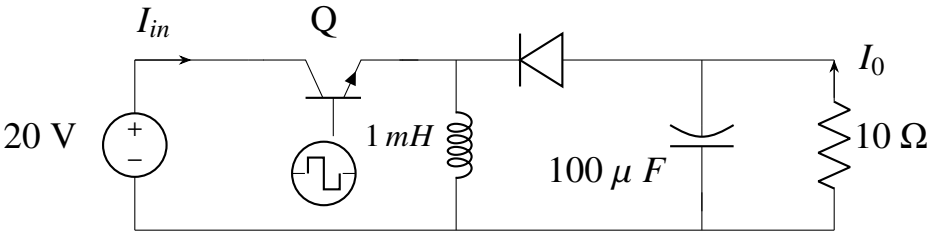
62) A CMOS Schmitt-trigger inverter has a low output level of $0\,V$ and a high output level of $5\,V$. It has input thresholds of $1.6\,V$ and $2.4\,V$. The input capacitance and ouput resistance of the Schmitt-trigger are negligible. The frequency of the oscillator shown is ... Hz.
(Round off to 2 decimal places.)



63) Consider the boost converter shown. Switch Q is operating at $25\,kHz$ with a duty cycle of 0.6. Assume the diode and switch to be ideal. Under steady-state condition, the average resistance R_{in} as seen by the source is ....
(Round off to 2 decimal places.)



64) Consider the buck-boost converter shown. Switch Q is operating at $25\,kHz$ with a duty cycle of 0.75. Assume the diode and switch to be ideal. Under steady-state condition, the average current flowing through teh inductor is ... A.



65) A single-phase full-bridge inverter fed by a $325\,V$ DC produces a symmetric quasi-square waveform across $'ab'$ as shown. To achieve a modulation index of 0.8, the angle θ expressed in degrees should be ....
(Round off to 2 decimal places.)

(Modulation index is defined as the ratio of the peak of the fundamental component v_{ab} to the applied DC value.)