Q. No. 1 – 5 Carry One Mark Each

1. Which of the following options is the closest in meaning to the phrase underlined in the sentence below?
   It is fascinating to see life forms cope with varied environmental conditions.
   (A) Adopt to (B) Adapt to (C) Adept in (D) Accept with

Answer: (B)

2. Choose the most appropriate word from the options given below to complete the following sentence.
   He could not understand the judges awarding her the first prize, because he thought that her performance was quite ____________________.
   (A) Superb (B) Medium (C) Mediocre (D) Exhilarating

Answer: (C)

3. In a press meet on the recent scam, the minister said, "The buck stops here". What did the minister convey by the statement?
   (A) He wants all the money (B) He will return the money
   (C) He will assume final responsibility (D) He will resist all enquiries

Answer: (C)

4. If $(z+1/z)^2 = 98$, compute (z^2+1/z^2)

Exp: 96

Expanding

$$z^2+\frac{1}{z^2}+2.z.\frac{1}{z}=98 \Rightarrow z^2+\frac{1}{z^2}=96$$

5. The roots of $ax^2+bx+c=0$ are real and positive a, b and c are real. Then $ax^2+b|x|+c=0$ has
   (A) No roots (B) 2 real roots (C) 3 real roots (D) 4 real roots

Answer: (D)

Exp: $ax^2+bx+c=0$

for roots to be real & +ve

$b^2-4ac>0$

This will have 2 real positive roots.

$ax^2+b|x|+c=0$

This can be written as;

ax^2+bx+c

$\text{Discriminant} = b^2-4ac>0$

ax^2-bx+c

$(-b)^2-4ac$

$\Rightarrow b^2-4ac$

Is also >0 This will have real roots

$\Rightarrow$ This will have 4 real roots.

Q. No. 6 – 10 Carry One Mark Each

6. The Palghat Gap (or Palakkad Gap), a region about 30 km wide in the southern part of the Western Ghats in India, is lower than the hilly terrain to its north and south. The exact reasons for the formation of this gap are not clear. It results in the neighbouring regions of Tamil Nadu getting more rainfall from the South West monsoon and the neighbouring regions of Kerala having higher summer temperatures.

What can be inferred from this passage?

(A) The Palghat gap is caused by high rainfall and high temperatures in southern Tamil Nadu and Kerala

(B) The regions in Tamil Nadu and Kerala that are near the Palghat Gap are low–lying

(C) The low terrain of the Palghat Gap has a significant impact on weather patterns in neighbouring parts of Tamil Nadu and Kerala

(D) Higher summer temperatures result in higher rainfall near the Palghat Gap area

Answer: (B)

7. Geneticists say that they are very close to confirming the genetic roots of psychiatric illnesses such as depression and schizophrenia, and consequently, that doctors will be able to eradicate these diseases through early identification and gene therapy.

On which of the following assumptions does the statement above rely?

(A) Strategies are now available for eliminating psychiatric illnesses

(B) Certain psychiatric illnesses have a genetic basis

(C) All human diseases can be traced back to genes and how they are expressed

(D) In the future, genetics will become the only relevant field for identifying psychiatric illnesses

Answer: (B)

8. Round–trip tickets to a tourist destination are eligible for a discount of 10% on the total fare. In addition, groups of 4 or more get a discount of 5% on the total fare. If the one way single person fare is Rs 100, a group of 5 tourists purchasing round–trip tickets will be charged Rs ________

Answer: 850

Exp: One way force =100

Two way fare per person=200

5 persons=1000/-

Total discount applicable=10+5=15%

$$\text{Discount amount} = \frac{15}{100} \times 1000 = 150$$

Amount to be paid=1000-150=850

9. In a survey, 300 respondents were asked whether they own a vehicle or not. If yes, they were further asked to mention whether they own a car or scooter or both. Their responses are tabulated below. What percent of respondents do not own a scooter?

		Men	Women
Own vehicle	Car	40	34
	Scooter	30	20
	Both	60	46
Do not own vehicle		20	50

Answer: 48%

Exp: Total respondents=300

Those who don't have scooter

$\Rightarrow$ Men= 40+20=60

$$\text{women} = 34 + 50 = \frac{84}{144}$$

$$\% = \frac{144}{300} \times 100$$

$$= 48\%$$

10. When a point inside of a tetrahedron (a solid with four triangular surfaces) is connected by straight lines to its corners, how many (new) internal planes are created with these lines? ____________________

Answer: 6

Q. No. 1 – 25 Carry One Mark Each

1. Given a system of equations:

$$x + 2y + 2z = b_1$$
$$5x + y + 3z = b_2$$

Which of the following is true regarding its solutions?

(A) The system has a unique solution for any given b_1 and b_2

(B) The system will have infinitely many solutions for any given b_1 and b_2

(C) Whether or not a solution exists depends on the given b_1 and b_2

(D) The system would have no solution for any values of b_1 and b_2

Answer: (B)

Exp:

$$[A/B] = \left[\begin{array}{ccc|c} 1 & 2 & 2 & b_1 \\ 5 & 1 & 3 & b_2 \end{array}\right]$$

$$R_2 \to R_2 - 5R_1 \left[\begin{array}{ccc|c} 1 & 2 & 2 & b_1 \\ 0 & -9 & -7 & b_2 - 5b_1 \end{array}\right]$$

$\therefore \text{rank}(A) = \text{rank}(A/B) <$ number of unknowns, for all values of b_1 and b_2

$\therefore$ The equations have infinitely many solutions, for any given b_1 and b_2

2. Let $f(x) = x e^{-x}$. The maximum value of the function in the interval $(0, \infty)$ is

(A) e^{-1} (B) e (C) $1 - e^{-1}$ (D) $1 + e^{-1}$

Answer: (A)

Exp:

$f'(x) = 0 \Rightarrow e^{-x}(1 - x) = 0 \Rightarrow x = 1$ and $f''(x) < 0$ at $x = 1$

$\therefore$ Maximum value is $f(1) = e^{-1}$

3. The solution for the differential equation $\frac{d^2x}{dt^2} = -9x$ with initial conditions $x(0) = 1$ and $\left.\frac{dx}{dt}\right|_{t=0} = 1$, is

(A) $t^2 + t + 1$

(B) $\sin 3t + \frac{1}{3}\cos 3t + \frac{2}{3}$

(C) $\frac{1}{3}\sin 3t + \cos 3t$

(D) $\cos 3t + t$

Answer: (C)

Exp: $\text{A.E}: m^2+9=0 \Rightarrow m=\pm 3i$

$\therefore$ Solution is $x = a\cos 3t + b\sin 3t \quad .....(1)$

and $\frac{dx}{dt} = -3a\sin 3t + 3b\cos 3t \quad ......(2)$

Using $x(0)=1$ and $\left.\frac{dx}{dt}\right|_{t=0} = 1$, (1) and (2) gives

$1 = a$ and $1 = 3b \Rightarrow b = \frac{1}{3}$

$\therefore x = \cos 3t + \frac{1}{3}\sin 3t$

4. Let $X(s) = \dfrac{3s+5}{s^2+10s+21}$ be the Laplace Transform of a signal x(t). Then, $x(0^+)$ is

(A) 0 (B) 3 (C) 5 (D) 21

Answer: (B)

Exp:

$$x\left[0^+\right] = \lim_{s\to\infty} \frac{s.\,3s+5}{\left(s^2+10s+21\right)} \left[\text{using initial value therorem}\right]$$

$$= \lim_{s\to\infty} \frac{s^2\left[3+\frac{5}{s}\right]}{s^2\left[1+\frac{10}{s}+\frac{21}{s^2}\right]} = 3$$

5. Let *S* be the set of points in the complex plane corresponding to the unit circle. (That is, $S = \{z : |z| = 1\}$. Consider the function $f(z) = zz^*$ where z^* denotes the complex conjugate of z. The $f(z)$ maps *S* to which one of the following in the complex plane

(A) Unit circle

(B) Horizontal axis line segment from origin to (1, 0)

(C) The point (1, 0)

(D) The entire horizontal axis

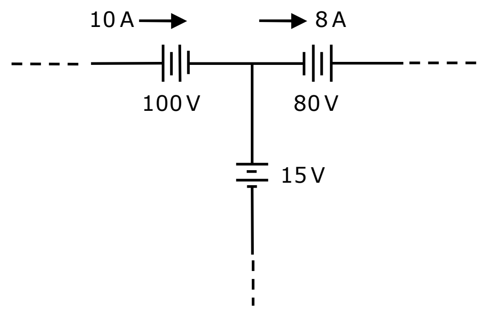
Answer: (C)

Exp: $f(Z) = Z.Z^*$ where Z^* is conjugate of Z

$= |Z|^2 = 1 = 1 + i.0$

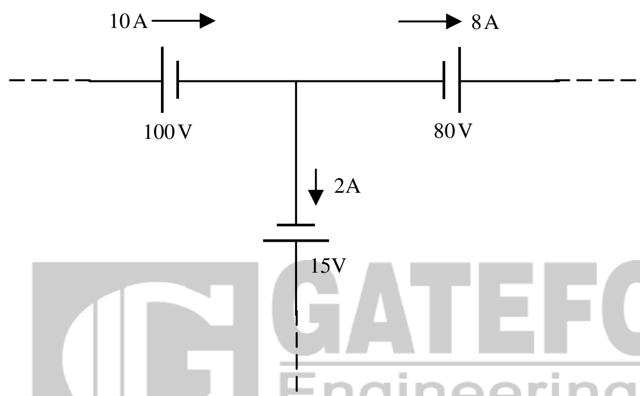
$\therefore f(Z)$ maps S to the point $(1,0)$ in the complex plane

6. The three circuit elements shown in the figure are part of an electric circuit. The total power absorbed by the three circuit elements in watts is ________________



Answer: 330 watts.

Exp:



By KCL, current through 15V source is 2A.

$\rightarrow$ When current entering in to +ve terminal of a battery means, it is absorbing the power.

$\rightarrow$ When current entering in to –ve terminal, means, delivering the power.

$\rightarrow$ 100V source is absorbing the power

i.e. (10) (100) = 1000 watts.

$\rightarrow$ 80V source is delivering the power

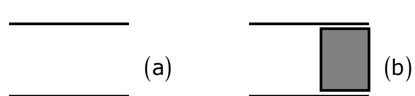
i.e. (8) (80) = 640 watts

$\rightarrow$ 15V source is delivering the power

i.e. (2) (15) = 30 watts

$\therefore$ The total power absorbed by the circuit elements ie = 1000 - (640+30) = 330 watts.

7. C_0 is the capacitance of a parallel plate capacitor with air as dielectric (as in figure (a)). If, half of the entire gap as shown in figure (b) is filled with a dielectric of permittivity $\in_r$, the expression for the modified capacitance is



(A) $\frac{C_0}{2}(1+\in_r)$ (B) $(C_0+\in_r)$ (C) $\frac{C_0}{2}\in_r$ (D) $C_0(1+\in_r)$

Answer: (A)

Exp:

$$C_0 = \frac{A\varepsilon_0}{d}$$

$$C = C_1 + C_2$$

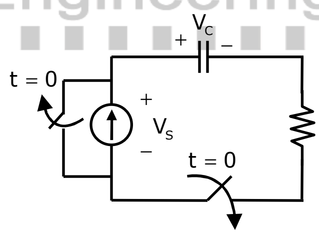
$$C = \frac{A_1\varepsilon_1}{d} + \frac{A_2\varepsilon_2}{d}$$

$$= \frac{A\varepsilon_0}{2d} + \frac{A\varepsilon_r\varepsilon_0}{2d}$$

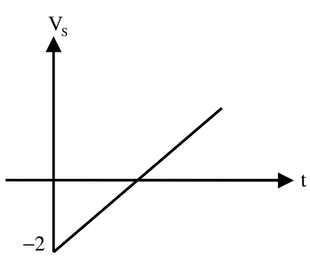
$$C = \frac{A\varepsilon_0}{2d}(1+\varepsilon_r)$$

$$\boxed{C = \frac{C_0}{2}(1+\varepsilon_r)}$$

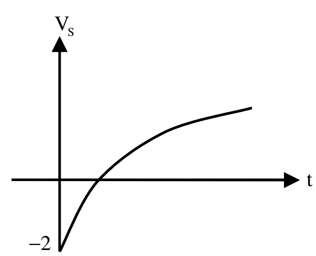
8. A combination of $1\mu F$ capacitor with an initial voltage $v_c(0) = -2V$ in series with a 100Ω resistor is connected to a 20 mA ideal dc current source by operating both switches at t = 0s as shown. Which of the following graphs shown in the options approximates the voltage v_s across the current source over the next few seconds?



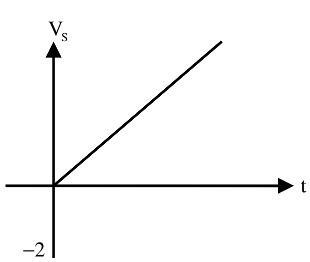
(A)



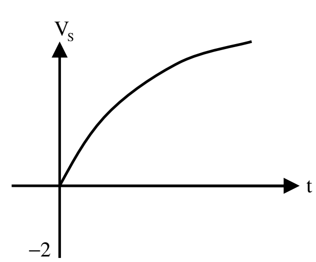
(B)



(C)

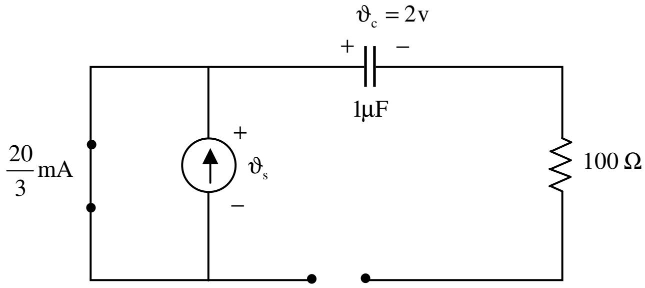


(D)

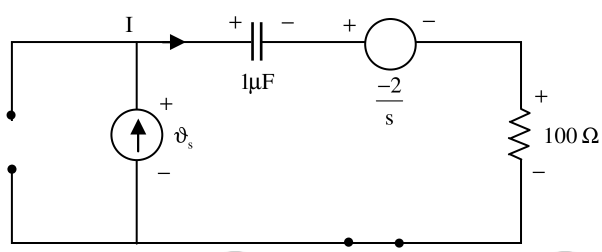


Answer: (C)

Exp: Under steady state,



When switch is opened:



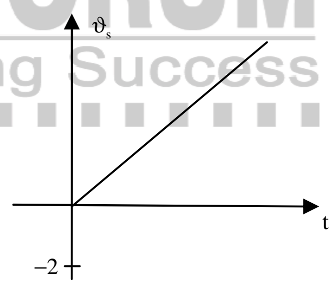
By using Laplace transform approach,

$$V_S(S) = \left[\frac{1}{S}\right]\left(\frac{1}{SC}\right) + \left(\frac{1}{S}\right)100 + \left(-2/S\right)$$

$$V_S(S) = \frac{20\times10^3}{S^2}$$

$$\Rightarrow \quad V_S(t) = \frac{2\times10}{S^2}$$

$$V_S(t) = 2\times10^4 t$$



9. x(t) is nonzero only for $T_x < t < T'_x$, and similarly, y(t) is nonzero only for $T_y < t < T'_y$. Let z(t) be convolution of x(t) and *y(t)*. Which one of the following statements is TRUE?

(A) z(t) can be nonzero over an unbounded interval

(B) z(t) is nonzero for $t < T_x + T_y$

(C) z(t) is zero outside of $T_x + T_y < t < T'_x + T'_y$

(D) z(t) is nonzero for $t > T'_x + T'_y$

Answer: (C)

Exp: Given that $z(t)$ is $x(t) * y(t)$

Range of z(t) is [sum of lower limits of $x(t)$ and $y(t)$ to sum of upper limit of x(t) and y(t)].

$T_x + T_y < t < T_x + T_y$

10. For a periodic square wave, which one of the following statements is TRUE?
(A) The Fourier series coefficients do not exist
(B) The Fourier series coefficients exist but the reconstruction converges at no point
(C) The Fourier series coefficients exist and the reconstruction converges at most points.
(D) The Fourier series coefficients exist and the reconstruction converges at every point

Answer: (C)

Exp: For a periodic square wave, fourier series coefficients value decreases as the 'k' increases. At some value of 'k' coefficient becomes zero, thus no conveyance otherwise it converges at most points.

11. An 8–pole, 3–phase, 50 Hz induction motor is operating at a speed of 700 rpm. The frequency of the rotor current of the motor in Hz is _______________

Answer: 3.33Hz

Exp: Given, P = 8, F = 50Hz, N=700 rpm

4 Frequency of Rotor current = s.f

$$S = \frac{N_s - N}{N_s} = \frac{750-700}{750} = 0.067 \quad \therefore f_r = (0.067)\times 50 = 3.33\text{Hz}$$

12. For a specified input voltage and frequency, if the equivalent radius of the core of a transformer is reduced by half, the factor by which the number of turns in the primary should change to maintain the same no load current is
(A) 1/4 (B) 1/2 (C) 2 (D) 4

Answer: (C)

Exp: If the equivalent Radius of the core of a transformer is reduced by half then the reluctance of the core becomes double.

4 to maintain same no-load current the primary turns should be double. Then flux remains same.

13. A star connected 400V, 50Hz, 4 pole synchronous machine gave the following open circuit and short circuit test results:

Open circuit test: $V_{oc} = 400\text{V}$ (rms, line–to–line) at field current, $I_f = 2.3\,\text{A}$

Short circuit test: $I_{sc} = 10\,\text{A}$ (rms, phase) at field current, $I_f = 1.5\,\text{A}$

The value of per phase synchronous impedance in Ω at rated voltage is _________________

Answer: $15.06\,\Omega/\text{ph}$

Exp: Given, O.C. test: $V_{OC} = 400\text{V}\,(L-L)_l\;\; I_f = 2.3\text{A}$

S.C test: $I_{sc} = 10\text{A (phase)},\; I_f = 1.5\text{A}$

4 Per phase synchronous impedance, $Z_s = ?$

` We know, $Z_s = \left.\dfrac{V_{oc}}{I_{sc}}\right| I_f \text{ is same}$

$$\therefore I_{sc} \text{ at } I_f = 2.3\text{A} \Rightarrow \frac{2.3}{1.5}\times 10 = 15.33\text{A}$$

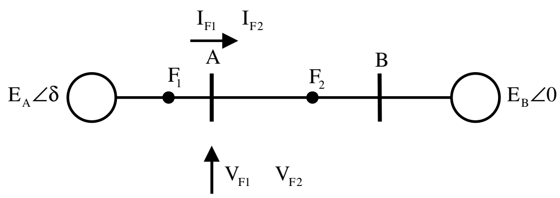
$$\therefore Z_s = \frac{400/\sqrt{3}}{15.33} = 15.06 = 15.06\,\Omega/\text{ph}$$

14. The undesirable property of an electrical insulating material is

(A) High dielectric strength
(B) High relative permittivity
(C) High thermal conductivity
(D) High insulation resistivity

Answer: (B)

15. Three–phase to ground fault takes place at locations F_1 and F_2 in the system shown in the figure

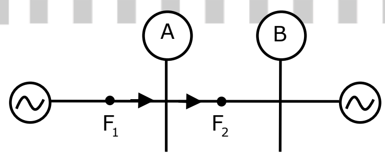


If the fault takes place at location F_1, then the voltage and the current at bus A are V_{F1} and I_{F1} respectively. If the fault takes place at location F_2, then the voltage and the current at bus A are V_{F2} and I_{F2} respectively. The correct statement about voltages and currents during faults at F_1 and F_2 is

(A) V_{F1} leads I_{F1} and V_{F2} leads I_{F2}
(B) V_{F1} leads I_{F1} and V_{F2} lags I_{F2}
(C) V_{F1} lags I_{F1} and V_{F2} leads I_{F2}
(D) V_{F1} lags I_{F1} and V_{F2} lags I_{F2}

Answer: (C)

Exp: When fault takes place at F_1

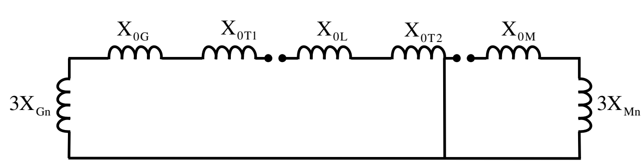


Current is feeding into the BUS A. It is like a generator delivering power to Bus (A)

When fault takes place at F_2, F_2 point is like load, taking power from generator.

16. A 2–bus system and corresponding zero sequence network are shown in the figure.

(a)



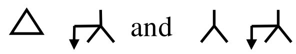
(b)

The transformers T_1 and T_2 are connected as

(A) 

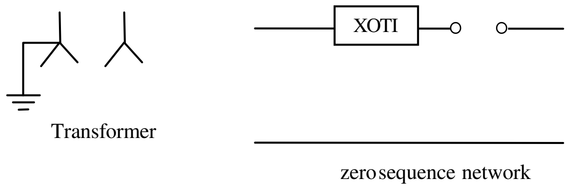
(B) 

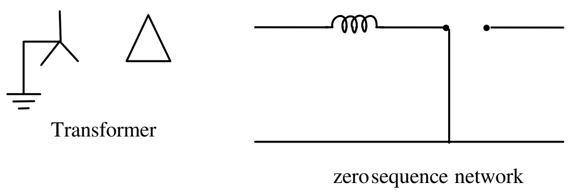
(C) 

(D) 

Answer: (B)

Exp:





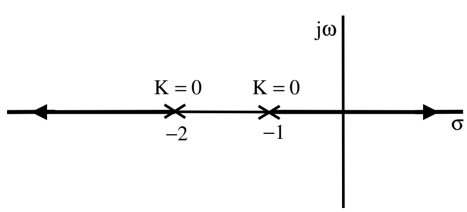
17. In the formation of Routh–Hurwitz array for a polynomial, all the elements of a row have zero values. This premature termination of the array indicates the presence of

(A) Only one root at the origin
(B) Imaginary roots
(C) Only positive real roots
(D) Only negative real roots

Answer: (B)

Exp: If all elements of a row have zero values. Which leads to auxiliary equation formation and roots of auxiliary equations gives imaginary roots.

18. The root locus of a unity feedback system is shown in the figure



The closed loop transfer function of the system is

(A) $\frac{C(s)}{R(s)} = \frac{K}{(s+1)(s+2)}$

(B) $\frac{C(s)}{R(s)} = \frac{-K}{(s+1)(s+2)+K}$

(C) $\frac{C(s)}{R(s)} = \frac{K}{(s+1)(s+2)-K}$

(D) $\frac{C(s)}{R(s)} = \frac{K}{(s+1)(s+2)+K}$

Answer: (C)

Exp: $\frac{C(s)}{R(s)} = \frac{k}{(s+1)(s+2)-k}$ will give the root locus given the diagram.

19. Power consumed by a balanced 3–phase, 3–wire load is measured by the two wattmeter method. The first wattmeter reads twice that of the second. Then the load impedance angle in radians is

(A) $\frac{\pi}{12}$ (B) $\frac{\pi}{8}$ (C) $\frac{\pi}{6}$ (D) $\frac{\pi}{3}$

Answer: C

Exp: When load impedance is $\pi/6$ radians. The first wattmeter reads twice that if the second wattmeter.

20. In an oscilloscope screen, linear sweep is applied at the

(A) Vertical axis (B) Horizontal axis

(C) Origin (D) Both horizontal and vertical axis

Answer: (B)

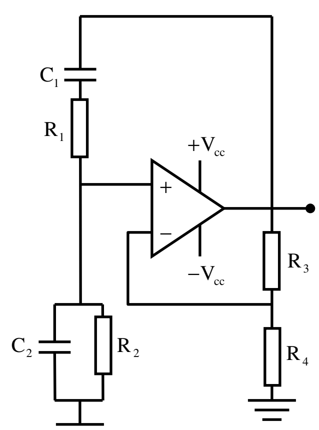
21. A cascade of three identical modulo–5 counters has an overall modulus of

(A) 5 (B) 25 (C) 125 (D) 625

Answer: (C)

Exp: When more than one modulus counter is cascaded then their overall modulus will be product of modulus of each individual .So, in this question overall modular of the counter $= 5 \times 5 \times 5 = 125$

22. In the Wien Bridge oscillator circuit shown in figure, the bridge is balanced when



(A) $\frac{R_3}{R_4} = \frac{R_1}{R_2}, \quad \omega = \frac{1}{\sqrt{R_1C_1R_2C_2}}$ (B) $\frac{R_2}{R_1} = \frac{C_2}{C_1}, \quad \omega = \frac{1}{R_1C_1R_2C_2}$

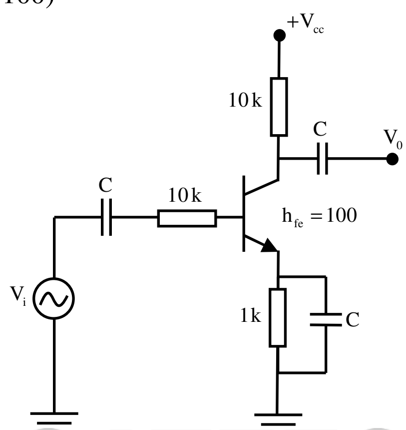
(C) $\frac{R_3}{R_4} = \frac{R_1}{R_2} + \frac{C_2}{C_1}, \quad \omega = \frac{1}{\sqrt{R_1C_1R_2C_2}}$ (D) $\frac{R_3}{R_4} + \frac{R_1}{R_2} = \frac{C_2}{C_1}, \quad \omega = \frac{1}{R_1C_1R_2C_2}$

Answer: (C)

Exp: When bridge is balanced, $z_1 z_4 = z_2 z_3$

$$\Rightarrow \frac{R_3}{R_4} = \frac{R_1}{R_2} + \frac{C_2}{C_1}, f = \frac{1}{2\pi\sqrt{R_1 R_2 C_1 C_2}}$$

23. The magnitude of the mid–band voltage gain of the circuit shown in figure is (assuming h_{fe} of the transistor to be 100)



(A) 1 (B) 10 (C) 20 (D) 100

Answer: (D)

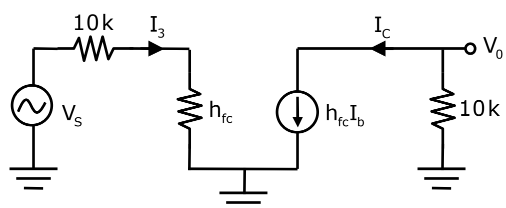
Exp: $A_{V_s} = \frac{V_o}{V_s}$

$$= \frac{-h_{fe} I_b (10k)}{I_b (10k) + I_b h_{ie}}$$

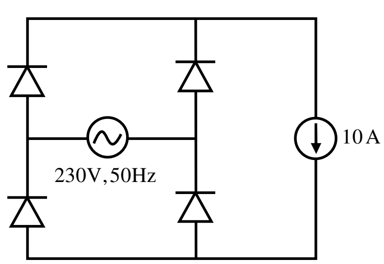
$$= \frac{-h_{fe}(10k)}{10k + h_{ie}}$$

$$A_{V_s} = \frac{-100 \times 10k}{10k} (\text{neglecting hie})$$

$$|A_{V_s}| = 100$$



24. The figure shows the circuit of a rectifier fed from a 230–V (rms), 50–Hz sinusoidal voltage source. If we want to replace the current source with a resistor so that the rms value of the current supplied by the voltage source remains unchanged, the value of the resistance (in ohms) is _______________ (Assume diodes to be ideal.)



Answer: 23Ω

Exp: $V_s = 230V, 50Hz$

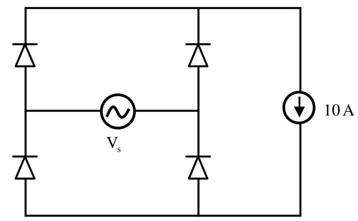
The rms volt of given

Rectifier $V_{or} = V_s$

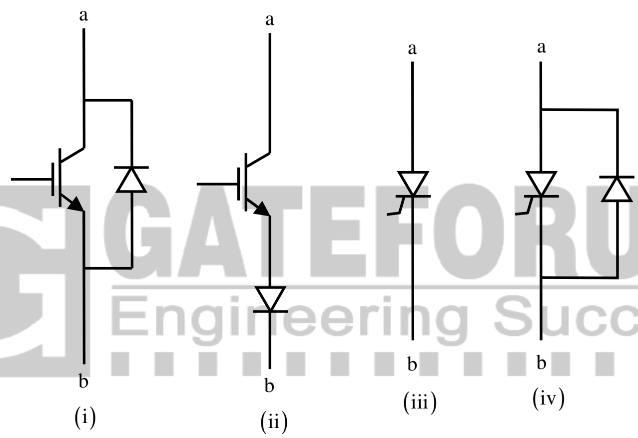
$\therefore V_{or} = 230V$

$$I_{or} = \frac{V_{or}}{R} \Rightarrow R = \frac{V_{or}}{I_{or}} = \frac{230}{10}$$

$\therefore R = 23\Omega$



25. Figure shows four electronic switches (i), (ii), (iii) and (iv). Which of the switches can block voltages of either polarity (applied between terminals 'a' and 'b') when the active device is in the OFF state?



(A) (i), (ii) and (iii) (B) (ii), (iii) and (iv)

(C) (ii) and (iii) (D) (i) and (iv)

Answer: (C)

Exp: Switch (i) blocks the voltage in only forward direction

Switch (ii) blocks the voltage in both forward and reverse directions

Switch (iii) blocks voltage in both direction

Switch (iv) blocks voltage in only forward direction

Hence Ans. is (C) because switch (i) & (ii) only satisfy the given requirement

Q. No. 26 – 55 Carry Two Marks Each

26. Let $g:[0,\infty) \to [0,\infty)$ be a function defined by $g(x) = x - [x]$, where $[x]$ represents the integer part of x. (That is, it is the largest integer which is less than or equal to x).

The value of the constant term in the Fourier series expansion of *g(x)* is ______________

Answer: 1/2

Exp: Clearly, g(x) is a periodic function with period '1'

consider, $g(x) = x - [x]$ for $0 < x < 1$

The constant term in the fourier series expansion of

$g(x)$ is $A_0 = \frac{a_0}{2} = \int_0^1 g(x)dx$

$$= \int_0^1 x\,dx - \int_0^1 [x]dx = \left(\frac{x^2}{2}\right)_0^1 - \int_0^1 (0)dx = \frac{1}{2}$$

27. A fair coin is tossed *n* times. The probability that the difference between the number of heads and tails is $(n-3)$ is

(A) 2^{-n} (B) 0 (C) ${}^{n}C_{n-3}2^{-n}$ (D) 2^{-n+3}

Answer: (B)

Exp: Let X = difference between the number of heads and tails.

Take $n = 2 \Rightarrow S = \{HH, HT, TH, TT\}$ and $X = -2, 0, 2$; Here, $n - 3 = -1$ is not possible

Take $n = 3 \Rightarrow S = \{HHH, HHT, HTH, HTT, THH, THT, TTH, TTT\}$ and $X = -3, -1, 1, 3$

Here $n - 3 = 0$ is not possible

Similarly, if a coin is tossed n times then the difference between heads and tails is $n-3$ is not possible

$\therefore$ required probability is 0

28. The line integral of function $F = yzi$, in the counterclockwise direction, along the circle $x^2 + y^2 = 1$ at $z = 1$ is

(A) -2π (B) $-\pi$ (C) π (D) 2π

Answer: (B)

Exp: $\text{Line integral} = \int_C \vec{F}.d\vec{r}$

$$= \int_C yzdx \qquad \begin{bmatrix} \text{C is circle } x^2 + y^2 = 1 \text{ at } Z = 1 \\ \Rightarrow x = \cos\theta, y = \sin\theta \text{ and } \theta = 0 \text{ to } 2\pi \end{bmatrix}$$

$$= \int_0^{2\pi} (\sin\theta)(1)(-\sin\theta d\theta)$$

$$= \int_0^{2\pi} \left(\frac{\cos 2\theta - 1}{2}\right) d\theta = \frac{1}{2}\left[\frac{\sin 2\theta}{2} - \theta\right]_0^{2\pi} = -\pi$$

29. An incandescent lamp is marked 40W, 240V. If resistance at room temperature $(26^\circ C)$ is 120Ω and temperature coefficient of resistance is $4.5 \times 10^{-3} / ^\circ C$, then its 'ON' state filament temperature in $^\circ C$ is approximately ________________

Answer: 2471

Exp: $P = 40W$

$V = 240V$

$$R_{lamp} = \frac{V^2}{P} = \frac{240^2}{40} = 1440\Omega$$

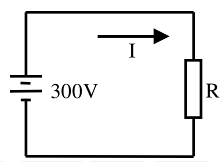
At $t = 26^{o}, R = 120\Omega, \alpha = 4.5\times10^{-3} / {}^{o}C$

$$R_{lamp} = R\left[1+\alpha\left(\theta_2 - \theta_1\right)\right]$$

$$1440 = 120\left[1+4.5\times10^{-3}\left[\theta_2 - 26\right]\right]$$

$$\boxed{\theta_2 = 2470.44^{o}C}$$

30. In the figure, the value of resistor R is $(25 + I/2)$ ohms, where I is the current in amperes. The current I is _______________



Answer: 10A

Exp: Given $R = \left(25 + \frac{I}{2}\right)$

$V = IR$

$$300 = I\left[25 + \frac{I}{2}\right]$$

$$\Rightarrow \quad I^2 + 50I - 600 = 0$$

$I = 10A\ 80 - 60A.$

The current 10A is correct based on the given direction.

31. In an unbalanced three phase system, phase current $I_a = 1\angle(-90^{o})$ pu, negative sequence current $I_{b2} = 4\angle(-150^{o})$ pu, zero sequence current $I_{C0} = 3\angle 90^{o}$ pu. The magnitude of phase current I_b in pu is

(A) 1.00 (B) 7.81 (C) 11.53 (D) 13.00

Answer: (C)

Exp:

$I_a = 1\underline{|-90}$ p.u

$I_{b2} = 4\underline{|-150}$ p.u

$I_{c0} = 3\underline{|90}$ p.u

$I_a = I_{a1} + I_{a2} + I_{a0}$

$\text{since } I_{b2} = \alpha I_{a2}$

$4\angle -150 = (1\angle 120)\, I_{a2}$

$I_{a2} = 4\angle -270$

$I_{a0} = I_{bo} = I_{co} = 3\angle 90°$

$I_{a1} = 1\angle -90 = I_{a1} + 4\angle -270 + 3\angle 90$

$I_{a1} = 8\angle -90$

$I_{b1} = \alpha^2 I_{a1} = (1\angle 240)(8\angle -90) = 8\angle +150$

$I_b = I_{b0} + I_{b1} + I_{b2} = 8\angle +150 + 4\angle -150 + 3\angle 90$

$= 11.53\angle +154.3 \text{ p.u}$

32. The following four vector fields are given in Cartesian co–ordinate system. The vector field which does not satisfy the property of magnetic flux density is

(A) $y^2 a_x + z^2 a_y + x^2 a_z$ (B) $z^2 a_x + x^2 a_y + y^2 a_z$

(C) $x^2 a_x + y^2 a_y + z^2 a_z$ (D) $y^2 z^2 a_x + x^2 z^2 a_y + x^2 y^2 a_z$

Answer: (C)

Exp: For magnetic fields $\nabla . B = 0$

By verification

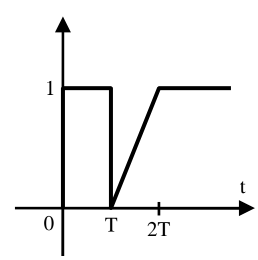
(a) $\nabla . B = (0) + 0$

(b) $\nabla . B = 0$

(c) $\nabla . B = 2x + 2y + 2z \neq 0$

So C is correct

33. The function shown in the figure can be represented as



(A) $u(t) - u(t-T) + \frac{(t-T)}{T} u(t-T) - \frac{(t-2T)}{T} u(t-2T)$

(B) $u(t) + \frac{t}{T} u(t-T) - \frac{t}{T} u(t-2T)$

(C) $u(t) - u(t-T) + \frac{(t-T)}{T} u(t) - \frac{(t-2T)}{T} u(t)$

(D) $u(t) + \frac{(t-T)}{T} u(t-T) - 2\frac{(t-2T)}{T} u(t-2T)$

Answer: (A)

Exp: $x(t) = u(t) - u(t-T) + \left(\frac{t-T}{T}\right) u(t-T) - \left(\frac{t-2T}{T}\right) u(t-2T)$

34. Let $X(z)=\frac{1}{1-z^{-3}}$ be the Z–transform of a causal signal x[n]. Then, the values of $x[2]$ and $x[3]$ are

(A) 0 and 0 (B) 0 and 1 (C) 1 and 0 (D) 1 and 1

Answer: (B)

Exp: Given $x(z)=\frac{1}{1-z^{-3}}$

$x(z)$ can be written as

$$=1+z^{-3}+z^{-6}+2^{-9}$$

$x[2]$ correspond to coefficient $z^{-2}=0$

$x[3]$ correspond to coefficient of $z^{-3}=1$

35. Let $f(t)$ be a continuous time signal and let $F(\omega)$ be its Fourier Transform defined by

$$F(\omega)=\int_{-\infty}^{\infty} f(t)e^{-j\omega t}dt$$

Define $g(t)$ by

$$g(t)=\int_{-\infty}^{\infty} F(u)e^{-jut}du$$

What is the relationship between $f(t)$ and $g(t)$?

(A) g(t) would always be proportional to f(t)

(B) g(t) would be proportional to f(t) if f(t) is an even function

(C) g(t) would be proportional to f(t) only if f(t) is a sinusoidal function

(D) g(t) would never be proportional to f(t)

Answer: (B)

Exp: We know the fourier transform relationship

$$F(\omega)=\int_{-\infty}^{\infty} f(t).e^{-j\omega t}dt$$

and $f(t)=\frac{1}{2\pi}\int_{-\infty}^{\infty} F(\omega)e^{jwt}d\omega$

ω can be replaced by u

$$f(t)=\frac{1}{2\pi}\int_{-\infty}^{\infty} F(u)e^{jut}du \qquad ....(1)$$

Now $g(t)=\int_{-\infty}^{\infty} F(u).e^{jut}du \qquad ....(2)$

replace t by $-t$ in (1)

$$f(-t)=\frac{1}{2\pi}\int_{-\infty}^{\infty} F(u)e^{-jut}du \qquad .....(3)$$

$$f(-t)=\frac{1}{2\pi}g(t)$$

if $f(t)=f(-t)[f(t) \text{ is even function}]$

$\Rightarrow g(t)=2\pi f(t)$

36. The core loss of a single phase, 230/115V, 50Hz power transformer is measured from 230 V side by feeding the primary (230V side) from a variable voltage variable frequency source while keeping the secondary open circuited. The core loss is measured to be 1050 W for 230V, 50Hz input. The core loss is again measured to be 500W for 138V, 30Hz input. The hysteresis and eddy current losses of the transformer for 230V, 50Hz input are respectively,

(A) 508 W and 542 W (B) 468 W and 582 W

(C) 498 W and 552 W (D) 488 W and 562 W

Answer: (A)

Exp: Given data, $1-\phi\frac{230}{115\,V}, 50\,Hz$

Care loss = 1050W at 230V, 50 Hz

Care loss = 500W at 138V, 30 Hz

4 In both cases $V/_f$ ratio is constant

Hence, $\underset{\text{CORE LOSS}}{\underset{\downarrow}{W_i}} = A.f + B.f^2 = W_n + W_e$

at $50\,Hz \Rightarrow 1050 = A(50) + B(50)^2$

at $30\,Hz \Rightarrow 500 = A(30) + B(30)^2$

$A = 10.167$

$B = 0.217$

$\therefore W_n$ at $50\,Hz = (10.167)\times 50 = 508\,W$

W_e at $50\,Hz = (0.217)\times(50)^2 = 542\,W$

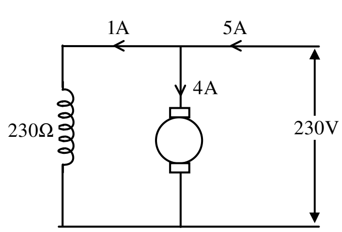
37. A 15kW, 230V dc shunt motor has armature circuit resistance of 0.4Ω and field circuit resistance of 230Ω. At no load and rated voltage, the motor runs at 1400 rpm and the line current drawn by the motor is 5 A. At full load, the motor draws a line current of 70A. Neglect armature reaction. The full load speed of the motor in rpm is ________________

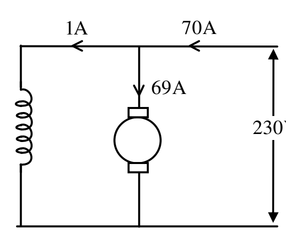
Answer: 1240 rpm.

Exp: Given 15kW, 230V . dc shunt motor

Armature resistance $R_a = 0.4\Omega$

Field Resistance, $R_{sh} = 230\Omega$





$\therefore E_{b1} = 230 - 4\times 0.4$
$= 228.4V$

$\therefore E_{b2} = 230 - 69\times 0.4$
$= 202.4V$

$$\therefore \frac{N_2}{N_1} = \frac{E_{b2}}{E_{b1}} \times \frac{\phi_1}{\phi_2}$$

$$= \frac{E_{b2}}{E_{b1}} \left(\because \text{Flux is constant} \right)$$

$$N_2 = 1400 \times \frac{202.4}{228.4} = 1240\,\text{rpm}$$

38. A 3 phase, 50 Hz, six pole induction motor has a rotor resistance of 0.1Ω and reactance of 0.92Ω. Neglect the voltage drop in stator and assume that the rotor resistance is constant. Given that the full load slip is 3%, the ratio of maximum torque to full load torque is

(A) 1.567 (B) 1.712 (C) 1.948 (D) 2.134

Answer: (C)

Exp: Given, $P = b,\ f = 50\text{Hz}$

$R_2 = 0.1\Omega,\ X_2 = 0.092\Omega$

$S_{fl} = 3\% = 0.03$

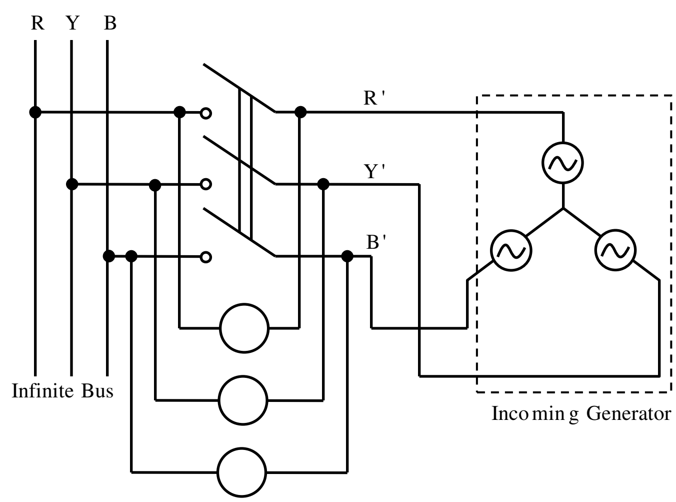
$$T_{max} = ?,\ \text{we know that} \Rightarrow \frac{T_{max}}{T_{fl}} = \frac{S_m^2 + S_{fl}^2}{2S_m S_{fl}}$$

$$\therefore \frac{T_{max}}{T_{fl}} = \frac{S_m^2 + S_{fl}^2}{2S_m S_{fl}}$$

$$\text{where } s_m = \frac{R_2}{x_2} = \frac{0.1}{0.92} = 0.108 = 0.03$$

$$\therefore \frac{T_{max}}{T_{fl}} = \frac{(0.108)^2 + (0.03)^2}{2(0.108)(0.03)} = 1.938 \simeq 1.94$$

39. A three phase synchronous generator is to be connected to the infinite bus. The lamps are connected as shown in the figure for the synchronization. The phase sequence of bus voltage is R–Y–B and that of incoming generator voltage is $R' - Y' - B'$.



It was found that the lamps are becoming dark in the sequence $L_a - L_b - L_c$. It means that the phase sequence of incoming generator is

(A) Opposite to infinite bus and its frequency is more than infinite bus

(B) Opposite to infinite bus but its frequency is less than infinite bus

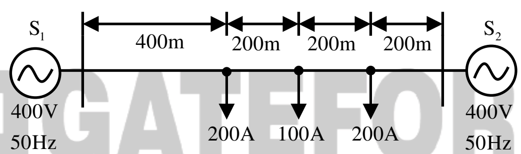
(C) Same as infinite bus and its frequency is more than infinite bus

(D) Same as infinite bus and its frequency is less than infinite bus

Answer: (A)

Exp: According to given connection of Lamp's. Tthey are becoming dark in the sequence L_a-L_b-L_c. Hence the phase sequences are different, and also the frequency is more than infinite bus.

40. A distribution feeder of 1km length having resistance, but negligible reactance, is fed from both the ends by 400V, 50Hz balanced sources. Both voltage sources S_1 and S_2 are in phase. The feeder supplies concentrated loads of unity power factor as shown in the figure.

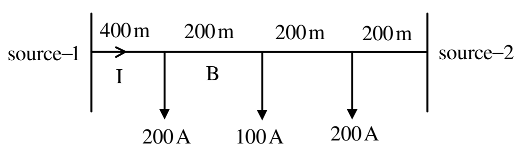


The contributions of S_1 and S_2 in 100A current supplied at location P respectively, are

(A) 75A and 25A
(B) 50A and 50A
(C) 25A and 75A
(D) 0A and 100A

Answer: (D)

Exp:



Let I be current supplied by source – 1

'r' be resistance/ length

$$400 = (400r)I + (200r)(I-200) + (200r)(I-300) + (200r)(I-500) + 400$$

$$0 = 400rI + 200rI - 40000r + 200rI - 60000 + 200rI - 100000r$$

$$100Ir = 20000r$$

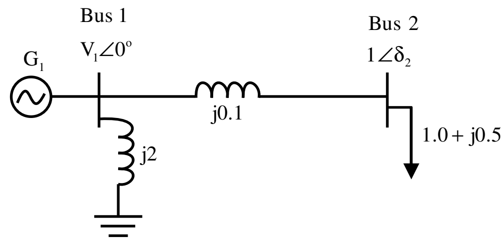
$$I = 200A$$

Current in branch- B is $I - 200 = 200 - 200 = 0$

4 point p, source-1 supplies 0A current

Source-2 supplies 100A current

41. A two bus power system shown in the figure supplies load of $1.0 + j0.5$ p.u.



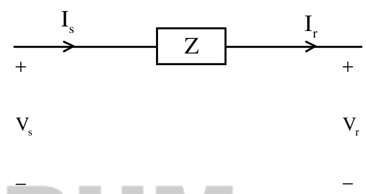
The values of V_1 in p.u. and δ_2 respectively are

(A) 0.95 and 6.00° (B) 1.05 and -5.44° (C) 1.1 and -6.00° (D) 1.1 and -27.12°

Answer: (B)

Exp:

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & j0.1 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0.1\angle 90 \\ 0 & 1 \end{bmatrix}$$



$$\begin{bmatrix} V_s \\ I_s \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix}\begin{bmatrix} V_r \\ I_r \end{bmatrix} \quad \begin{matrix} V_s = V_1\angle 0, \ B = 0.1\angle 90 \\ V_r = 1\angle\delta_2, \ A = 1\angle 0 \end{matrix}$$

$$V_s = AV_r + BI_r$$

$$I_r = \frac{V_s}{B} - \frac{A}{B}V_r = \frac{V_1\angle 0}{0.1\angle 90}\left(1(\delta_2)\right)$$

$$= 10V_1\angle{-90} - 10\angle\delta_2 - 90$$

$$I_r^* = 10V_1\angle 90 - 10\angle 90 - \delta_2$$

$$S_r = P_r + jQ_r = V_r I_r^* = \left(1\angle\delta_2\right)\left[10V_1\angle 90 - \delta_2\right]$$

$$= 10V_1\angle 90 + \delta_2 - 10\angle 90$$

$$= 10\left[V_1\cos(90+\delta_2) + jV_1\sin(90+\delta_2)\right] - j10$$

$$= 10[-V_1\sin\delta_2 + jV_1\cos\delta_2] - j10$$

$$= [-10V_1\sin\delta_2] + j[10V_1\cos\delta_2 - 10]$$

Given $S_r = 1 + j0.5$

$$\left.\begin{matrix} -10V_1\sin\delta_2 = +1 \longrightarrow 10V_1\sin\delta_2 = -1 \\ 10V_1\cos\delta_2 - 10 = 0.5 \longrightarrow 10V_1\cos\delta_2 = 10.5 \end{matrix}\right\} \tan\delta_2 = \frac{-1}{10.5} \Rightarrow \delta_2 = -5.44$$

From $10V_1\sin\delta_2 = -1$

$$10V_1\sin[5.44] = -1$$

$$V_1 = 1.054$$

42. The fuel cost functions of two power plants are

Plant $P_1 : C_1 = 0.05 Pg_1^2 + APg_1 + B$

Plant $P_2 : C_2 = 0.10 Pg_2^2 + 3APg_2 + 2B$

Where, P_{g1} and P_{g2} are the generated powers of two plants, and *A* and *B* are the constants. If the two plants optimally share 1000 MW load at incremental fuel cost of 100 Rs/MWh, the ratio of load shared by plants P_1 and P_2 is

(A) 1:4 (B) 2:3 (C) 3:2 (D) 4:1

Answer: (D)

Exp: $C_1 = Pg_1^2(0.05) + APg_1 + B$ $\quad Pg_1 + Pg_2 = 1000$

$C_2 = 0.1Pg_2^2 + 3A\,Pg_2 + B$ $\quad \frac{dc_1}{dpg_1} = \frac{dc^2}{dp_2} = 1000$

$$\frac{dc_1}{dpg_1} = 2\times 0.05 Pg_1 + A = 100$$

$$\frac{dc_2}{dpg_2} = 2\times 0.1 Pg_2 + 3A = 100$$

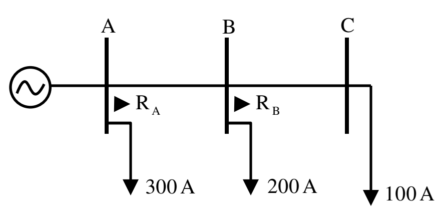
$$\left.\begin{array}{l} 0.1Pg_1 + A = 100 \\ 0.2Pg_2 + 3A = 100 \end{array}\right\} \begin{array}{l} 0.3Pg_1 - 0.2Pg_2 = 200 \\ Pg_1 + Pg_2 = 1000 \end{array}$$

Solving, $Pg_1 = 800\,MW$

$Pg_2 = 200\,MW$

$$\frac{Pg_1}{Pg_2} = \frac{4}{1}$$

43. The over current relays for the line protection and loads connected at the buses are shown in the figure



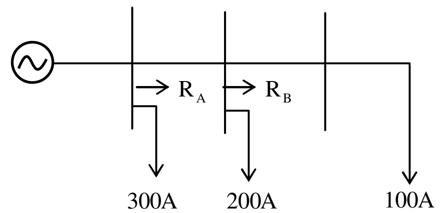
The relays are IDMT in nature having the characteristic

$$t_{op} = \frac{0.14 \times \text{Time Multiplier Setting}}{(\text{Plug Setting Multiplier})^{0.02} - 1}$$

The maximum and minimum fault currents at bus B are 2000 A and 500 A respectively. Assuming the time multiplier setting and plug setting for relay R_B to be 0.1 and 5A respectively, the operating time of R_B (in seconds) is _______________

Answer: 0.23

Exp:



$$t_{op} = \frac{0.14 \times T.M.S}{(P.S.M)^{0.02} - 1}$$

For Relay B

T.M.S = 0.1

P.S.M = 5A

$$I_{fault(max)} = 2000A$$

$$I_{fault(min)} = 500A$$

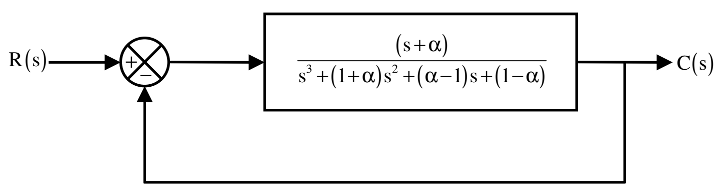
Maximum load current at C = 100A

For a setting current of 1A, plug setting is 100%

$$PSM = \frac{\text{Max fault current}}{\text{CT ratio} \times \text{current setting}} = \frac{2000}{100 \times 1} = 20$$

$$t_{op} = \frac{0.14 \times T.M.S}{(P.S.M)^{0.02} - 1} = \frac{0.14 \times 0.1}{(20)^{0.02} - 1} = 0.227 \approx 0.23\text{sec}$$

44. For the given system, it is desired that the system be stable. The minimum value of α for this condition is ________________



Answer: 0.618

Exp: The characteristic equation is 1 + G(s) = 0

$$1 + \frac{(s+\alpha)}{s^3 + (1+\alpha)s^2 + (\alpha-1)s + (1-\alpha)} = 0$$

$$\Rightarrow s^3 + (1+\alpha)s^2 + \alpha s + 1 = 0$$

For stable system α should be 0.618

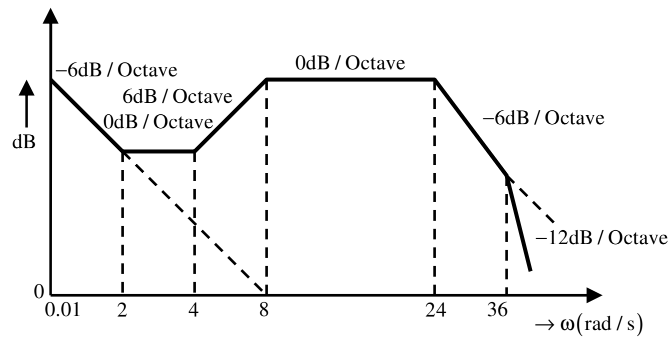
By R- H criteria, $(1+\alpha)\alpha > 1.$

$$(\alpha^2 + \alpha - 1) > 0$$

$$\alpha = 0.618 \ \& \ -0.618$$

45. The Bode magnitude plot of the transfer function $G(s)=\dfrac{K(1+0.5s)(1+as)}{s\left(1+\frac{s}{8}\right)(1+bs)\left(1+\frac{s}{36}\right)}$ I shown below:

Note that $-6dB/octave=-20dB/decade$. The value of $\dfrac{a}{bK}$ is ________________



Answer: 0.75

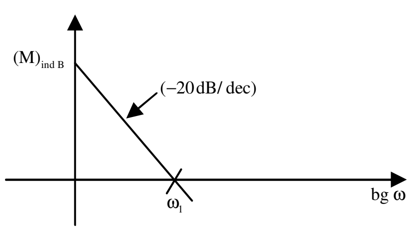
Exp: By observing the magnitude plot,

$$G(s)=\frac{K\left[1+\frac{S}{2}\right]\left[1+\frac{S}{4}\right]}{S\left[1+\frac{S}{8}\right]\left[1+\frac{S}{24}\right]\left[1+\frac{S}{36}\right]}$$

By comparing with given transfer function,

$a=\frac{1}{4};\quad b=\frac{1}{24}.$

For finding K:



$K=(\omega_1)^n$: where n is no.of poles from the given plot; $K=(8)^1$

i.e. $K=8$

So, $\dfrac{a}{bk}=\dfrac{1/4}{1/24 \cdot 8}\Rightarrow 0.75$

46. A system matrix is given as follows

$$A = \begin{bmatrix} 0 & 1 & -1 \\ -6 & -11 & 6 \\ -6 & -11 & 5 \end{bmatrix}$$

The absolute value of the ratio of the maximum eigen value to the minimum eigen value is ________

Answer: 1/3

Exp: Characteristic equation is $|A - \lambda I| = 0$

$$\text{i.e.,} \begin{vmatrix} -\lambda & 1 & -1 \\ -6 & -11-\lambda & 6 \\ -6 & -11 & 5-\lambda \end{vmatrix} = 0$$

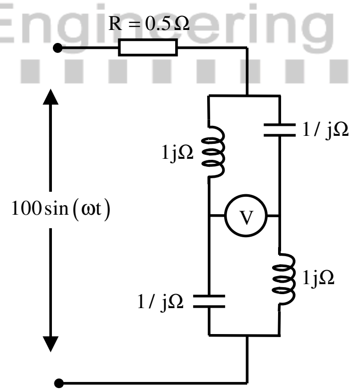
$\Rightarrow \lambda^3 + 6\lambda^2 + 11\lambda + 6 = 0$

$\Rightarrow \lambda = -1, -2, -3$ are the eigen values of A

$\lambda_{max} = -1$ and $\lambda_{min} = -3$

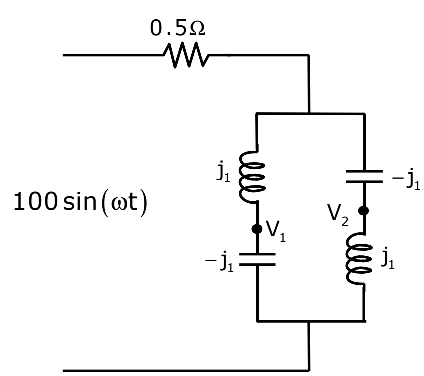
$$\therefore \left|\frac{\lambda_{max}}{\lambda_{min}}\right| = \left|\frac{-1}{-3}\right| = \frac{1}{3}$$

47. The reading of the voltmeter (rms) in volts, for the circuit shown in the figure is ________



Answer: 142

Exp: Net $z = j_1 - j_1 = 0$, acts as short circuit



$$i(t) = \frac{100\sin(\omega t)}{0.5} = 200\sin(\omega t)$$

$$i_{V_1} = \frac{i(t)}{2} = 100\sin(\omega t) = i_{V_2}$$

$V_1 = (-j_1)100\sin(\omega t)$

$V_2 = (j_1)100\sin(\omega t)$

$V = V_1 - V_2 = -j200\sin\omega t$

$$V_{RMS} = \frac{V_m}{\sqrt{2}} = \frac{200}{\sqrt{2}} = 141.42 \text{ Volts}$$

48. The dc current flowing in a circuit is measured by two ammeters, one PMMC and another electrodynamometer type, connected in series. The PMMC meter contains 100 turns in the coil, the flux density in the air gap is $0.2\ \text{Wb}/\text{m}^2$, and the area of the coil is $80\,\text{mm}^2$. The electrodynamometer ammeter has a change in mutual inductance with respect to deflection of 0.5 mH/deg. The spring constants of both the meters are equal. The value of current, at which the deflections of the two meters are same, is ________________

Answer: 3.2

Exp: $\rightarrow$ Given pmmc and electro dynamometer type meters are connectsed in series.

$\rightarrow$ Both meters are carrying same current. And both are having same spring constants.

$\rightarrow$ Both are reflecting same readings. i.e. we should equate the reflecting torques.

For pmmc, T def = BAN.I.

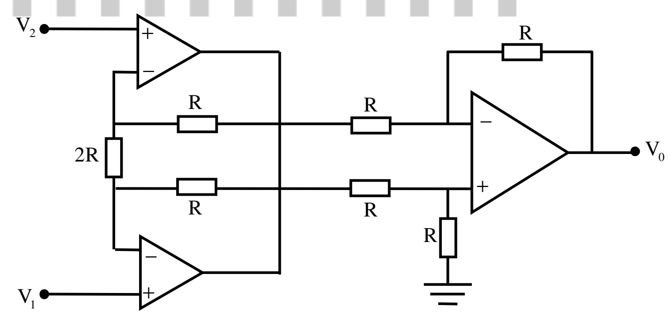
$$\text{Electrodynometer, } T\,\text{def} = I^2.\frac{dM}{d\theta}$$

$$BAN.I = I^2.\frac{dm}{d\theta}$$

$$(0.2)\times\left(80\times10^{-6}\right)\times100\times I = I^2\times0.5\times10^{-3}$$

$$\Rightarrow \boxed{I = 3.2}$$

49. Given that the op–amps in the figure are ideal, the output voltage V_0 is



(A) $(V_1 - V_2)$

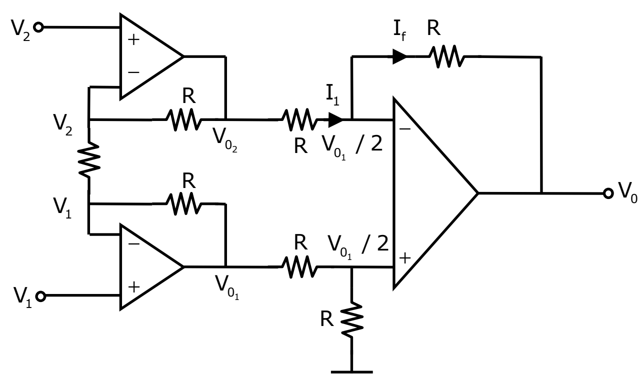
(B) $2(V_1 - V_2)$

(C) $(V_1 - V_2)/2$

(D) $(V_1 + V_2)$

Answer: (B)

Exp:



$$\frac{V_2 - V_1}{2R} + \frac{V_2 - V_{02}}{R} = 0 \qquad \frac{V_1 - V_2}{2R} + \frac{V_1 - V_{01}}{R} = 0$$

$$\Rightarrow V_{0_2} = \frac{3V_2 - V_1}{2} ....(1) \qquad \Rightarrow V_{01} = \frac{3V_1 - V_2}{2} ....(2)$$

$$\because I_1 = I_f$$

$$\frac{\left(V_{02} - \frac{V_{01}}{2}\right)}{R} = \frac{\left(\frac{V_{01}}{2} - V_0\right)}{R}$$

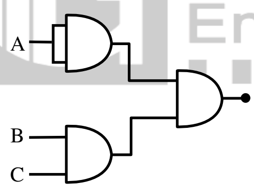
$$\Rightarrow V_0 = V_{01} - V_{02} = \left(\frac{3V_1 - V_2}{2}\right) - \left(\frac{3V_2 - V_1}{2}\right) \quad \text{from}(1) \,\&\, (2)$$

$$V_0 = 2(V_1 - V_2)$$

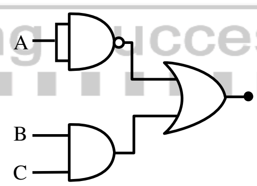
50. Which of the following logic circuits is a realization of the function F whose Karnaugh map is shown in figure.

C \ AB	00	01	11	10
0	1	1		
1		1	1	

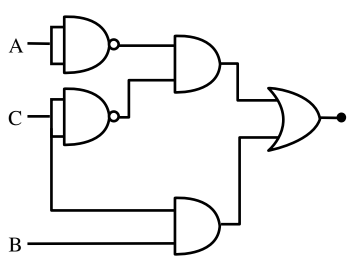
(A)



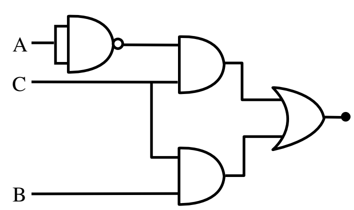
(B)



(C)

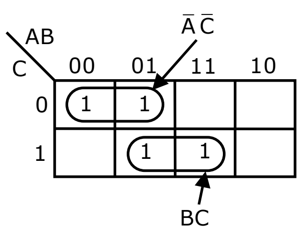


(D)



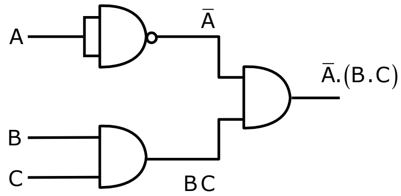
Answer: (C)

Exp:

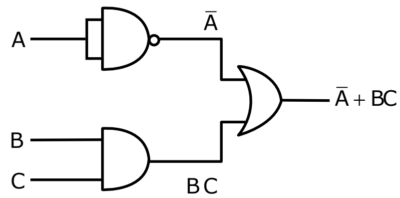


$$F = \bar{A}\,\bar{C} + BC$$

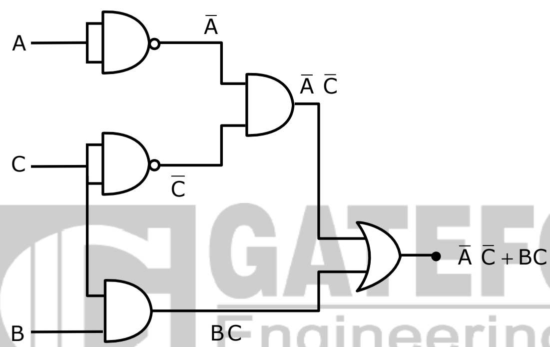
(A)



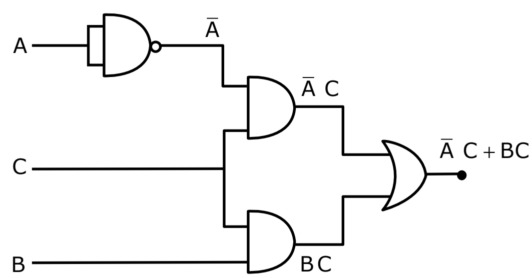
(B)



(C)

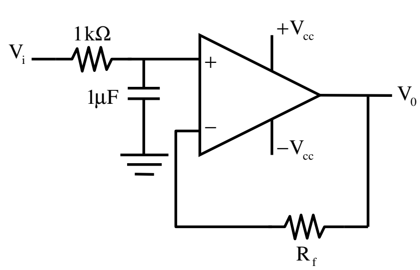


(D)

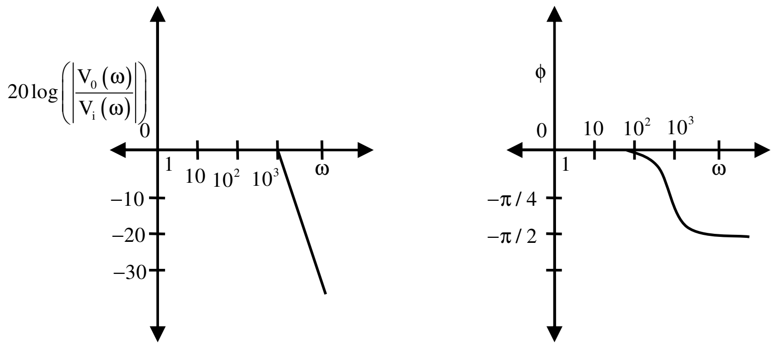


Among all the options, option (C) is matching with function $F=\bar{A}\,\bar{C}+BC$

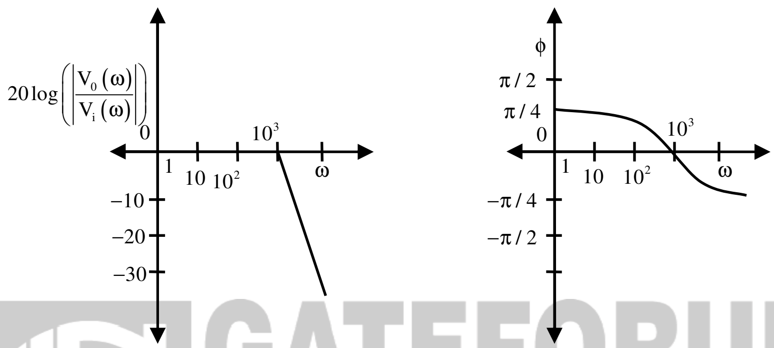
51. In the figure shown, assume the op–amp to be ideal. Which of the alternatives gives the correct Bode plots for the transfer function $\dfrac{V_0(\omega)}{V_1\omega}$?



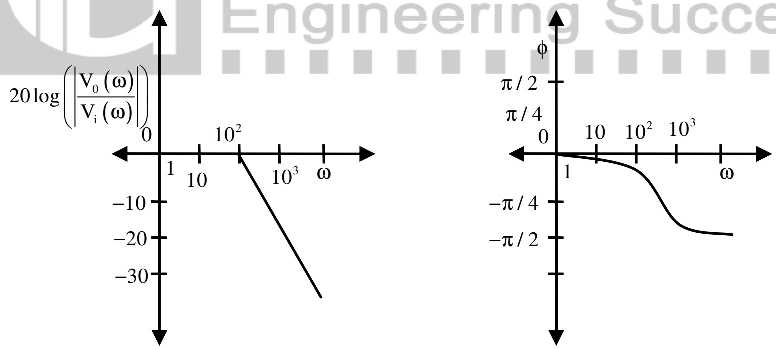
(A)


$20\log\left(\left|\frac{V_0(\omega)}{V_i(\omega)}\right|\right)$
0
1
10
10^2
10^3
ω
−10
−20
−30
ϕ
0
10
10^2
10^3
1
ω
$-\pi/4$
$-\pi/2$

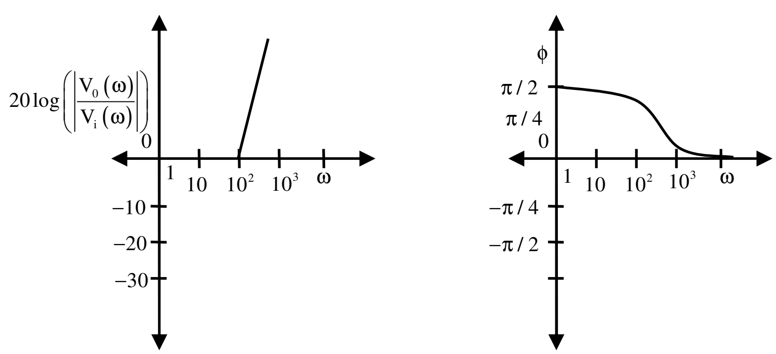
(B)


$20\log\left(\left|\frac{V_0(\omega)}{V_i(\omega)}\right|\right)$
0
10^3
1
10
10^2
ω
−10
−20
−30
ϕ
$\pi/2$
$\pi/4$
0
10^3
1
10
10^2
ω
$-\pi/4$
$-\pi/2$

(C)

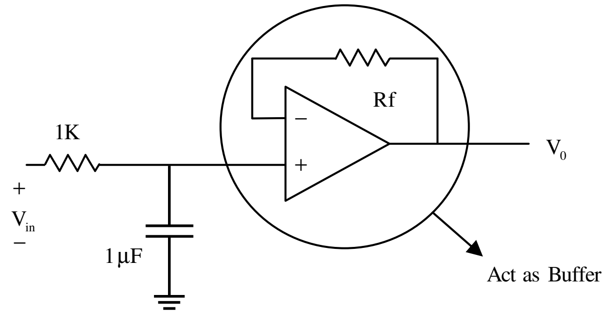

$20\log\left(\left|\frac{V_0(\omega)}{V_i(\omega)}\right|\right)$
0
10^2
1
10
10^3
ω
−10
−20
−30
ϕ
$\pi/2$
$\pi/4$
0
10
10^2
10^3
1
ω
$-\pi/4$
$-\pi/2$

(D)


$20\log\left(\left|\frac{V_0(\omega)}{V_i(\omega)}\right|\right)$
0
1
10
10^2
10^3
ω
−10
−20
−30
ϕ
$\pi/2$
$\pi/4$
0
1
10
10^2
10^3
ω
$-\pi/4$
$-\pi/2$

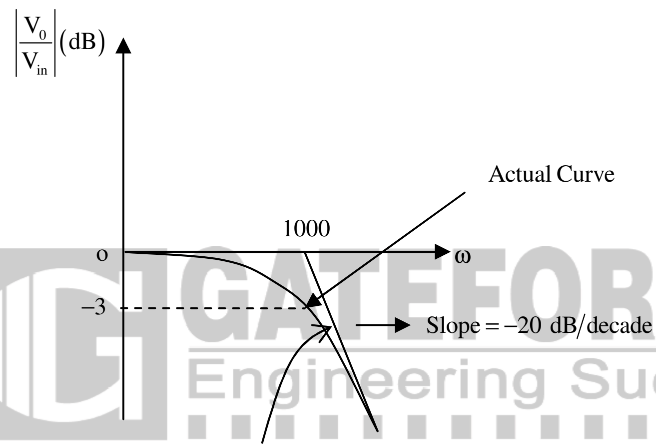
Answer: (A)

Exp:



The given circuit is LPF (Low Pass Filter)

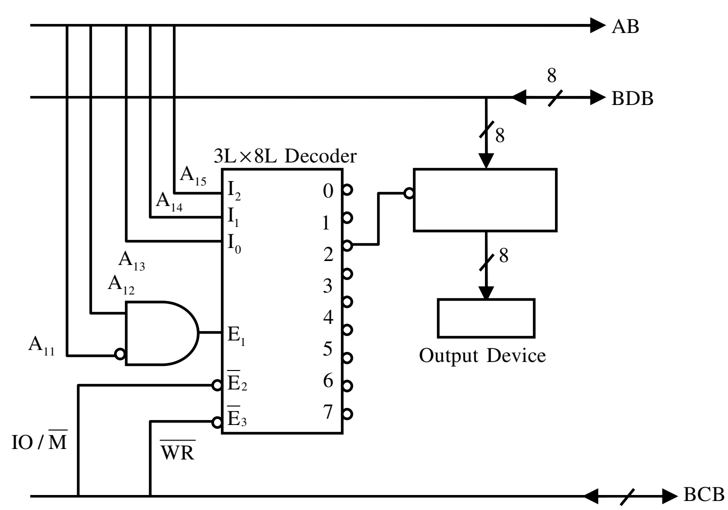
$$\frac{V_0}{V_{in}}=\frac{1}{1+SCR}=\frac{1}{1+j\omega\left(10^{3}\right)\left(10^{-6}\right)}=\frac{1}{1+j\omega\left(10^{-3}\right)}=\frac{1000}{1000+j\omega}=\frac{1}{1+\frac{S}{1000}}$$



Corner frequency is at $\omega=1000$

Low frequency gain=1{ $\omega=0$}

52. An output device is interfaced with 8–bit microprocessor 8085A. The interfacing circuit is shown in figure



The interfacing circuit makes use of 3 Line to 8 Line decoder having 3 enable lines $E_1, \bar{E}_2, \bar{E}_3$. The address of the device is

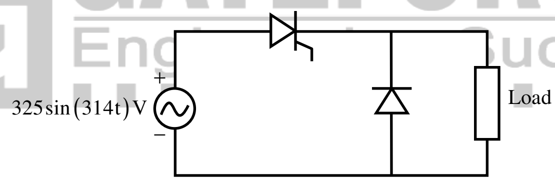
(A) 50_H (B) 500_H (C) $A0_H$ (D) $A000_H$ s

Answer: (B)

Exp: To enable $3L\times 8L$ decoder, three enable lines E_1 (which is connected as an output of AND-gate) should be HIGH and $\bar{E}_2$ and $\bar{E}_3$ should be active low, it means $\frac{I_0}{\bar{m}}$ should be active low which is indicating that it is memory mapped I/O interfacing. So, address of the device will be in 16-bits. To select output port through decoder 2nd line the status of $A_{15}(I_2)A_{14}(I_1)A_{13}(I_0)=010$ and to enable decoder through E_1 enable line $A_{12}=1$ and $A_{11}=0$ and by default as a starting address other address lines $(A_{10}......A_0)$ should be zero .So, overall port address is

$$\begin{matrix} A_{15} & A_{14} & A_{13} & A_{12} & A_{11} & A_{10} & A_9 & A_8 & A_7 & A_6 & A_5 & A_4 & A_3 & A_2 & A_1 & A_0 & \\ 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & =5000H \end{matrix}$$

53. The figure shows the circuit diagram of a rectifier. The load consists of a resistance 10Ω and an inductance 0.05H connected in series. Assuming ideal thyristor and ideal diode, the thyristor firing angle (in degree) needed to obtain an average load voltage of 70V is ______________

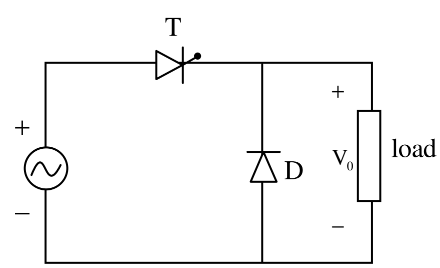


Answer: $\alpha = 69.3°$

Exp: $V_o = 70v$; Load, $R = 10\Omega$; $L = 0.05H$

Firing angled = ?

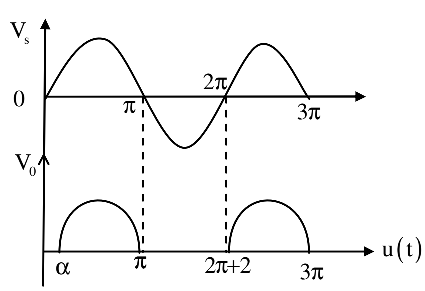
The o/p volt of given converter is



$$V_0 = \frac{V_m}{2\pi}(1+\cos\alpha)$$

$$70 = \frac{525}{2\pi}(1+\cos\alpha)$$

$$\alpha = 69.3°$$



54. Figure (i) shows the circuit diagram of a chopper. The switch S in the circuit in figure (i) is switched such that the voltage v_D across the diode has the wave shape as shown in figure (ii). The capacitance C is large so that the voltage across it is constant. If switch S and the diode are ideal,
the peak to peak ripple (in A) in the inductor current is ______________

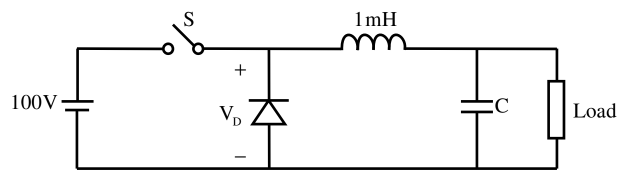


Figure (i)

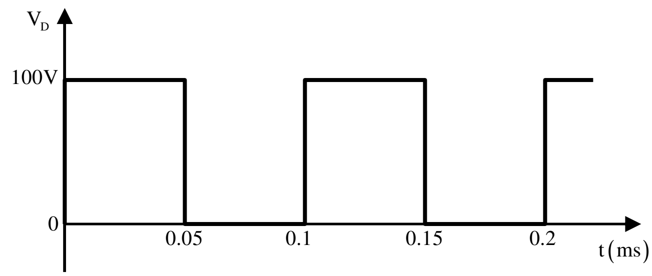


Figure (ii)

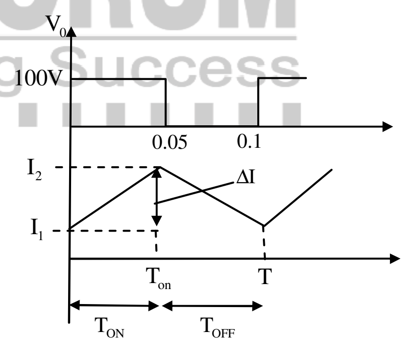
Answer: 2.5 A

Exp: Peak to peak ripple in inductor current in

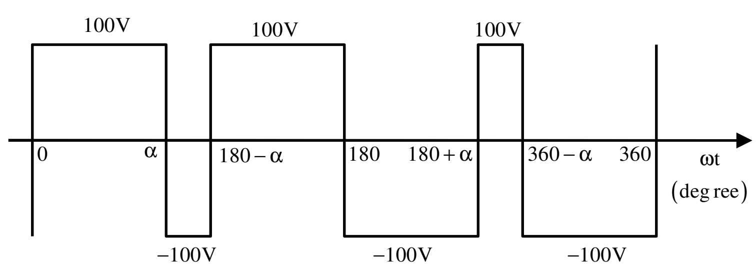
$$\Delta I = \frac{V_s - V_o}{L} T_m$$

$$= \frac{100 - \left(100 \times \frac{0.05}{0.1}\right)}{1 \times 10^{-3}} \times 0.05 \times 10^{-3}$$

$$= 50 \times 0.05 \Rightarrow \Delta I = 2.5\,A$$



55. The figure shows one period of the output voltage of an inverter. α should be chosen such that $60^o < \alpha < 90^o$. If rms value of the fundamental component is 50V, then α in degree is ______________



Answer: 76 to 77

Exp: $b_1 = \frac{4}{\pi} V_s \left[\int_0^{\alpha} \sin\theta d\theta - \int_{\alpha}^{\frac{\pi}{2}} \sin\theta d\theta \right]$

$$= \frac{4V_s}{\pi}[1 - \cos\alpha - \cos\alpha + 0]$$

$$= \frac{4V_s}{\pi}[1 - 2\cos\alpha]$$

$$\text{RMS Value of } V_{01} = \frac{4V_s}{\pi\sqrt{2}}(1 - 2\cos\alpha)$$

$$\Rightarrow 50 = \frac{400}{\pi\sqrt{2}}(1 - 2\cos\alpha)$$

$$\alpha = 77.15^{\circ}$$