

Q.1 The man who is now Municipal Commissioner worked as

- a) the security guard at a university
- b) a security guard at the university
- c) a security guard at university
- d) the security guard at the university

(GATE EE 2016)

Q.2 Nobody knows how the Indian cricket team is going to cope with the difficult and seamer-friendly wickets in Australia. Choose the option which is closest in meaning to the underlined phrase in the above sentence.

- a) put up with
- b) put in with
- c) put down to
- d) put up against

(GATE EE 2016)

Q.3 Find the odd one in the following group of words. mock, deride, praise, jeer

- a) mock
- b) deride
- c) praise
- d) jeer

(GATE EE 2016)

Q.4 Pick the odd one from the following options.

- a) CADBE
- b) JHKIL
- c) XUYWZ
- d) ONPMQ

(GATE EE 2016)

Q.5 In a quadratic function, the value of the product of the roots (α, β) is 4. Find the value of $\frac{\alpha^n + \beta^n}{\alpha^{-n} + \beta^{-n}}$

- a) n^4
- b) 4^n
- c) 2^{2n-1}
- d) 4^{n-1}

(GATE EE 2016)

Q.6 Among 150 faculty members in an institute, 55 are connected with each other through Facebook® and 85 are connected through WhatsApp. 30 faculty members do not have Facebook or WhatsApp accounts. The number of faculty members connected only through Facebook® accounts is _____.

- a) 35
- b) 45
- c) 65
- d) 90

(GATE EE 2016)

Q.7 Computers were invented for performing only high-end useful computations. However, it is no understatement that they have taken over our world today. The internet, for example, is ubiquitous. Many believe that the internet itself is an unintended consequence of the original invention. With the advent of mobile computing on our phones, a whole new dimension is now enabled. One is left wondering if all these developments are good or, more importantly, required. Which of the statement(s) below is/are logically valid and can be inferred from the above paragraph?

- (i) The author believes that computers are not good for us.
- (ii) Mobile computers and the internet are both intended inventions

- a) (i) only
- b) (ii) only
- c) both (i) and (ii)
- d) neither (i) nor (ii)

(GATE EE 2016)

Q.8 All hill-stations have a lake. Ooty has two lakes. Which of the statement(s) below is/are logically valid and can be inferred from the above sentences?

(i) Ooty is not a hill-station.

(ii) No hill-station can have more than one lake.

a) (i) only

b) (ii) only

c) both (i) and (ii)

d) neither (i) nor (ii)

(GATE EE 2016)

Q.9 In a 2×4 rectangle grid shown below, each cell is a rectangle. How many rectangles can be observed in the grid?

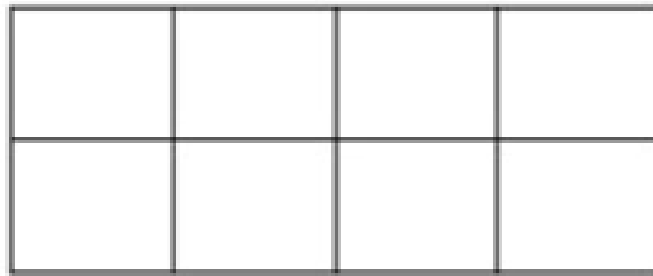


Fig. 1.

a) 21

b) 27

c) 30

d) 36

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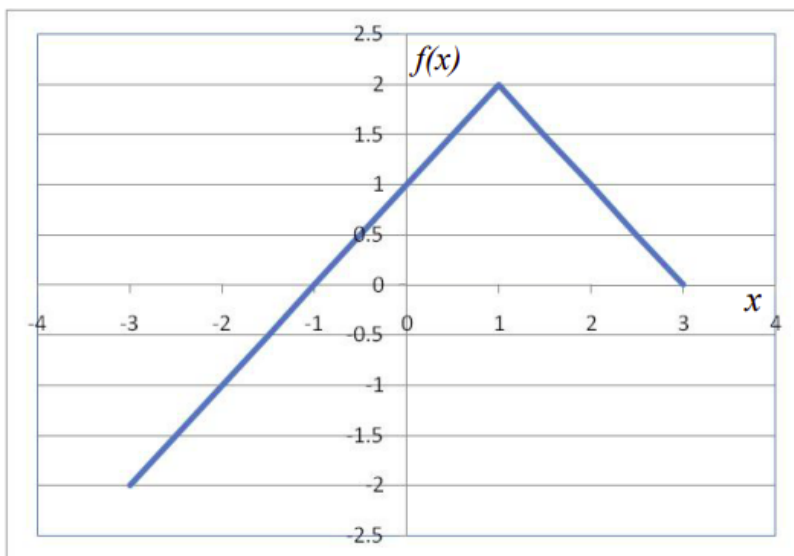


Fig. 2.

Q.10 Choose the correct expression for $f(x)$ given in the graph.

- a) $f(x) = 1 - |x - 1|$
 b) $f(x) = 1 + |x - 1|$

- c) $f(x) = 2 - |x - 1|$
 d) $f(x) = 2 + |x - 1|$

(GATE EE 2016)

Q.11 The maximum value attained by the function $f(x) = x(x-1)(x-2)$ in the interval $[1, 2]$ is _____.

(GATE EE 2016)

Q.12 Consider a 3×3 matrix with every element being equal to 1. Its only non-zero eigenvalue is _____.

(GATE EE 2016)

Q.13 The Laplace Transform of $f(t) = e^{2t} \sin(5t) u(t)$ is

- a) $\frac{5}{s^2 - 4s + 29}$
 b) $\frac{5}{s^2 + 5}$

- c) $\frac{s-2}{s^2 - 4s + 29}$
 d) $\frac{5}{s+5}$

(GATE EE 2016)

Q.14 A function $y(t)$ such that $y(0) = 1$ and $y(1) = 3e^{-1}$, is a solution of the differential equation $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + y = 0$. Then $y(2)$ is

- a) $5e^{-1}$
 b) $5e^{-2}$

- c) $7e^{-1}$
 d) $7e^{-2}$

(GATE EE 2016)

Q.15 The value of the integral $\oint_c \frac{2z+5}{(z-\frac{1}{2})(z^2-4z+5)} dz$ over the contour $|z| = 1$, taken in the anti-clockwise direction, would be

- a) $\frac{24\pi i}{13}$
 b) $\frac{48\pi i}{13}$

- c) $\frac{24}{13}$
 d) $\frac{12}{13}$

(GATE EE 2016)

Q.16 The transfer function of a system is $\frac{Y(s)}{R(s)} = \frac{s}{s+2}$. The steady state output $y(t)$ is $A \cos(2t + \varphi)$ for the input $\cos(2t)$. The values of A and φ , respectively are

- a) $\frac{1}{\sqrt{2}}, -45^\circ$
 b) $\frac{1}{\sqrt{2}}, +45^\circ$

- c) $\sqrt{2}, -45^\circ$
 d) $\sqrt{2}, +45^\circ$

(GATE EE 2016)

Q.17 The phase cross-over frequency of the transfer function $G(s) = \frac{100}{(s+1)^3}$ in rad/s is

- a) $\sqrt{3}$
 b) $\frac{1}{\sqrt{3}}$

- c) 3
 d) $3\sqrt{3}$

(GATE EE 2016)

Q.18 Consider a continuous-time system with input $x(t)$ and output $y(t)$ given by $y(t) = x(t) \cos(t)$. This system is

- a) linear and time-invariant
 b) non-linear and time-invariant

- c) linear and time-varying
 d) non-linear and time-varying

(GATE EE 2016)

Q.19 The value of $\int_{-\infty}^{+\infty} e^{-t} \delta(2t-2) dt$, where $\delta(t)$ is the Dirac delta function, is

a) $\frac{1}{2^e}$
b) $\frac{2}{e}$

c) $\frac{1}{e^2}$
d) $\frac{1}{2e^2}$

(GATE EE 2016)

Q.20 A temperature in the range of -40°C to 55°C is to be measured with a resolution of 0.1°C . The minimum number of ADC bits required to get a matching dynamic range of the temperature sensor is

a) 8
b) 10

c) 12
d) 14

(GATE EE 2016)

Q.21 Consider the following circuit which uses a 2-to-1 multiplexer as shown in the figure below. The Boolean expression for output F in terms of A and B is

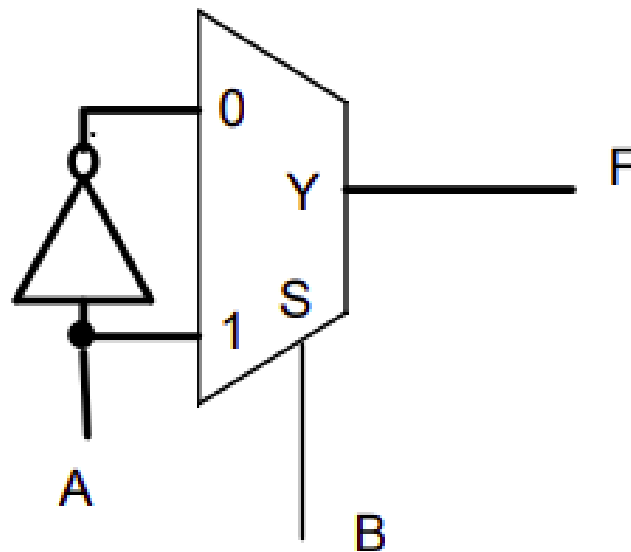


Fig. 3.

a) $A \oplus B$
b) $\overline{A + B}$

c) $A + B$
d) \overline{AB}

(GATE EE 2016)

Q.22 A transistor circuit is given below. The Zener diode breakdown voltage is 5.3 V as shown. Take base to emitter voltage drop to be 0.6 V. The value of the current gain β is _____.

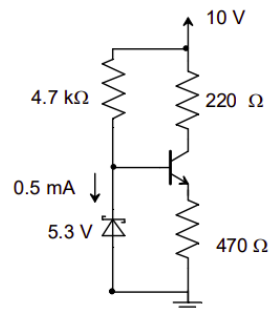


Fig. 4.

(GATE EE 2016)

Q.23 In cylindrical coordinate system, the potential produced by a uniform ring charge is given by $\varphi = f(r, z)$, where f is a continuous function of r and z . Let \mathbf{E} be the resulting electric field. Then the magnitude of $\nabla \times \mathbf{E}$

- a) increases with r .
 b) is 0.
 c) is 3.
 d) decreases with z .

(GATE EE 2016)

Q.24 A soft-iron toroid is concentric with a long straight conductor carrying a direct current I . If the relative permeability μ_r of soft-iron is 100, the ratio of the magnetic flux densities at two adjacent points located just inside and just outside the toroid, is _____.

(GATE EE 2016)

Q.25 R_A and R_B are the input resistances of circuits as shown below. The circuits extend infinitely in the direction shown. Which one of the following statements is TRUE?

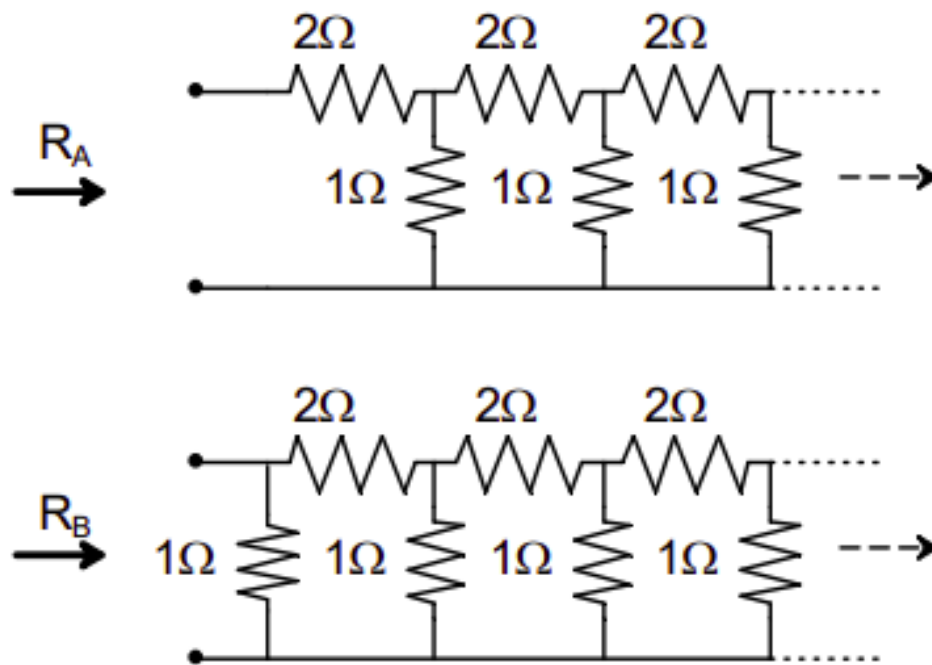


Fig. 5.

- a) $R_A = R_B$
 b) $R_A = R_B = 0$
 c) $R_A < R_B$
 d) $R_B = R_A / (1 + R_A)$

(GATE EE 2016)

Q.26 In a constant V/f induction motor drive, the slip at the maximum torque

- a) is directly proportional to the synchronous speed.
 b) remains constant with respect to the synchronous speed.
 c) has an inverse relation with the synchronous speed.
 d) has no relation with the synchronous speed.

(GATE EE 2016)

Q.27 In the portion of a circuit shown, if the heat generated in 5Ω resistance is 10 calories per second, then heat generated by the 4Ω resistance, in calories per second, is _____.

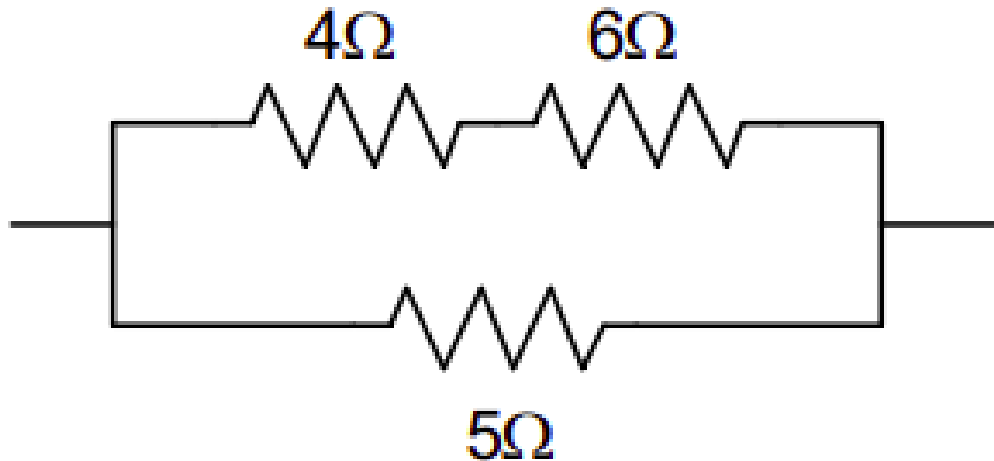


Fig. 6.

(GATE EE 2016)

Q.28 In the given circuit, the current supplied by the battery, in ampere, is _____.

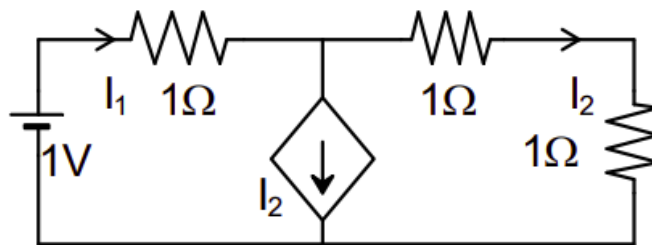


Fig. 7.

(GATE EE 2016)

Q.29 In a 100 bus power system, there are 10 generators. In a particular iteration of Newton Raphson load flow technique (*inpolarcoordinates*), two of the PV buses are converted to PQ type. In this iteration,

- the number of unknown voltage angles increases by two and the number of unknown voltage magnitudes increases by two.
- the number of unknown voltage angles remains unchanged and the number of unknown voltage magnitudes increases by two.
- the number of unknown voltage angles increases by two and the number of unknown voltage magnitudes decreases by two.
- the number of unknown voltage angles remains unchanged and the number of unknown voltage magnitudes decreases by two.

(GATE EE 2016)

Q.30 The magnitude of three-phase fault currents at buses A and B of a power system are 10 pu and 8 pu, respectively. Neglect all resistances in the system and consider the pre-fault system to be unloaded. The pre-fault voltage at all buses in the system is 1.0 pu. The voltage magnitude at bus B during a three-phase fault at bus A is 0.8 pu. The voltage magnitude at bus A during a three-phase fault at bus B, in pu, is _____.

(GATE EE 2016)

Q.31 Consider a system consisting of a synchronous generator working at a lagging power factor, a synchronous motor working at an overexcited condition and a directly grid-connected induction generator. Consider capacitive VAR to be a source and inductive VAR to be a sink of reactive power. Which one of the following statements is TRUE?

- Synchronous motor and synchronous generator are sources and induction generator is a sink of reactive power.
- Synchronous motor and induction generator are sources and synchronous generator is a sink of reactive power.
- Synchronous motor is a source and induction generator and synchronous generator are sinks of reactive power.
- All are sources of reactive power.

(GATE EE 2016)

Q.32 A buck converter, as shown in Figure (a) below, is working in steady state. The output voltage and the inductor current can be assumed to be ripple free. Figure (b) shows the inductor voltage V_L during a complete switching interval. Assuming all devices are ideal, the duty cycle of the buck converter is _____.

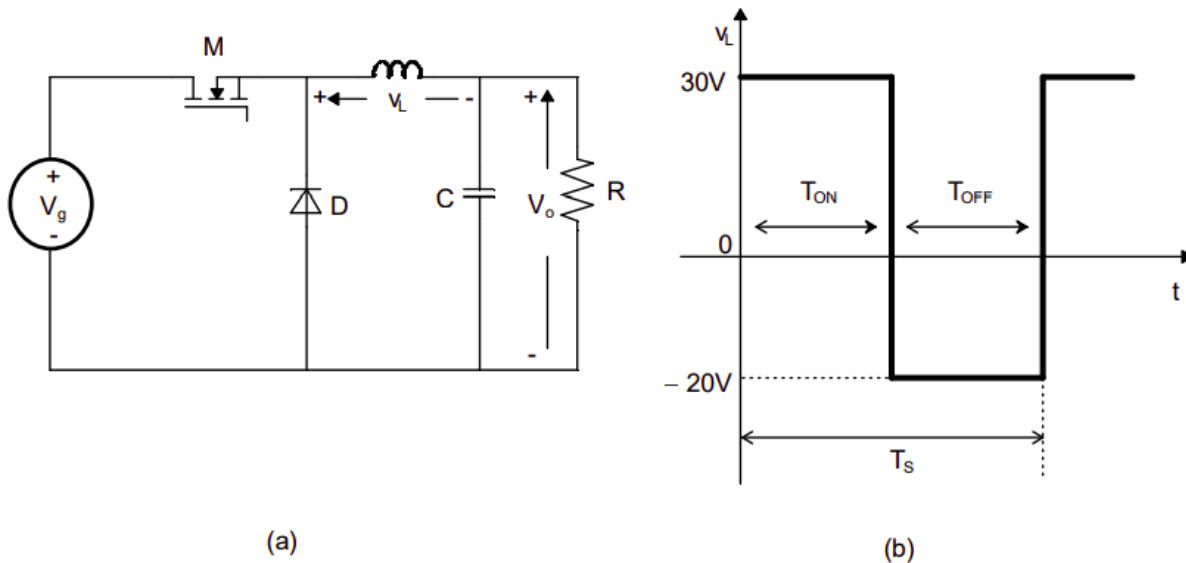


Fig. 8.

(GATE EE 2016)

Q.33 A steady dc current of 100 A is flowing through a power module (S, D) as shown in Figure (a). The V-I characteristics of the IGBT (S) and the diode (D) are shown in Figures (b) and (c), respectively. The conduction power loss in the power module (S, D), in watts, is _____.

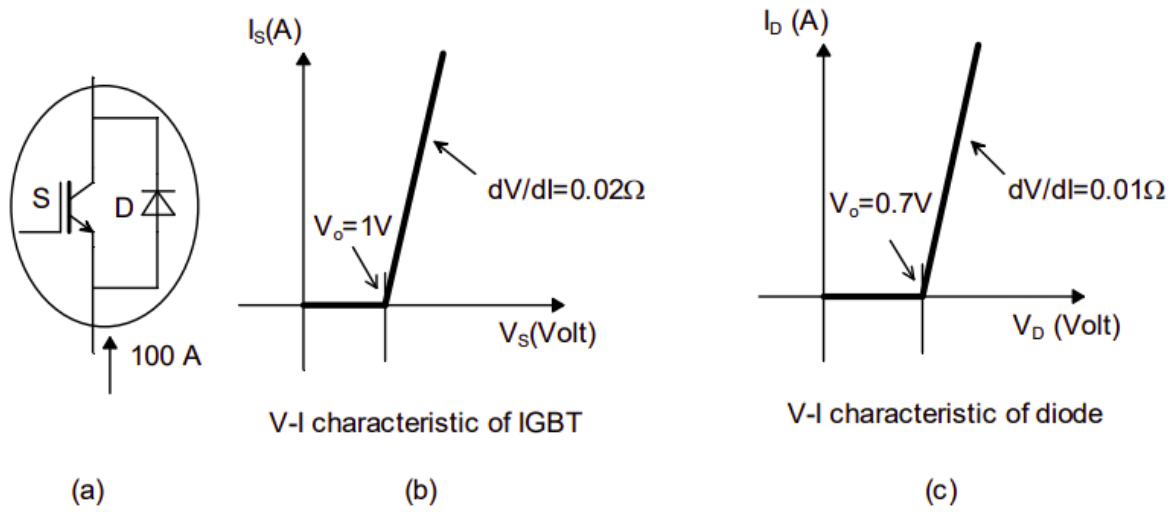
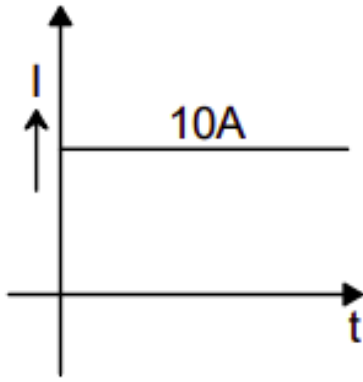


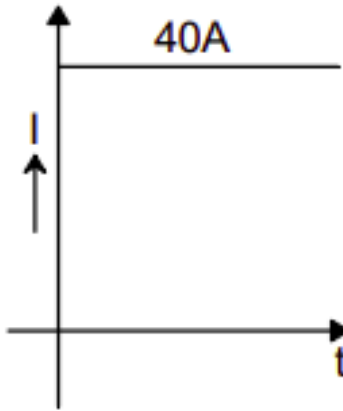
Fig. 9.

(GATE EE 2016)

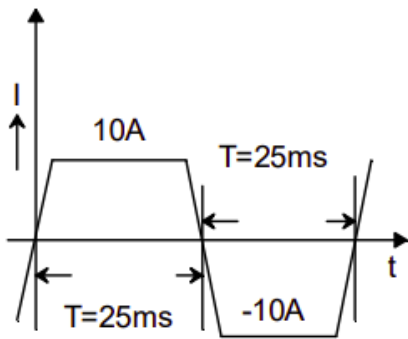
Q.34 A 4-pole, lap-connected, separately excited dc motor is drawing a steady current of 40 A while running at 600 rpm. A good approximation for the waveshape of the current in an armature conductor of the motor is given by



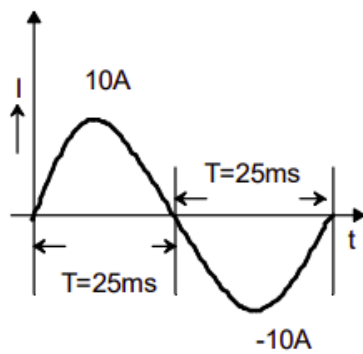
a)



b)



c)



d)

Fig. 10.

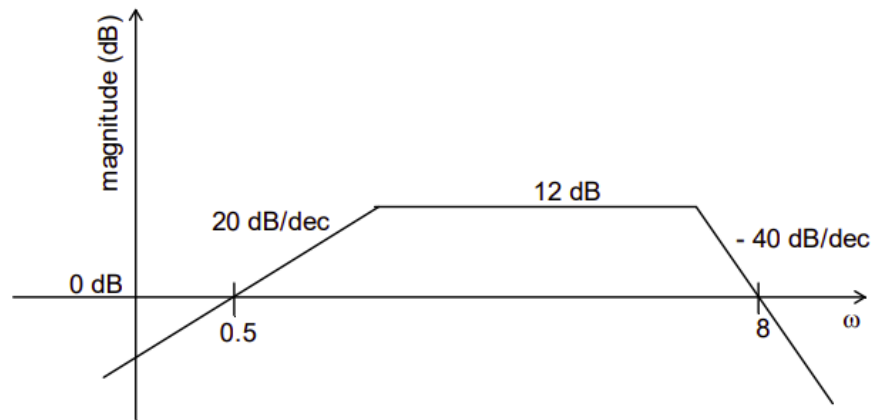


Fig. 12.

Which one of the following transfer functions is best represented by the above Bode magnitude plot?

- a) $\frac{2s}{(1+0.5s)(1+0.25s)^2}$
- b) $\frac{4(1+0.5s)}{s(1+0.25s)}$
- c) $\frac{2s}{(1+2s)(1+4s)}$
- d) $\frac{4s}{(1+2s)(1+4s)^2}$

(GATE EE 2016)

Q.41 Consider the following state-space representation of a linear time-invariant system. $\dot{\mathbf{x}}(t) = \begin{pmatrix} 1 & 0 \\ 0 & 2 \end{pmatrix} \mathbf{x}(t)$, $y(t) =$

$\mathbf{c}^T \mathbf{x}(t)$, $\mathbf{c} = \begin{pmatrix} 1 \\ 1 \end{pmatrix}$ and $\mathbf{x}(0) = \begin{pmatrix} 1 \\ 1 \end{pmatrix}$. The value of $y(t)$ for $t = \log_e 2$ is _____.

(GATE EE 2016)

Q.42 Loop transfer function of a feedback system is $G(s)H(s) = \frac{s+3}{s^2(s-3)}$. Take the Nyquist contour in the clockwise direction. Then, the Nyquist plot of $G(s)H(s)$ encircles $-1 + j0$

- a) once in clockwise direction
- b) twice in clockwise direction
- c) once in anticlockwise direction
- d) twice in anticlockwise direction

(GATE EE 2016)

Q.43 Given the following polynomial equation $s^3 + 5.5s^2 + 8.5s + 3 = 0$, the number of roots of the polynomial, which have real parts strictly less than -1 , is _____.

(GATE EE 2016)

Q.44 Suppose $x_1(t)$ and $x_2(t)$ have the Fourier transforms as shown below.

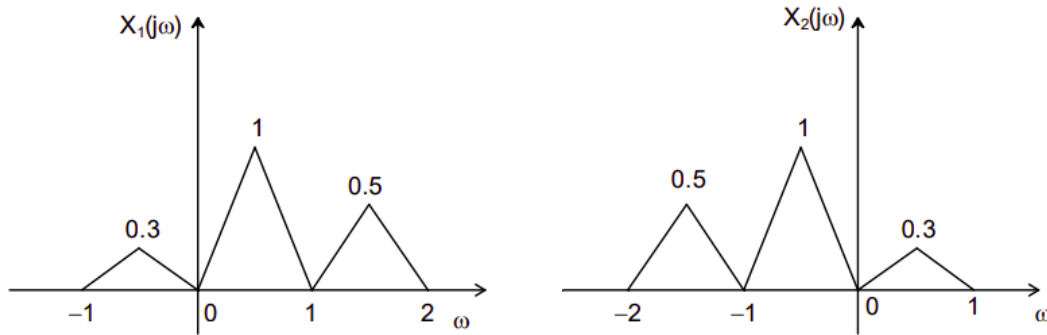


Fig. 13.

Which one of the following statements is TRUE?

- a) $x_1(t)$ and $x_2(t)$ are complex and $x_1(t)x_2(t)$ is also complex with nonzero imaginary part
- b) $x_1(t)$ and $x_2(t)$ are real and $x_1(t)x_2(t)$ is also real
- c) $x_1(t)$ and $x_2(t)$ are complex but $x_1(t)x_2(t)$ is real
- d) $x_1(t)$ and $x_2(t)$ are imaginary but $x_1(t)x_2(t)$ is real

(GATE EE 2016)

Q.45 The output of a continuous-time, linear time-invariant system is denoted by $\mathcal{T}\{x(t)\}$ where $x(t)$ is the input signal. A signal $z(t)$ is called eigen-signal of the system T, when $\mathcal{T}\{z(t)\} = \gamma z(t)$, where γ is a complex number, in general, and is called an eigenvalue of T. Suppose the impulse response of the system T is real and even. Which of the following statements is TRUE?

- a) $\cos(t)$ is an eigen-signal but $\sin(t)$ is not
- b) $\cos(t)$ and $\sin(t)$ are both eigen-signals but with different eigenvalues
- c) $\sin(t)$ is an eigen-signal but $\cos(t)$ is not
- d) $\cos(t)$ and $\sin(t)$ are both eigen-signals with identical eigenvalues

(GATE EE 2016)

Q.46 The current state $Q_A Q_B$ of a two JK flip-flop system is 00. Assume that the clock rise-time is much smaller than the delay of the JK flip-flop. The next state of the system is

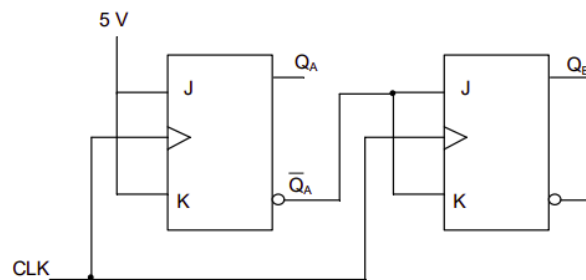


Fig. 14.

- a) 00
- b) 01
- c) 11
- d) 10

(GATE EE 2016)

Q.47 A 2-bit flash Analog to Digital Converter (ADC) is given below. The input is $0 \leq V_{IN} \leq 3$ Volts. The expression for the LSB of the output B_0 as a Boolean function of X_2, X_1 , and X_0 is

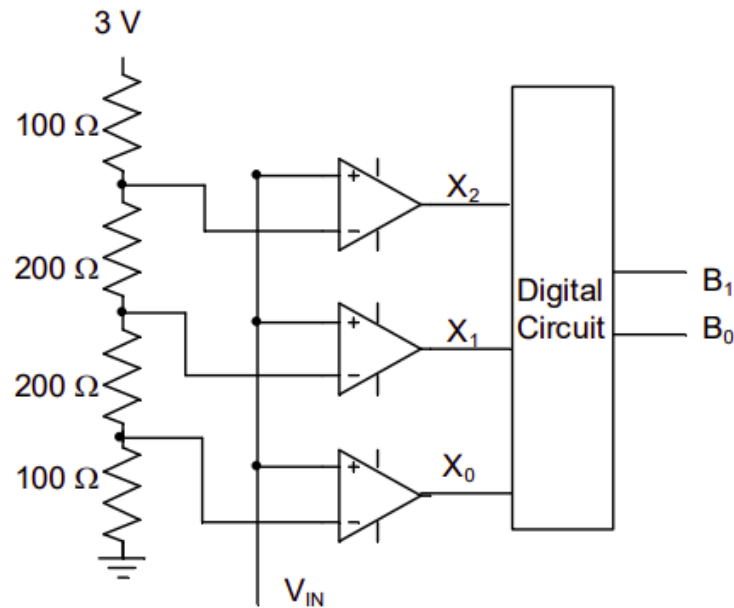


Fig. 15.

- a) $X_0[\overline{X_2 \oplus X_1}]$
 b) $\bar{X}_0[X_2 \oplus X_1]$

- c) $X_0[X_2 \oplus X_1]$
 d) $\bar{X}_0[X_2 \oplus X_1]$

(GATE EE 2016)

Q.48 Two electric charges q and $-2q$ are placed at $(0, 0)$ and $(6, 0)$ on the x-y plane. The equation of the zero equipotential curve in the x-y plane is

- a) $x = -2$
 b) $y = 2$

- c) $x^2 + y^2 = 2$
 d) $(x + 2)^2 + y^2 = 16$

(GATE EE 2016)

Q.49 In the circuit shown, switch S2 has been closed for a long time. At time $t = 0$ switch S1 is closed. At $t = 0^+$, the rate of change of current through the inductor, in amperes per second, is _____.

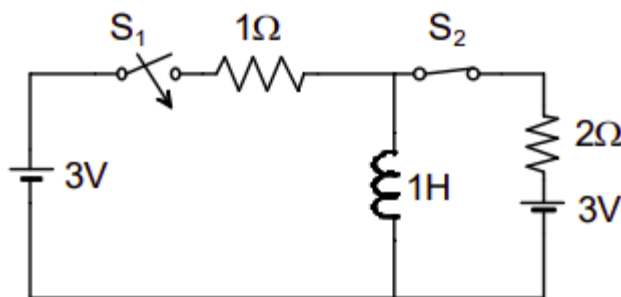


Fig. 16.

(GATE EE 2016)

Q.50 A three-phase cable is supplying 800 kW and 600 kVAR to an inductive load. It is intended to supply an additional resistive load of 100 kW through the same cable without increasing the heat dissipation in the cable, by providing a three-phase bank of capacitors connected in star across the load. Given

the line voltage is 3.3 kV, 50 Hz, the capacitance per phase of the bank, expressed in microfarads, is _____.

(GATE EE 2016)

- Q.51 A 30 MVA, 3-phase, 50 Hz, 13.8 kV, star-connected synchronous generator has positive, negative and zero sequence reactances, 15%, 15% and 5% respectively. A reactance (X_n) is connected between the neutral of the generator and ground. A double line to ground fault takes place involving phases 'b' and 'c', with a fault impedance of $j0.1$ p.u. The value of X_n (in p.u.) that will limit the positive sequence generator current to 4270 A is _____.

(GATE EE 2016)

- Q.52 If the star side of the star-delta transformer shown in the figure is excited by a negative sequence voltage, then

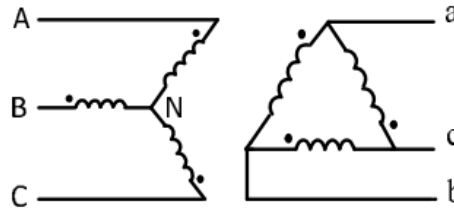


Fig. 17.

- | | |
|--|--|
| a) V_{AB} leads V_{ab} by 60° | c) V_{AB} leads V_{ab} by 30° |
| b) V_{AB} lags V_{ab} by 60° | d) V_{AB} lags V_{ab} by 30° |

(GATE EE 2016)

- Q.53 A single-phase thyristor-bridge rectifier is fed from a 230 V, 50 Hz, single-phase AC mains. If it is delivering a constant DC current of 10 A, at firing angle of 30° , then value of the power factor at AC mains is

- | | |
|---------|---------|
| a) 0.87 | c) 0.78 |
| b) 0.9 | d) 0.45 |

(GATE EE 2016)

- Q.54 The switches T1 and T2 in Figure (a) are switched in a complementary fashion with sinusoidal pulse width modulation technique. The modulating voltage $v_m(t) = 0.8 \sin(200\pi t)$ V and the triangular carrier voltage (v_c) are as shown in Figure (b). The carrier frequency is 5 kHz. The peak value of the 100 Hz component of the load current (i_L), in ampere, is _____.

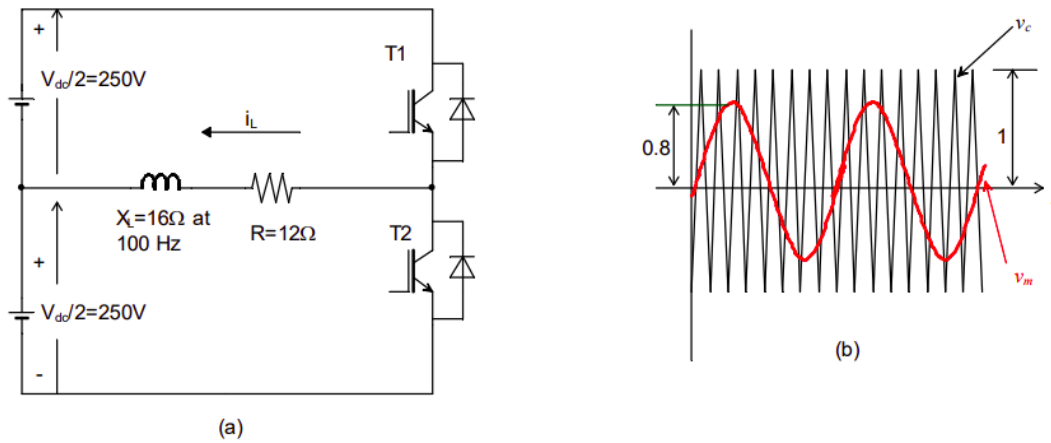


Fig. 18.

(GATE EE 2016)

Q.55 The voltage (v_s) across and the current (i_s) through a semiconductor switch during a turn-ON transition are shown in figure. The energy dissipated during the turn-ON transition, in mJ, is _____.

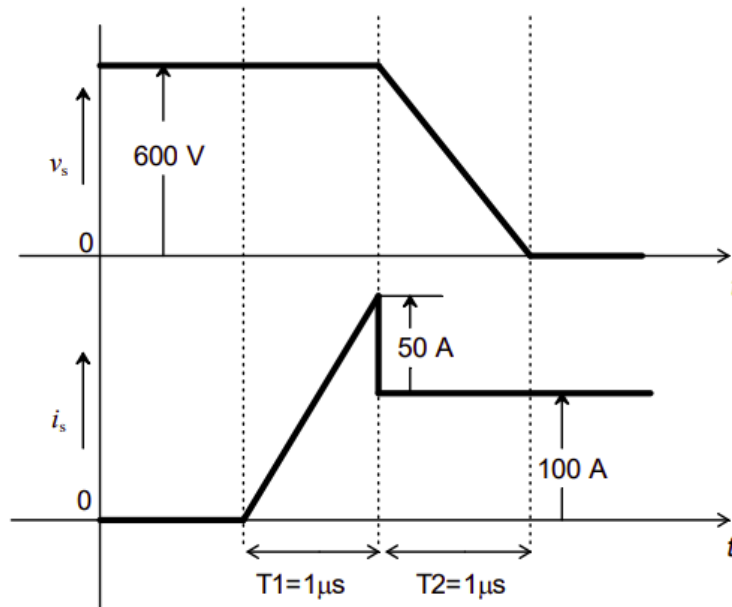


Fig. 19.

(GATE EE 2016)

Q.56 A single-phase 400 V, 50 Hz transformer has an iron loss of 5000 W at the rated condition. When operated at 200 V, 25 Hz, the iron loss is 2000 W. When operated at 416 V, 52 Hz, the value of the hysteresis loss divided by the eddy current loss is _____.

(GATE EE 2016)

Q.57 A DC shunt generator delivers 45 A at a terminal voltage of 220 V. The armature and the shunt field resistances are 0.01Ω and 44Ω respectively. The stray losses are 375 W. The percentage efficiency of the DC generator is _____.

(GATE EE 2016)

Q.63 A dc voltage with ripple is given by $v(t) = [100 + 10 \sin(\omega t) - 5 \sin(3\omega t)]$ volts. Measurements of this voltage $v(t)$, made by moving-coil and moving-iron voltmeters, show readings of V_1 and V_2 respectively. The value of $V_2 - V_1$, in volts, is _____.

(GATE EE 2016)

Q.64 The circuit below is excited by a sinusoidal source. The value of R , in Ω , for which the admittance of the circuit becomes a pure conductance at all frequencies is _____.

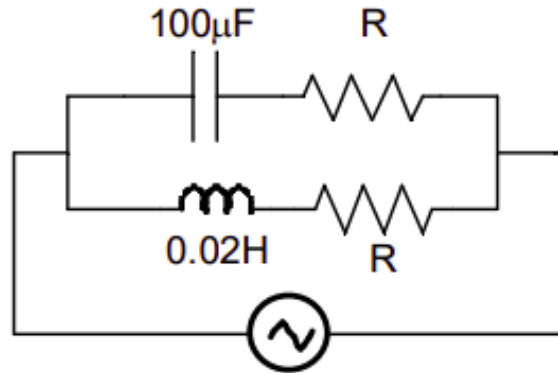


Fig. 21.

(GATE EE 2016)

Q.65 In the circuit shown below, the node voltage V_A is _____ V.

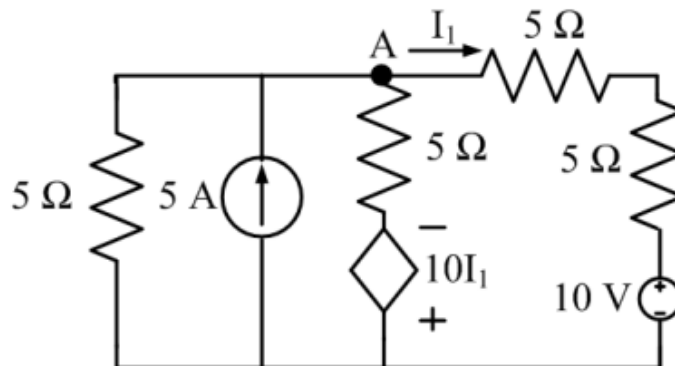


Fig. 22.

(GATE EE 2016)

Q.66 The chairman requested the aggrieved shareholders to _____ him.

- a) bare with
- b) bore with

- c) bear with
- d) bare

(GATE EE 2016)

Q.67 Identify the correct spelling out of the given options:

- a) Managable
b) Manageable

- c) Mangaible
d) Managible

(GATE EE 2016)

Q.68 Pick the odd one out in the following: 13, 23, 33, 43, 53

- a) 23
b) 33

- c) 43
d) 53

(GATE EE 2016)

Q.69 R2D2 is a robot. R2D2 can repair aeroplanes. No other robot can repair aeroplanes. Which of the following can be logically inferred from the above statements?

- a) R2D2 is a robot which can only repair aeroplanes.
b) R2D2 is the only robot which can repair aeroplanes.
c) R2D2 is a robot which can repair only aeroplanes.
d) Only R2D2 is a robot.

(GATE EE 2016)

Q.70 If $|9y - 6| = 3$, then $y^2 - 4y/3$ is _____.

- a) 0
b) $+1/3$

- c) $-1/3$
d) undefined

(GATE EE 2016)

Q.71 The following graph represents the installed capacity for cement production (*int tonnes*) and the actual production (*int tonnes*) of nine cement plants of a cement company. Capacity utilization of a plant is defined as ratio of actual production of cement to installed capacity. A plant with installed capacity of at least 200 tonnes is called a large plant and a plant with lesser capacity is called a small plant. The difference between total production of large plants and small plants, in tonnes is _____.

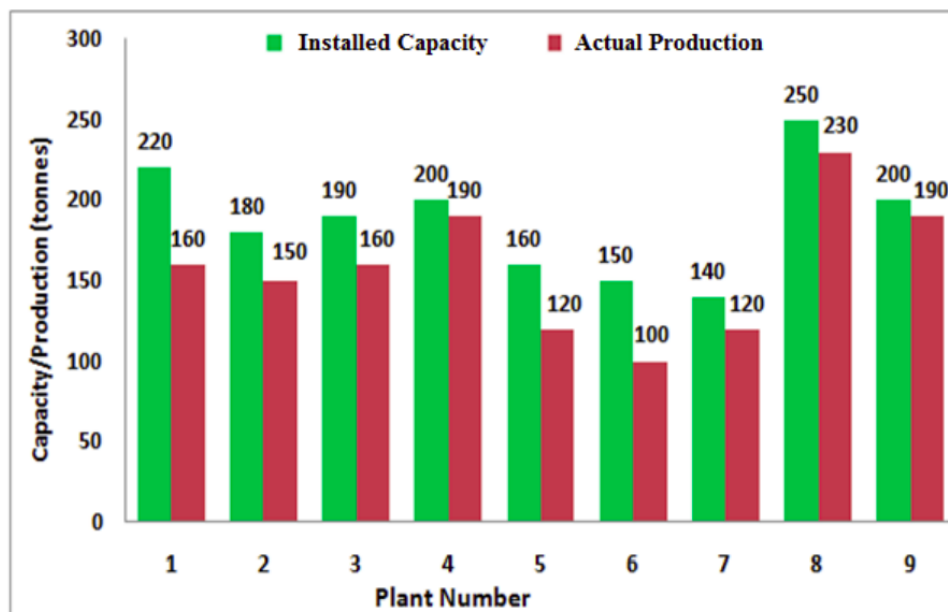


Fig. 23.

(GATE EE 2016)

Q.72 A poll of students appearing for masters in engineering indicated that 60% of the students believed that mechanical engineering is a profession unsuitable for women. A research study on women with masters or higher degrees in mechanical engineering found that 99% of such women were successful in their professions. Which of the following can be logically inferred from the above paragraph?

- a) Many students have misconceptions regarding various engineering disciplines.
- b) Men with advanced degrees in mechanical engineering believe women are well suited to be mechanical engineers.
- c) Mechanical engineering is a profession well suited for women with masters or higher degrees in mechanical engineering.
- d) The number of women pursuing higher degrees in mechanical engineering is small.

(GATE EE 2016)

Q.73 Sourya committee had proposed the establishment of Sourya Institutes of Technology (*SITs*) in line with Indian Institutes of Technology (*IITs*) to cater to the technological and industrial needs of a developing country. Which of the following can be logically inferred from the above sentence? Based on the proposal,

- (i) In the initial years, SIT students will get degrees from IIT.
- (ii) SITs will have a distinct national objective.
- (iii) SIT like institutions can only be established in consultation with IIT.
- (iv) SITs will serve technological needs of a developing country.

- a) (iii) and (iv) only.
- b) (i) and (iv) only.
- c) (ii) and (iv) only.
- d) (ii) and (iii) only.

(GATE EE 2016)

Q.74 Shaquille O' Neal is a 60% career free throw shooter, meaning that he successfully makes 60 free throws out of 100 attempts on average. What is the probability that he will successfully make exactly 6 free throws in 10 attempts?

- a) 0.2508
- b) 0.2816
- c) 0.2934
- d) 0.6000

(GATE EE 2016)

Q.75 The numeral in the units position of $211^{870} + 146^{127} \times 3^{424}$ is _____.

(GATE EE 2016)

Q.76 The output expression for the Karnaugh map shown below is

		BC			
		00	01	11	10
A	0	1	0	0	1
	1	1	1	1	1

Fig. 24.

- a) $A + \bar{B}$
b) $A + \bar{C}$

- c) $\bar{A} + \bar{C}$
d) $\bar{A} + C$

(GATE EE 2016)

Q.77 The circuit shown below is an example of a

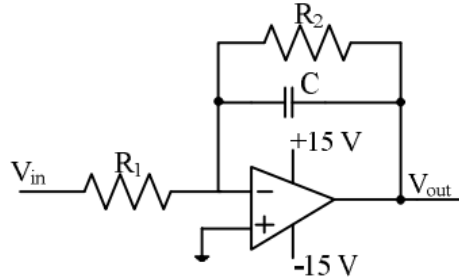


Fig. 25.

- a) low pass filter.
b) band pass filter.

- c) high pass filter.
d) notch filter.

(GATE EE 2016)

Q.78 The following figure shows the connection of an ideal transformer with primary to secondary turns ratio of 1 : 100. The applied primary voltage is 100 V (*rms*), 50 Hz, AC. The rms value of the current I, in ampere, is _____.

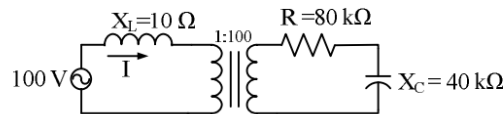


Fig. 26.

(GATE EE 2016)

Q.79 Consider a causal LTI system characterized by differential equation $\frac{dy(t)}{dt} + \frac{1}{6}y(t) = 3x(t)$. The response of the system to the input $x(t) = 3e^{-t/3}u(t)$, where $u(t)$ denotes the unit step function, is

- a) $9e^{-t/3}u(t)$.
b) $9e^{-t/6}u(t)$.
c) $9e^{-t/3}u(t) - 6e^{-t/6}u(t)$.
d) $54e^{-t/6}u(t) - 54e^{-t/3}u(t)$.

(GATE EE 2016)

Q.80 Suppose the maximum frequency in a band-limited signal $x(t)$ is 5 kHz. Then, the maximum frequency in $x(t) \cos(2000\pi t)$, in kHz, is _____.

(GATE EE 2016)

Q.81 Consider the function $f(z) = z + z^*$ where z is a complex variable and z^* denotes its complex conjugate. Which one of the following is TRUE?

- a) $f(z)$ is both continuous and analytic
b) $f(z)$ is continuous but not analytic
c) $f(z)$ is not continuous but is analytic
d) $f(z)$ is neither continuous nor analytic

(GATE EE 2016)

Q.82 A 3×3 matrix P is such that, $P^3 = P$. Then the eigenvalues of P are

- a) 1, 1, -1
 b) 1, $0.5 + j0.866$, $0.5 - j0.866$
 c) 1, $-0.5 + j0.866$, $-0.5 - j0.866$
 d) 0, 1, -1

(GATE EE 2016)

Q.83 The solution of the differential equation, for $t > 0$, $y''(t) + 2y'(t) + y(t) = 0$ with initial conditions $y(0) = 0$ and $y'(0) = 1$, is ($u(t)$ denotes the unit step function),

- a) $te^{-t}u(t)$
 b) $(e^{-t} - te^{-t})u(t)$
 c) $(-e^{-t} + te^{-t})u(t)$
 d) $e^{-t}u(t)$

(GATE EE 2016)

Q.84 The value of the line integral $\int_C (2xy^2 dx + 2x^2 y dy + dz)$ along a path joining the origin (0, 0, 0) and the point (1, 1, 1) is

- a) 0
 b) 2
 c) 4
 d) 6

(GATE EE 2016)

Q.85 Let $f(x)$ be a real, periodic function satisfying $f(-x) = -f(x)$. The general form of its Fourier series representation would be

- a) $f(x) = a_0 + \sum_{k=1}^{\infty} a_k \cos(kx)$
 b) $f(x) = \sum_{k=1}^{\infty} b_k \sin(kx)$
 c) $f(x) = a_0 + \sum_{k=1}^{\infty} a_{2k} \cos(kx)$
 d) $f(x) = \sum_{k=0}^{\infty} a_{2k+1} \sin((2k+1)x)$

(GATE EE 2016)

Q.86 A resistance and a coil are connected in series and supplied from a single phase, 100 V, 50 Hz ac source as shown in the figure below. The rms values of plausible voltages across the resistance (V_R) and coil (V_C) respectively, in volts, are)

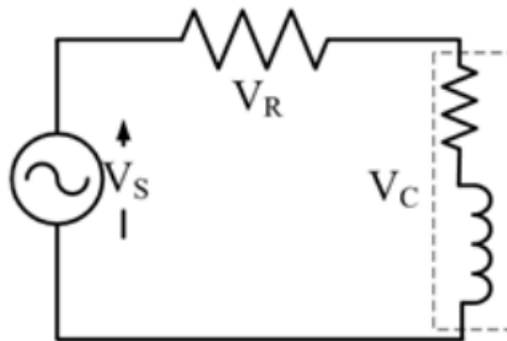


Fig. 27.

- a) 65, 35
 b) 50, 50
 c) 60, 90
 d) 60, 80

(GATE EE 2016)

Q.87 The voltage (V) and current (A) across a load are as follows. $v(t) = 100 \sin(\omega t)$, $i(t) = 10 \sin(\omega t - 60^\circ) + 2 \sin(3\omega t) + 5 \sin(5\omega t)$. The average power consumed by the load, in W, is _____.

(GATE EE 2016)

Q.88 A power system with two generators is shown in the figure below. The system (generators, buses and transmission lines) is protected by six overcurrent relays R1 to R6. Assuming a mix of directional and nondirectional relays at appropriate locations, the remote backup relays for R4 are

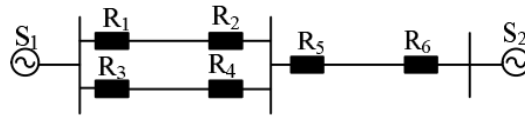


Fig. 28.

- a) R1, R2
b) R2, R6
c) R2, R5
d) R1, R6

(GATE EE 2016)

Q.89 A power system has 100 buses including 10 generator buses. For the load flow analysis using Newton-Raphson method in polar coordinates, the size of the Jacobian is

- a) 189×189
b) 100×100
c) 90×90
d) 180×180

(GATE EE 2016)

Q.90 The inductance and capacitance of a 400 kV, three-phase, 50 Hz lossless transmission line are 1.6 mH/km/phase and 10 nF/km/phase respectively. The sending end voltage is maintained at 400 kV. To maintain a voltage of 400 kV at the receiving end, when the line is delivering 300 MW load, the shunt compensation required is

- a) capacitive
b) inductive
c) resistive
d) zero

(GATE EE 2016)

Q.91 A parallel plate capacitor filled with two dielectrics is shown in the figure below. If the electric field in the region A is 4 kV/cm, the electric field in the region B, in kV/cm, is

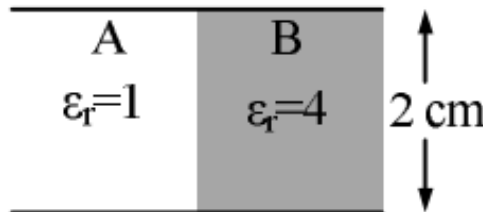


Fig. 29.

- a) 1
b) 2
c) 4
d) 16

(GATE EE 2016)

Q.92 A 50 MVA, 10 kV, 50 Hz, star-connected, unloaded three-phase alternator has a synchronous reactance of 1 p.u. and a sub-transient reactance of 0.2 p.u. If a 3-phase short circuit occurs close to the generator

terminals, the ratio of initial and final values of the sinusoidal component of the short circuit current is _____.

(GATE EE 2016)

Q.93 Consider a linear time-invariant system with transfer function $H(s) = \frac{1}{s+1}$. If the input is $\cos(t)$ and the steady state output is $A \cos(t + \alpha)$, then the value of A is _____.

(GATE EE 2016)

Q.94 A three-phase diode bridge rectifier is feeding a constant DC current of 100 A to a highly inductive load. If three-phase, 415 V, 50 Hz AC source is supplying to this bridge rectifier then the rms value of the current in each diode, in ampere, is _____.

(GATE EE 2016)

Q.95 A buck-boost DC-DC converter, shown in the figure below, is used to convert 24 V battery voltage to 36 V DC voltage to feed a load of 72 W. It is operated at 20 kHz with an inductor of 2 mH and output capacitor of 1000 μF . All devices are considered to be ideal. The peak voltage across the solid-state switch (S), in volt, is _____.

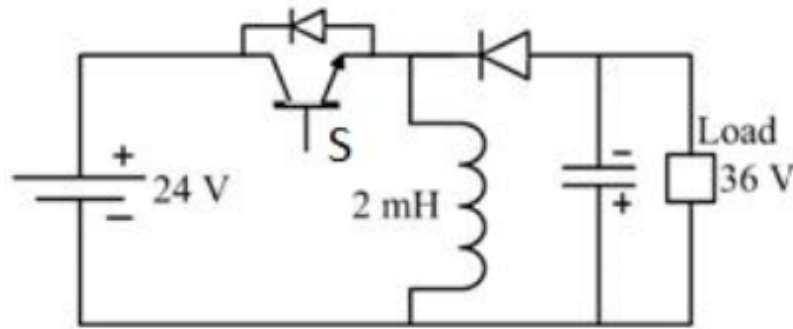


Fig. 30.

(GATE EE 2016)

Q.96 For the network shown in the figure below, the frequency (in rad/s) at which the maximum phase lag occurs is, _____.

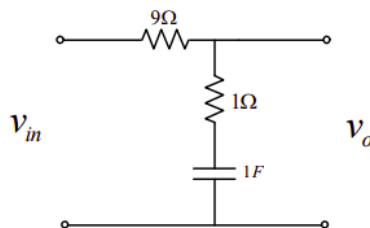


Fig. 31.

(GATE EE 2016)

Q.97 The direction of rotation of a single-phase capacitor run induction motor is reversed by

- interchanging the terminals of the AC supply.
- interchanging the terminals of the capacitor.
- interchanging the terminals of the auxiliary winding.
- interchanging the terminals of both the windings.

(GATE EE 2016)

Q.98 In the circuit shown below, the voltage and current sources are ideal. The voltage V_{out} across the current source, in volts, is

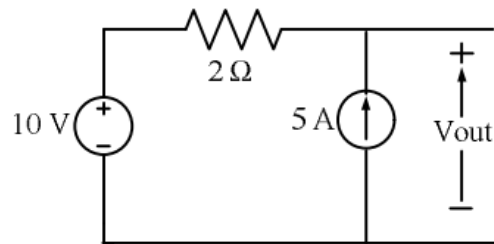


Fig. 32.

- a) 0
b) 5
c) 10
d) 20

(GATE EE 2016)

Q.99 The graph associated with an electrical network has 7 branches and 5 nodes. The number of independent KCL equations and the number of independent KVL equations, respectively, are

- a) 2 and 5
b) 5 and 2
c) 3 and 4
d) 4 and 3

(GATE EE 2016)

Q.100 Two electrodes, whose cross-sectional view is shown in the figure below, are at the same potential. The maximum electric field will be at the point

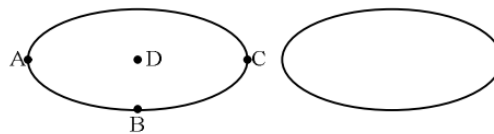


Fig. 33.

- a) A
b) B
c) C
d) D

(GATE EE 2016)

Q.101 The Boolean expression $\overline{(\bar{a} + \bar{b} + c + \bar{d})} + (b + \bar{c})$ simplifies to

- a) 1
b) $\overline{a.b}$
c) $a.b$
d) 0

(GATE EE 2016)

Q.102 For the circuit shown below, taking the opamp as ideal, the output voltage V_{out} in terms of the input voltages V_1 , V_2 and V_3 is

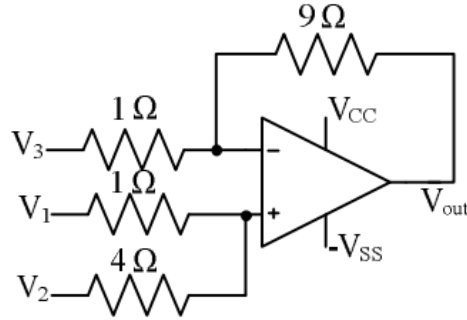


Fig. 34.

- a) $1.8V_1 + 7.2V_2 - V_3$ c) $7.2V_1 + 1.8V_2 - V_3$
 b) $2V_1 + 8V_2 - 9V_3$ d) $8V_1 + 2V_2 - 9V_3$

(GATE EE 2016)

Q.103 Let $x_1(t) \leftrightarrow X_1(\omega)$ and $x_2(t) \leftrightarrow X_2(\omega)$ be two signals whose Fourier Transforms are as shown in the figure below. In the figure, $h(t) = e^{-2|t|}$ denotes the impulse response. For the system shown above, the minimum sampling rate required to sample $y(t)$, so that $y(t)$ can be uniquely reconstructed from its samples, is

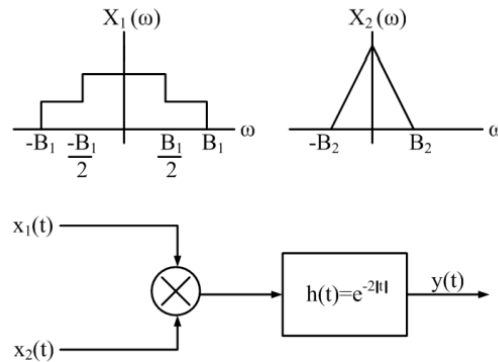


Fig. 35.

- a) $2B_1$ c) $4(B_1 + B_2)$
 b) $2(B_1 + B_2)$ d) ∞

(GATE EE 2016)

Q.104 The value of the integral $\int_{-\infty}^{\infty} \left(\frac{\sin(2\pi t)}{\pi t} \right)^2 dt$ is equal to

- a) 0 c) 1
 b) 0.5 d) 2

(GATE EE 2016)

Q.105 Let $y(x)$ be the solution of the differential equation $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = 0$ with initial conditions $y(0) = 0$ and $\frac{dy}{dx}\big|_{x=0} = 1$. Then the value of $y(1)$ is _____.

(GATE EE 2016)

Q.106 The line integral of the vector field $F = 5xz\hat{i} + (3x^2 + 2y)\hat{j} + x^2z\hat{k}$ along a path from $(0, 0, 0)$ to $(1, 1, 1)$ parametrized by (t, t^2, t) is _____.

Q.107 Let $P = \begin{pmatrix} 3 & 1 \\ 1 & 3 \end{pmatrix}$. Consider the set S of all vectors $\begin{pmatrix} x \\ y \end{pmatrix}$ such that $a^2 + b^2 = 1$ where $\begin{pmatrix} a \\ b \end{pmatrix} = P \begin{pmatrix} x \\ y \end{pmatrix}$. Then S is

- a) a circle of radius $\sqrt{10}$
- b) a circle of radius $\frac{1}{\sqrt{10}}$
- c) an ellipse with major axis along $\begin{pmatrix} 1 \\ 1 \end{pmatrix}$
- d) an ellipse with minor axis along $\begin{pmatrix} 1 \\ 1 \end{pmatrix}$

(GATE EE 2016)

Q.108 Let the probability density function of a random variable, X, be given as: $f_X(x) = 32e^{-3x}u(x) + ae^{4x}u(-x)$ where $u(x)$ is the unit step function. Then the value of 'a' and $\text{Prob}\{X \geq 0\}$, respectively, are

- a) $2, \frac{1}{2}$
- b) $4, \frac{1}{2}$
- c) $2, \frac{1}{4}$
- d) $4, \frac{1}{4}$

(GATE EE 2016)

Q.109 The driving point input impedance seen from the source V_s of the circuit shown below, in Ω , is _____.

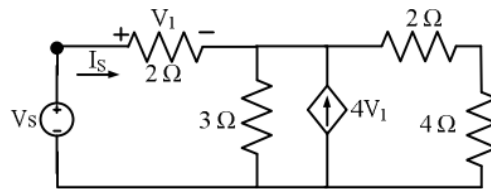


Fig. 36.

(GATE EE 2016)

Q.110 The z-parameters of the two port network shown in the figure are $z_{11} = 40\Omega$, $z_{12} = 60\Omega$, $z_{21} = 80\Omega$ and $z_{22} = 100\Omega$. The average power delivered to $R_L = 20\Omega$, in watts, is _____.

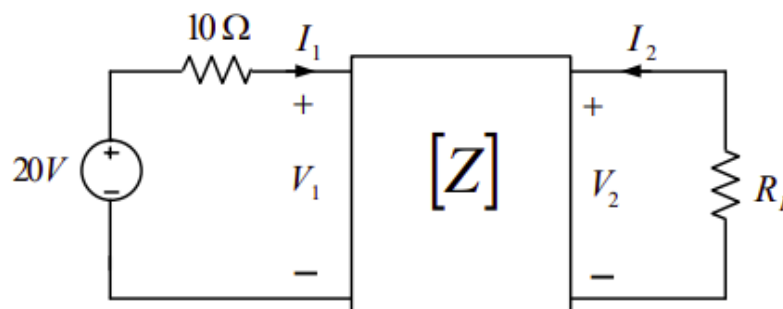


Fig. 37.

(GATE EE 2016)

Q.111 In the balanced 3-phase, 50 Hz, circuit shown below, the value of inductance (L) is 10 mH. The value of the capacitance (C) for which all the line currents are zero, in millifarads, is _____.

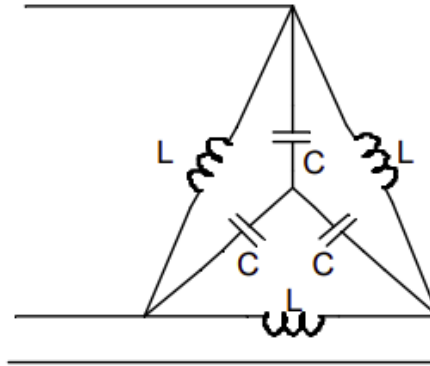


Fig. 38.

(GATE EE 2016)

Q.112 In the circuit shown below, the initial capacitor voltage is 4 V. Switch S_1 is closed at $t = 0$. The charge (in μC) lost by the capacitor from $t = 25 \mu\text{s}$ to $t = 100 \mu\text{s}$ is _____.

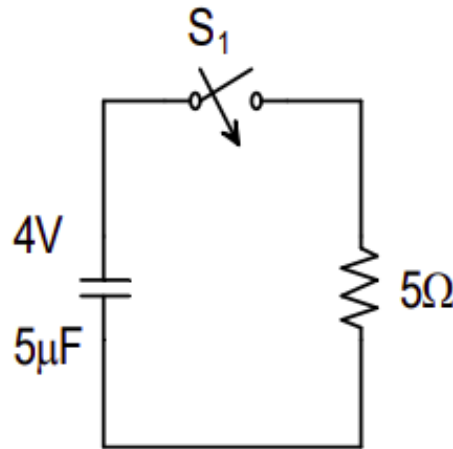


Fig. 39.

(GATE EE 2016)

Q.113 The single line diagram of a balanced power system is shown in the figure. The voltage magnitude at the generator internal bus is constant and 1.0 p.u. The p.u. reactances of different components in the system are also shown in the figure. The infinite bus voltage magnitude is 1.0 p.u. A three phase fault occurs at the middle of line 2. The ratio of the maximum real power that can be transferred during the pre-fault condition to the maximum real power that can be transferred under the faulted condition is _____.

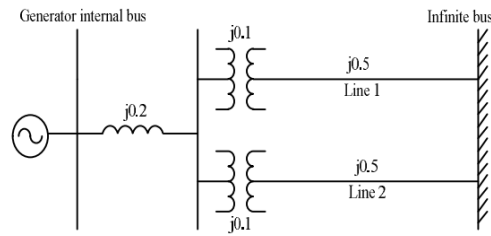


Fig. 40.

(GATE EE 2016)

Q.114 The open loop transfer function of a unity feedback control system is given by

$$G(s) = \frac{K(s+1)}{s(1+Ts)(1+2s)}, K > 0, T > 0.$$

The closed loop system will be stable if,

- | | |
|---------------------------------|---------------------------------|
| a) $0 < T < \frac{4(K+1)}{K-1}$ | c) $0 < K < \frac{T+2}{T-2}$ |
| b) $0 < K < \frac{4(T+2)}{T-2}$ | d) $0 < T < \frac{8(K+1)}{K-1}$ |

(GATE EE 2016)

Q.115 At no load condition, a 3-phase, 50 Hz, lossless power transmission line has sending-end and receiving-end voltages of 400 kV and 420 kV respectively. Assuming the velocity of traveling wave to be the velocity of light, the length of the line, in km, is _____.

(GATE EE 2016)

Q.116 The power consumption of an industry is 500 kVA, at 0.8 p.f. lagging. A synchronous motor is added to raise the power factor of the industry to unity. If the power intake of the motor is 100 kW, the p.f. of the motor is _____.

(GATE EE 2016)

Q.117 The flux linkage (λ) and current (i) relation for an electromagnetic system is $\lambda = (\sqrt{i})/g$. When $i = 2$ A and g (air-gap length) = 10 cm, the magnitude of mechanical force on the moving part, in N, is _____.

(GATE EE 2016)

Q.118 The starting line current of a 415 V, 3-phase, delta connected induction motor is 120 A, when the rated voltage is applied to its stator winding. The starting line current at a reduced voltage of 110 V, in ampere, is _____.

(GATE EE 2016)

Q.119 A single-phase, 2 kVA, 100/200 V transformer is reconnected as an auto-transformer such that its kVA rating is maximum. The new rating, in kVA, is _____.

(GATE EE 2016)

Q.120 A full-bridge converter supplying an RLE load is shown in figure. The firing angle of the bridge converter is 120° . The supply voltage $v_m(t) = 200\pi \sin(100\pi t)$ V, $R=20\Omega$, $E=800$ V. The inductor L is large enough to make the output current I_L a smooth dc current. Switches are lossless. The real power fed back to the source, in kW, is _____.

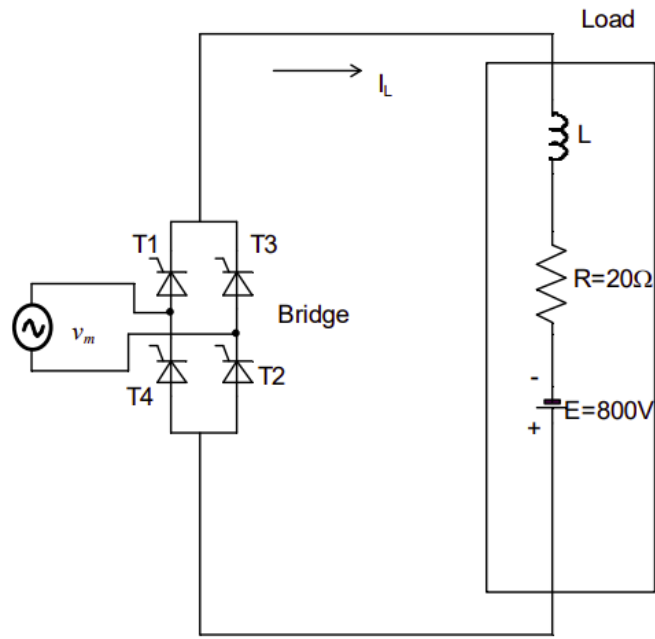


Fig. 41.

(GATE EE 2016)

- Q.121 A three-phase Voltage Source Inverter (VSI) as shown in the figure is feeding a delta connected resistive load of $30\Omega/\text{phase}$. If it is fed from a 600 V battery, with 180° conduction of solid-state devices, the power consumed by the load, in kW, is _____.

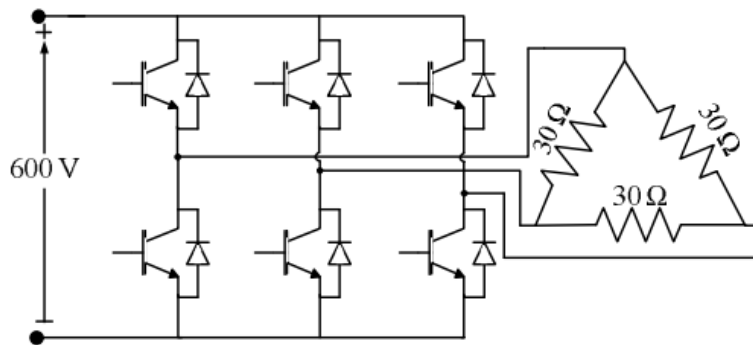


Fig. 42.

(GATE EE 2016)

- Q.122 A DC-DC boost converter, as shown in the figure below, is used to boost 360V to 400 V, at a power of 4 kW. All devices are ideal. Considering continuous inductor current, the rms current in the solid state switch (S), in ampere, is _____.

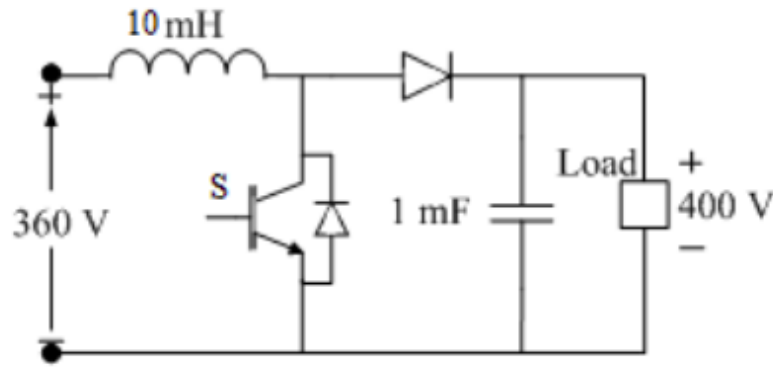


Fig. 43.

(GATE EE 2016)

- Q.123 A single-phase bi-directional voltage source converter (VSC) is shown in the figure below. All devices are ideal. It is used to charge a battery at 400 V with power of 5 kW from a source $V_s = 220$ V (rms), 50 Hz sinusoidal AC mains at unity p.f. If its AC-side interfacing inductor is 5 mH and the switches are operated at 20 kHz, then the phase shift (δ) between AC mains voltage (V_s) and fundamental AC rms VSC voltage (V_{C1}), in degree, is _____.

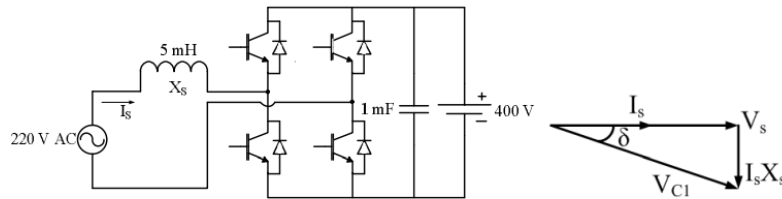


Fig. 44.

(GATE EE 2016)

- Q.124 Consider a linear time-invariant system $\dot{x} = Ax$, with initial condition $x(0)$ at $t = 0$. Suppose α and β are eigenvectors of a (2×2) matrix A corresponding to distinct eigenvalues λ_1 and λ_2 , respectively. Then the response $x(t)$ of the system due to initial condition $x(0) = \alpha$ is

- $e^{\lambda_1 t} \alpha$
- $e^{\lambda_2 t} \beta$
- $e^{\lambda_2 t} \alpha$
- $e^{\lambda_1 t} \alpha + e^{\lambda_2 t} \beta$

(GATE EE 2016)

- Q.125 A second-order real system has the following properties: a) the damping ratio $\zeta = 0.5$ and undamped natural frequency $\omega_n = 10$ rad/s, b) the steady state value of the output, to a unit step input, is 1.02. The transfer function of the system is

- $\frac{1.02}{s^2 + 5s + 100}$
- $\frac{102}{s^2 + 10s + 100}$
- $\frac{100}{s^2 + 10s + 100}$
- $\frac{102}{s^2 + 5s + 100}$

(GATE EE 2016)

Q.126 Three single-phase transformers are connected to form a delta-star three-phase transformer of 110 kV/ 11 kV. The transformer supplies at 11 kV a load of 8 MW at 0.8 p.f. lagging to a nearby plant. Neglect the transformer losses. The ratio of phase currents in delta side to star side is

- a) $1 : 10\sqrt{3}$ c) $1 : 10$
b) $10\sqrt{3} : 1$ d) $\sqrt{3} : 10$

(GATE EE 2016)

Q.127 The gain at the breakaway point of the root locus of a unity feedback system with open loop transfer function $G(s) = \frac{K}{s(s-1)(s-4)}$ is

- a) 1 c) 5
b) 2 d) 9

(GATE EE 2016)

Q.128 Two identical unloaded generators are connected in parallel as shown in the figure. Both the generators are having positive, negative and zero sequence impedances of $j0.4$ p.u., $j0.3$ p.u. and $j0.15$ p.u., respectively. If the pre-fault voltage is 1 p.u., for a line-to-ground ($L-G$) fault at the terminals of the generators, the fault current, in p.u., is _____.

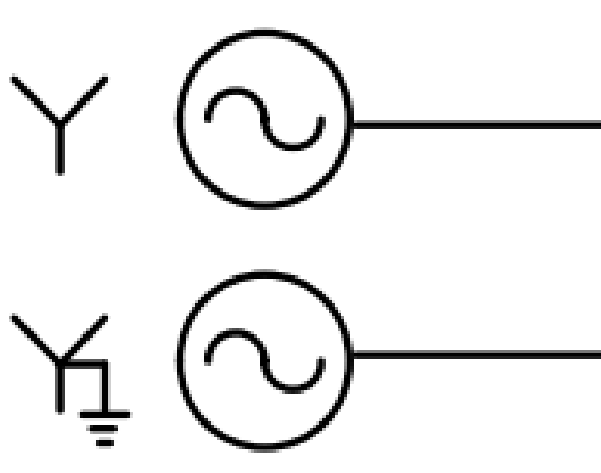


Fig. 45.

(GATE EE 2016)

Q.129 An energy meter, having meter constant of 1200 revolutions/kWh, makes 20 revolutions in 30 seconds for a constant load. The load, in kW, is _____.

(GATE EE 2016)

Q.130 A rotating conductor of 1 m length is placed in a radially outward (*about the z-axis*) magnetic flux density (B) of 1 Tesla as shown in figure below. Conductor is parallel to and at 1 m distance from the z-axis. The speed of the conductor in r.p.m. required to induce a voltage of 1 V across it, should be _____.

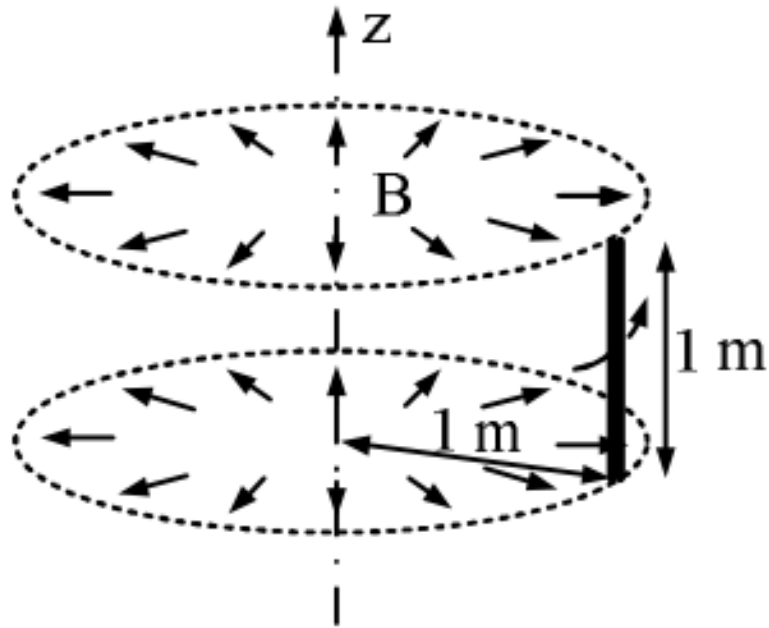


Fig. 46.

(GATE EE 2016)