IES MASTER

Institute for Engineers (IES/GATE/PSUs)

UPPSC 2020

Assistant Engineer
Prelims Exam
Electrical Engineering
Paper-I
Detailed Solution (SET-C)

Exam Date - 13th December   Time - 09:00 AM - 11:30 AM

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UPPSC-AE-2020
Detailed Solution
Electrical Engineering-I

SET - C

1. 'पवन' शब्द का सन्धि-विच्छेद है

(a) पौ+अन (b) पो+अन

(c) प+अवन (d) प+वन

Ans. (b)

2. इनमें से शुद्ध वर्तनी का रूप है

(a) निरझरणी (b) निरझरिणी

(c) निर्झरिणी (d) निर्झरणी

Ans. (c)

3. निम्नलिखित में से एक शब्द में से उपसर्ग का प्रयोग नहीं हुआ है, वह शब्द है

(a) सहज (b) अनुभव

(c) संचार (d) नयन

Ans. (a)

4. इनमें से 'अनघ' का विलोम शब्द है

(a) निरघ (b) अघी

(c) कृती (d) सनघ

Ans. (b)

5. नीचे दिये गये वाक्यांश और उसके लिए प्रयुक्त होने वाले एक शब्द का एक युग्म गलत है, वह है

(a) उत्तराधिकार में प्राप्त सम्पत्ति-धरोहर

(b) जिसे प्रमाण द्वारा सिद्ध न किया जा सके-अप्रमेय

(c) सीमा का अनुचित रूप से किया गया उल्लघंन-अतिक्रमण

(d) पूरब और उत्तर (दिशा) के बीच का कोना-ईशान

Ans. (a)

6. इनमें से 'पक्षी' शब्द का पर्यायवाची नहीं है

(a) पिशुन (b) विहंग

(c) शकुनि (d) द्विज

Ans. (a)

7. निम्नलिखित में से 'महीसुर' शब्द का अर्थ है

(a) पृथ्वी का रक्षक (b) महिषासुर

(c) राक्षस (d) ब्राह्मण

Ans. (a)

8. निम्नलिखित में से तत्सम शब्द है

(a) विवाह (b) ईख

(c) खीर (d) गिद्ध

Ans. (a)

9. 'ने+अन' = 'नयन' में सन्धि है

(a) यण सन्धि (b) गुण सन्धि

(c) अयादि सन्धि (d) वृद्धि सन्धि

Ans. (c)

10. निम्नलिखित में से शुद्ध वर्तनी का शब्द है

(a) उज्ज्वल (b) उज्जवल

(c) उजवल (d) उज्वल

Ans. (a)

11. 'बुद्धिहीन' शब्द व्याकरण की दृष्टि से इनमें से किस संवर्ग में है?

(a) संज्ञा (b) सर्वनाम

(c) विशेषण (d) क्रिया

Ans. (c)

12. इनमें से दन्त्य ध्वनियाँ हैं

(a) च, छ, ज, झ (b) प, फ, ब, भ

(c) त, थ, द, ध (d) ट, ठ, ड, ढ

Ans. (c)

13. इनमें से एक वाक्य शुद्ध है, वह है

(a) मेरा प्राण संकट में है।

(b) सोमवार को रेलवे के कई कर्मचारी गिरफ्तार हुए।

(c) अपराधी को मृत्युदंड की सजा दी गयी है।

(d) महादेवी वर्मा छायावाद की प्रसिद्ध कवयित्री हैं।

Ans. (d)

14. इनमें से व्यंजन सन्धि आधारित शब्द है

(a) अन्वेषण (b) उद्धार

(c) लघूर्मि (d) पुरोहित

Ans. (b)

15. 'चौराहा' शब्द में समाप्त है

(a) तत्पुरुष (b) बहुव्रीहि

(c) अव्ययीभाव (d) द्विगु

Ans. (d)

16. 'निवृत्ति' शब्द का विलोम है

(a) सद्वृत्ति (b) सुवृत्ति

(c) प्रवृत्ति (d) कुवृत्ति

Ans. (c)

17. निम्नलिखित में से 'शारदा' का पर्यायवाची शब्द है

(a) कमला (b) कौमुदी

(c) वारुणी (d) गिरा

Ans. (d)

18. 'मृत्यु के इच्छुक'-इस वाक्यांश के लिए एक शब्द है

(a) मुमुक्षा (b) मुमूर्षु

(c) मुमूर्षा (d) मुमुक्षु

Ans. (b)

19. 'चीनांशुक' शब्द का अर्थ है

(a) तंतु (b) रेणु

(c) रेशम (d) चीनी मिट्टी

Ans. (c)

20. निम्नलिखित में से तद्भव शब्द है

(a) वानर (b) तेल

(c) पीत (d) घोटक

Ans. (b)

21. अनेकार्थक शब्द 'सारंग' का निम्नलिखित में से एक अर्थ नहीं है

(a) भौंरा (b) कामदेव

(c) तलवार (d) ज्योतिषी

Ans. (d)

22. 'अंदर-अंदर कड़ाही में गुड़ पगना' - इस मुहावरे का सही अर्थ है

(a) ज्ञान होना

(b) गुप्त मंत्रणा होना

(c) स्वसीमित होना

(d) किसी काम न आना

Ans. (b)

23. निम्नलिखित में से शुद्ध वर्तनी का शब्द है

(a) अनाधिकार (b) रचइता

(c) सहस्र (d) संग्रहीत

Ans. (c)

24. समास–योजना की दृष्टि से इनमें से एक अशुद्ध युग्म है

(a) सतसई – द्विगु समास

(b) तुलसीकृत – तत्पुरुष समास

(c) मंदोदरी – बहुव्रीहि समास

(d) मरणासन्न – अव्वयीभाव समास

Ans. **(d)**

25. अलग होने के अर्थ में 'से' कारक–चिन्ह का प्रयोग होता है

(a) अपादान कारक में

(b) करण कारक में

(c) करण कारक तथा अपादान दोनों मे

(d) सम्बन्ध कारक में

Ans. **(a)**

26. For the input-output characteristic of amplifier shown in figure below the voltage gain is

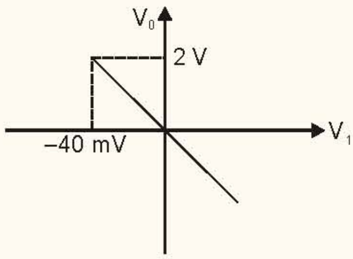


Figure: Typical input-output characteristic of inverting amplifiers.

(a) A = 50 (b) A = – 50

(c) A = 0.08 (d) A = – 0.08

Ans. **(b)**

Sol. $A_V = \frac{2}{-40\times10^{-3}} = -50$

27. In a crystal oscillator, a crystal has thickness of t. If you reduce t by 1%, what happens to the frequency 'f' ?

(a) f will increase by 2%

(b) f will decrease by 2%

(c) f will increase by 1%

(d) f will decrease by 1%

Ans. **(d)**

Sol. $f \propto \frac{1}{2\pi\sqrt{LC}}$

$\because \quad C = \frac{\varepsilon_o A}{d}$

$f_1 \propto \sqrt{d_1}$; d = thickness

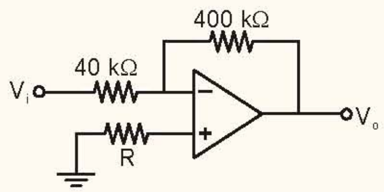
If thickness is reduced by 1%

$f_2 \propto \sqrt{0.99 d_1}$

$f_2 \propto 0.994\sqrt{d_1}$

F decrease by 1%

28. For the circuit shown in figure below the value of $Av = \frac{V_o}{V_i}$ is

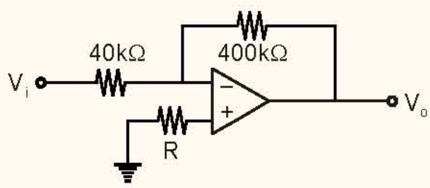


(a) –10 (b) 10

(c) –11 (d) 11

Ans. **(a)**

Sol.



Above circuit is inverting amplifier, so A_V is

$A_V = \frac{V_o}{V_i} = -\frac{400K}{40K} = -10$

29. For an electric field $E = E_0 \sin\omega t$, what is the phase difference between the conduction current and displacement current ?

(a) 0° (b) 45°

(c) 90° (d) 180°

Ans. **(c)**

Sol. Conduction current in phase of electric field displacement current

$$I_D = \frac{\partial D}{\partial t} = \varepsilon\frac{\partial E}{\partial t} = E_0 \varepsilon \cos\omega t$$

So, phase difference between the conduction current and displacement current is 90°.

30. Match List-I and List-II and select the correct answer using the codes.

List-I	**List-II**
A. Continuity equation	1. $\nabla \times \vec{H} = \vec{J} + \frac{\partial \vec{D}}{\partial t}$
B. Ampere's Law	2. $\vec{J} = \frac{\partial \vec{D}}{\partial t}$
C. Displacement current	3. $\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$
D. Faraday's Law	4. $\nabla \times \vec{J} = -\frac{\partial \rho_v}{\partial t}$

Codes :

	A	B	C	D
(a)	4	3	2	1
(b)	4	1	2	3
(c)	2	3	4	1
(d)	2	1	4	3

Ans. **(b)**

Sol. Continuity equation, $\nabla \times \vec{J} = -\frac{\partial \rho_V}{\partial t}$

Ampere's law, $\nabla \times \vec{H} = \vec{J} + \frac{\partial \vec{D}}{\partial t}$

Displacement current, $\vec{J} = \frac{\partial \vec{D}}{\partial t}$

Faraday's law, $\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$

31. List-II gives Mathematical Expressions for the variables given in List-I. Match List-I with List-II and select the correct answer using the codes.

List-I

A. Intrinsic impedance

B. Velocity of wave propagation

C. Skin depth

D. Attenuation constant

List-II

1. $\frac{1}{\sqrt{\mu\varepsilon}}$ 2. $\sqrt{\mu/\varepsilon}$

3. $\frac{1}{\sqrt{\mu f \pi \sigma}}$ 4. $\frac{1}{f\sqrt{\mu}\,\omega}$

5. $\sqrt{\omega}\,\mu\sigma$

Codes :

	A	B	C	D
(a)	1	2	3	4
(b)	2	1	4	5
(c)	2	1	3	5
(d)	1	2	5	3

Ans. **(c)**

Sol. Intrinsic impedance = $\sqrt{\frac{\mu}{\varepsilon}}$

Velocity of wave propagation = $\frac{1}{\sqrt{\mu\varepsilon}}$

Skin depth = $\frac{1}{\sqrt{\mu F \pi \sigma}}$

Attenuation constant = $\sqrt{\omega}\,\mu\sigma$

32. The ratio of charge stored by two metallic spheres raised to the same potential is 6.

The ratio of the surface areas of the sphere is

(a) 6 (b) 1/6

(c) 36 (d) $\frac{1}{\sqrt{6}}$

Ans. **(c)**

Sol. Same sphere potential

$$\frac{Q_1}{4\pi\varepsilon_1 R_1} = \frac{Q_2}{4\pi\varepsilon_0 R_2}$$

$$\frac{R_1}{R_2} = \frac{Q_1}{Q_2} = 6$$

Area of sphere = $4\pi R^2$

$$\frac{A_1}{A_2} = \left(\frac{R_1}{R_2}\right)^2 = 36$$

33. In cylindrical co-ordinates

$$\frac{1}{\rho}\frac{\partial}{\partial \rho}\left(\rho\frac{\partial V}{\partial \rho}\right) + \frac{1}{\rho^2}\frac{\partial^2 V}{\partial \phi^2} = 0 \text{ is}$$

(a) Laplace's equation

(b) Poisson's equation

(c) Euler's equation

(d) None of the above

Ans. **(a)**

34. Which of the following instruments are capable of serving as transfer instruments

(a) Moving Iron

(b) Moving coil

(c) Electro dynamometer

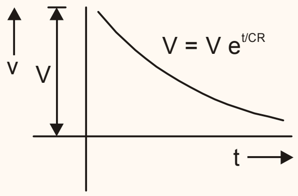
(d) None of the above

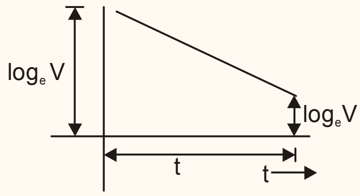
Ans. **(c)**

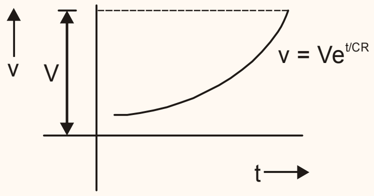
Sol. The electrodynanometer is a transfer instrument.

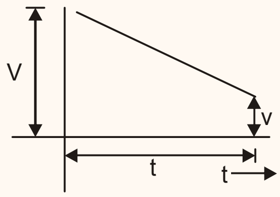
A transfer type instrument is one that may be calibrated with a DC source and then used without modification to measure AC.

35. For measurement of high resistance by loss of charge method which graph be used for more accurate results ?

(a)


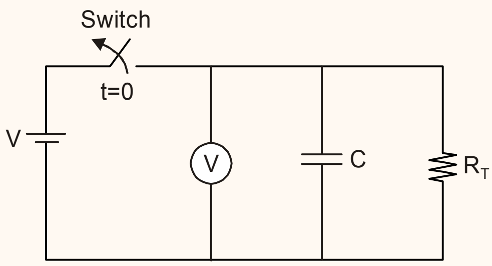
(b)


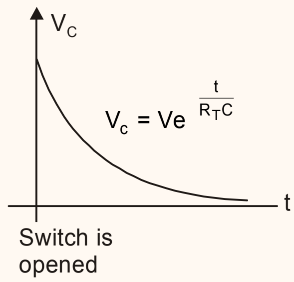
(c)


(d)


Ans. **(a)**

Sol. Loss of charge method :





36. The scale of moving coil instruments are

(a) Linear

(b) Non-linear

(c) Not uniform

(d) None of the above

Ans. (a)

37. The first two-row of Rought's tabulation of a third order equation are

s^3 2 2

s^2 4 4

This means there are

(a) Two roots at $s = \pm j$ and one root is right half of s-plane

(b) Two roots at $s = \pm j2$ and one root is left half of s-plane

(c) Two roots at $s = \pm j2$ and one root is right half of the s-plane

(d) Two roots at $s = \pm j$ and one root is left half of s-plane

Ans. (d)

Sol. Given R-H criteria

$$\begin{array}{c|cc} s^3 & 2 & 2 \\ s^2 & 4 & 4 \\ s^1 & \not{0}\ (8) & \not{0}\ (0) \\ s^0 & 4 & \end{array}$$

Auxillary equation :

$A(s) = 4s^2 + 4$

$$\frac{dA(s)}{ds} = 8s$$

Roots of auxillary equation

$4s^2 + 4 = 0$

$s^2 = -1$

$s = \pm j$

So two roots at s = ±j and one root is left half of s-plane because no sign change in first column.

38. The open-loop transfer function of unity feed-back control system is given by $G(S) = \dfrac{K(S+2)}{(S+1)(S-7)}$ for K > 6, the stability characteristic of the open-loop and closed-loop configurations of the system are respectively

(a) Stable and stable

(b) Unstable and stable

(c) Stable and unstable

(d) Unstable and unstable

Ans. (c)

Sol. Open loop transfer function

$$G(s) = \frac{K(s+2)}{(s+1)(s-7)}$$

Open loop : Poles = –1, 7 ; zeros = –2

One pole lies in right side of s-plane, so open loop system is unstable

For closed loop system stability used R-H criteria

Characteristic equation :

$1 + G(s)H(s) = 0$

$$1 + \frac{K(s+2)}{(s+1)(s-7)} = 0$$

$(s + 1)(s - 7) + K(s + 2) = 0$

$s^2 - 6s - 7 + Ks + 2K = 0$

$s^2 + s(K - 6) + 2K - 7 = 0$

RH criteria :

$$\begin{array}{c|cc} s^2 & 1 & 2K-7 \\ s^1 & K-6 & 0 \\ s^0 & 2K-7 & \end{array}$$

From here stability condition,

$K - 6 > 0$

$K > 6$ and $2K - 7 > 0$

$K > 7/2$

So, overall for K > 6 closed loop system is stable because no change sign in first column of R-H criteria.

39. A second order control system has a transfer function $\frac{16}{S^2 + 4S + 16}$

What is the time for the first overshoot ?

(a) $\frac{2\pi}{\sqrt{3}}S$ (b) $\frac{\pi}{\sqrt{3}}S$

(c) $\frac{\pi}{2\sqrt{3}}S$ (d) $\frac{\pi}{4\sqrt{3}}S$

Ans. **(c)**

Sol. Given transfer function,

$$T(s) = \frac{16}{s^2 + 4s + 16}$$

Time for the first overshoot is peak time

$$t_p = \frac{\pi}{\omega_d}$$

From transfer function, $\omega_n = \sqrt{16} = 4$

or, $2\xi\omega_n = 4$

$2\xi \times 4 = 4$

$\xi = 0.5 = \frac{1}{2}$

$$\omega_d = \omega_n\sqrt{1-\xi^2} = 4\sqrt{1-\frac{1}{(2)^2}} = 2\sqrt{3}$$

Peak time = $\frac{\pi}{2\sqrt{3}}$ sec

40. Derivative error compensation is employed in feedback control system to

(a) Increase the effective damping in the system

(b) Decrease the effective damping in the system

(c) Improve the stable state response of system

(d) None of the above

Ans. **(b)**

41. Consider the characteristic polynomial of a feedback system $q(s) = s^4+s^3+s^2+s+K$

(a) The system is stable for all K > 0

(b) The system is unstable for K > 0

(c) K = 8 results in marginal stability

(d) None of the above is correct

Ans. **(b)**

Sol. Given : $q(s) = s^4 + s^3 + s^2 + s + K$

RH criteria :

s^4	1	1	K
s^3	1	1	
s^2	$\not{0}_{\varepsilon}$	K	
s^1	$\frac{\varepsilon - K}{\varepsilon}$	0	
s^0	K		

If zero appears in the first column of a non-zero row in Routh array, replace it with a small positive number (ε).

For stability first column should have same sign (here positive)

When K > 0, s^1 row become negative i.e. for K > 0 system is unstable.

42. Effect of back emf in a armature controlled

(a) To increase effective motor friction thereby reducing motor time constant

(b) To increase effective motor friction thereby increasing motor time constant

(c) To increase motor inertia, thereby increasing motor time constant

(d) To increase motor inertia, thereby reducing motor time constant

Ans. **(a)**

43. A linear time invariant system is described by state variable model

$$\begin{bmatrix} x_1' \\ x_2' \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & 2 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix}u$$

$$y(t) = \begin{bmatrix} 1 & 2 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

(a) The system is uncontrollable and completely observable

(b) The system is completely controllable and observable

(c) The system is completely controllable and unobservable

(d) The system is uncontrollable and unobservable

Ans. **(a)**

Sol. From state variable model

$$A = \begin{bmatrix} -1 & 0 \\ 0 & 2 \end{bmatrix}; B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, C = \begin{bmatrix} 1 & 2 \end{bmatrix}$$

As we know, for controllable

$[P] = [B \;\; AB] \neq 0$

$$\because \quad [AB] = \begin{bmatrix} -1 & 0 \\ 0 & 2 \end{bmatrix}\begin{bmatrix} 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 0 \\ 2 \end{bmatrix}$$

$$\therefore \quad [P] = \begin{bmatrix} 0 & 0 \\ 1 & 2 \end{bmatrix}$$

$$|P| = \begin{vmatrix} 0 & 0 \\ 1 & 2 \end{vmatrix} = 0$$

So, system is uncontrollable

For observable, $[Q] = \begin{bmatrix} C^T & A^TC^T \end{bmatrix}$

$$\begin{bmatrix} C^T \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$$

$$\begin{bmatrix} A^T & C^T \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & 2 \end{bmatrix}\begin{bmatrix} 1 \\ 2 \end{bmatrix} = \begin{bmatrix} -1 \\ 4 \end{bmatrix}$$

$$[Q] = \begin{bmatrix} 1 & -1 \\ 2 & 4 \end{bmatrix}$$

$$|Q| = \begin{vmatrix} 1 & -1 \\ 2 & 4 \end{vmatrix} = 4 + 2 = 6 \neq 0$$

So, system is observable.

44. The most commonly used input signal in control system is

(a) Step function

(b) Ramp function

(c) Accelerating function

(d) All of the above

Ans. **(a)**

45. When a two winding transformer is connected as an auto transformer its efficiency at full load

(a) Decreases

(b) Increases

(c) Remains same

(d) None of the above

Ans. **(b)**

Sol. In an ordinary transformer the total electrical power is transferred from primary to secondary by transformation. Power transformation results in power loss.

In an autotransformer electrical power is transferred from primary to secondary partly by the process of transformation and partly by direct electrical connection. Power conductively transferred produces no transformer losses.

46. During blocked rotor test on an induction motor, the power is drawn mainly for

(a) Core loss

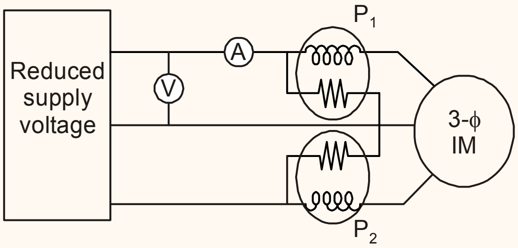
(b) Copper loss

(c) Windage and frictionloss

(d) Both (a) and (b)

Ans. **(b)**

Sol.



Total power input P_{in} = Stator ohmic loss + Rotor ohmic loss.

47. A synchronous phase modifier as compared to the synchronous motor used for mechanical loads has

(a) Larger shaft and higher speed

(b) Smaller shaft and higher speed

(c) Laarger shaft and lower speed

(d) Smaller shaft and lower speed

Ans. **(b)**

48. A 6-pole lap-connected DC generator has 480 conductors and armature circuit resistance is 0.06 ohm. If the conductors are reconnected to form wave winding, other things remaining unchanged, the value of armature circuit resistance will be

(a) 0.01Ω (b) 0.08Ω

(c) 0.36Ω (d) 0.54Ω

Ans. **(d)**

Sol. No. of conductors = 480

Parallel paths = 6

R_a = 0.06

Each parallel path has 80 conductors

Let resistance of each conductor = R

Then, $R_a = 0.06 = \frac{80R}{6} \Rightarrow R = 0.0045\Omega$

Now winding connected in wave winding

No. of parallel path = 2

Each parallel path has 480/2 = 240 conductors

Then, $R_a = \frac{240 \times 0.0045}{2} = 0.54\Omega$

49. The relative speed between the magnetic fields of stator and rotor under steady state operation is zero for

(a) Induction motor

(b) DC machine

(c) A synchronous machine

(d) All of the above

Ans. **(d)**

50. During hunting of synchronous motor

(a) Negative phase sequence currents are generated

(b) Damper bar develops torque

(c) Harmonics are developed in the armature circuit

(d) Field excitation increases

Ans. **(b)**

51. The DC Motor, which can provide zero speed regulation at full load without any controller is

(a) Series motor

(b) Shunt motor

(c) Cumulative compound

(d) Differential compound

Ans. **(d)**

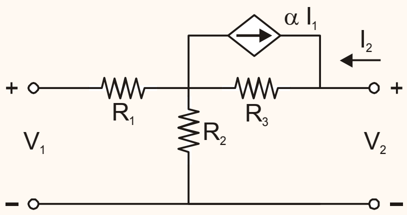
Sol. DC shunt motor it is somewhat less than 10% voltage regulation

DC series motor has poor value of regulation.

Compound DC motor for DC commulative compound the speed regulation around 25%.

While differential compound has its excellent value of 5%.

52. The hybrid parameter h_{12} for the two port network shown in figure

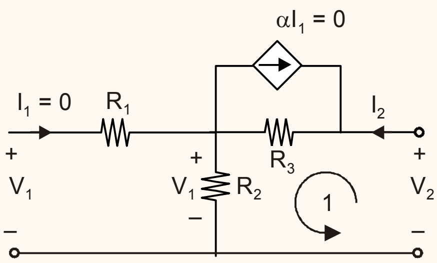


(a) $\dfrac{aR_2}{(R_2+R_3)}$ (b) $\dfrac{(1-\alpha)R_3}{R_2+R_3}$

(c) $\dfrac{(1-\alpha)R_2}{R_2+R_3}$ (d) $\dfrac{R_2}{(R_2+R_3)}$

Ans. **(d)**

Sol. Two port network :



As we know, $h_{12} = \left.\dfrac{V_1}{V_2}\right|_{I_1=0}$

$\therefore \quad I_2 = \dfrac{V_1}{R_2}$ ...(1)

KVL in Loop-1

$V_2 = I_2R_3 + V_1$

From equation (1)

$$V_2 = \frac{V_1R_3}{R_2} + V_1$$

$$\frac{V_1}{V_2} = \left(\frac{R_2}{R_2+R_3}\right)$$

53. Fourier transform and Laplace transform are related through

(a) Time domain

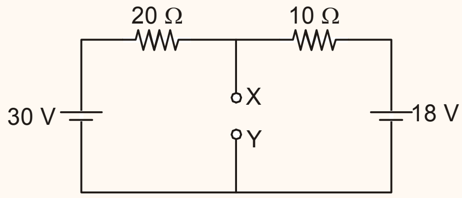
(b) Frequency domain

(c) Both time and frequency domains

(d) None of these

Ans. **(b)**

54. Find Norton equivalent current source at terminal X-Y in figure below



(a) $I_N = 4\,mA,\ R_N = 5\Omega$

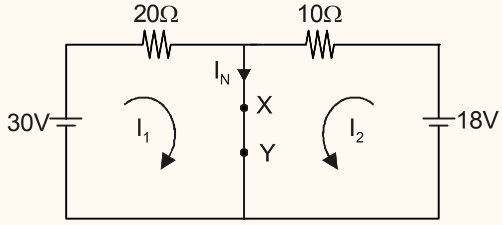
(b) $I_N = 1\,A,\ R_N = 3.5\Omega$

(c) $I_N = 2.5\,A,\ R_N = 6\Omega$

(d) $I_N = 3.3\,A,\ R_N = 6.67\Omega$

Ans. **(d)**

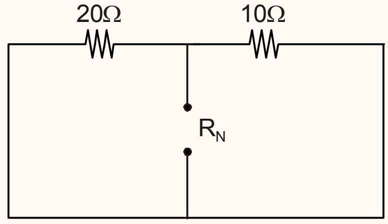
Sol. To find I_N short-circuit X and Y



$I_N = I_1 + I_2$

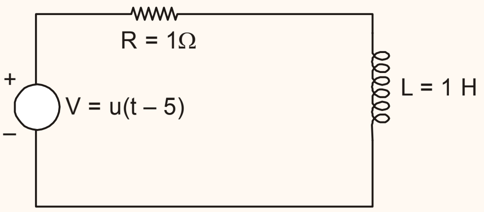
$$I_N = \frac{30}{20} + \frac{18}{10} = 1.5 + 1.8 = 3.3A$$

To find R_N, short-circuit voltage sources



$R_N = 20||10 = 6.67\,\Omega$

55. A unit step voltage u(t – 5) is applied to the R-L network below. The current is given by



(a) $1 - e^{-t}$

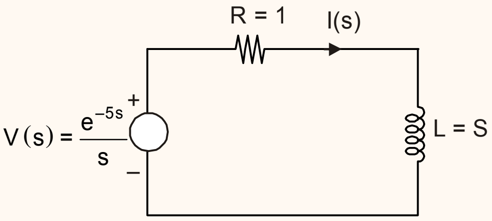
(b) $[1 - e^{-(t-5)}]u(t - 5)$

(c) $[1 - e^{-t}]u(t - 5)$

(d) $1 - e^{-(t-5)}$

Ans. **(b)**

Sol. Redraw the circuit in s-domain



Current $I(s) = \frac{e^{-5s}}{s(s+1)} = e^{-5s}\left[\frac{1}{s} - \frac{1}{s+1}\right]$

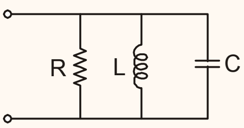
Taking inverse laplace

$i(t) = u(t - 5) - e^{-(t-5)}u(t - 5)$

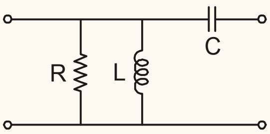
$= \left[1 - e^{-(t-5)}\right]u(t-5)$

56. An R-L-C circuit for the driving point admittance function $\left[\frac{\frac{1}{RLS}}{\left(\frac{1}{R}+\frac{1}{LS}\right)} + CS\right]$ is

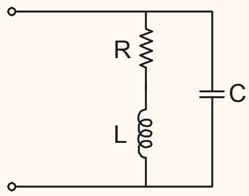
(a)



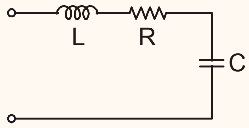
(b)



(c)

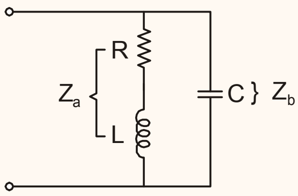


(d)



Ans. **(c)**

Sol. From options we check



$Z_a = R + SL$

$Z_b = 1/SC$

$Y = Y_a + Y_b$

$Y = \frac{1}{R+SL} + SC$

57. An ideal current source has zero

(a) Internal conductance

(b) Internal resistance

(c) Voltage on no-load

(d) Ripple

Ans. **(a)**

Sol. A ideal current source has infinite internal resistance, so zero internal conductance.

58. The drain gate capacitance of a junction FET is 2 pF. Assuming common source voltage gain of 20, what is the input capacitance due to Miller effect?

(a) 21 pF (b) 40 pF

(c) 42 pF (d) 10 pF

Ans. **(c)**

Sol. Input capacitance due to Miller effect

$C_m = C(1 + A_V) = 2pF(1 + 20)$

$C_m = 42\ pF$

59. Which of the following for the JFETs is NOT applicable?

(a) Depletion Mode (N-Channel)

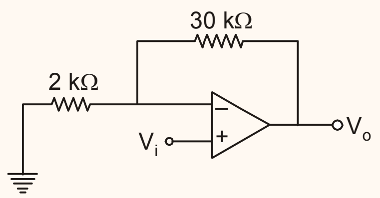
(b) Depletion Mode (P-Channel)

(c) Enhancement Mode (N-Channel)

(d) None of the above

Ans. **(c)**

60. Consider the non-inverting amplifier circuit of figure given below. The closed loop voltage gain is



(a) 16 (b) –14

(c) 15 (d) 14

Ans. **(a)**

Sol. Closed loop voltage gain,

$$A_V = \frac{V_o}{V_1} = \left(1 + \frac{30}{2}\right) = 16$$

61. If the bias voltage applied across the p-n junction increases the potential barrier, the applied voltage is known as

(a) Forward bias voltage

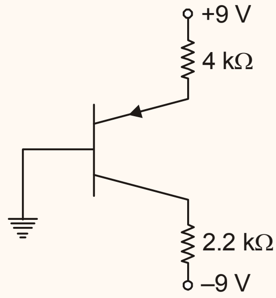
(b) Reverse bias voltage

(c) Transition voltage

(d) None of the above

Ans. **(b)**

62. For the circuit shown below the transistor α = 0.992, the value of voltage V_{BC} is

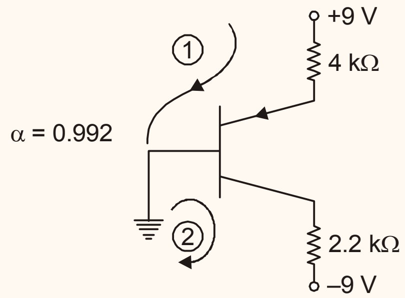


(a) 8.51 V (b) 4.47 V

(c) 2.16 V (d) 10.23 V

Ans. **(b)**

Sol.



kVL in loop (1),

$-9 + 4 I_E + 0.7 = 0$

$I_E = 2.075\ mA$

as we know $I_C = \alpha I_E$

$= 2.075 \times 0.992 = 2.0584\ mA$

kVL in loop (2),

$V_{BC} + I_C \times 2.2k - 9 = 0$

$V_{BC} = 9 - I_C \times 2.2k = 9 - 2.0584 \times 2.2$

$V_{BC} = 4.47\ V$

63. A plane electromagnetic wave is travelling in an unbounded, lossless dielectric having $\mu_r = 1$ and $\varepsilon_r = 4$. The time average poynting vector of the wave is 5 W/m³. The phase velocity V_P (assuming velocity of light as 3 × 10⁸ m/s) is

(a) 3×10^8 m/s (b) 2.5×10^8 m/s
(c) 0.5×10^8 m/s (d) 1.5×10^8 m/s

Ans. **(d)**

64. A long, straight wire carries a current I = 100 A. At what distance the magnetic field is 1 A/m?

(a) 1.59 m (b) 0.159 m
(c) 0.0159 m (d) 15.9 m

Ans. **(d)**

Sol. Ampere law, $H\cdot(2\pi R) = I$

$$R = \frac{I}{(H\cdot 2\pi)} = \frac{100}{1\times 2\pi} = 15.9\text{ m}$$

65. For a transmission line if $\frac{L}{C} = \frac{R}{G}$ then which of the following is incorrect?

(a) $Z_o^2 = R/G$
(b) The line is called a distortionless line
(c) If a series of pulses are transmitted they arrive undistorted
(d) The line is lossless

Ans. **(a)**

Sol. For distortionless line, $Z_o^2 = \frac{L}{C}$

66. Check whether the potential function V = A log P + B in cylindrical co-ordinate is a solution of Laplace's equation. A and B are constants.

(a) Satisfies
(b) Not satisfies
(c) Can not be concluded
(d) None of the above

Ans. **(a)**

Sol. In cylindrical system,

Laplace equation, $\nabla^2 V = 0$

$$\frac{1}{\rho}\frac{\partial}{\partial \rho}\left(\rho\frac{\partial V}{\partial \rho}\right) + \frac{1}{\rho^2}\frac{\partial^2 V}{\partial \phi^2} + \frac{\partial^2 V}{\partial z^2} = 0$$

If volume is function of ρ

$$\frac{1}{\rho}\frac{\partial}{\partial \rho}\left(\rho\frac{\partial V}{\partial \rho}\right) = 0$$

Integration both side, $\rho\frac{\partial V}{\partial \rho} = A$

$$\frac{\partial V}{\partial \rho} = \frac{A}{\rho}$$

Again integration, $V = A\log\rho + B$

67. Find the volume charge density that is associated with the field $D = a_r c/m^2$.

(a) 1 c/m^3 (b) 0 c/m^3
(c) 2/r c/m^3 (d) r c/m^3

Ans. **(c)**

Sol. $\rho_v = \vec{\nabla}\cdot\vec{D}$

$$\rho_v = \frac{1}{r^2}\frac{\partial r^2}{\partial r}\cdot(1) = \frac{1}{r^2}2r = \frac{2}{r}\text{ C/m}^3$$

68. In a fluxmeter, the controlling torque is

(a) Produced by weight attached to the moving coil
(b) Produced by spring
(c) Not provided at all
(d) Provided by crossed coil mechanism

Ans. **(c)**

69. Thermistors can be used as

(a) Measurement of thermal conductivity
(b) Vacuum measurements
(c) Measurement of composition of gases
(d) All of the above

Ans. **(d)**

70. The value of capacitor C connected across swamp resistance (R) of voltmeter (MI) be

(a) $C = L/R^2$

(b) $C = LR^2$

(c) $C = L^2/R$

(d) None of the above

Ans. **(a)**

Sol. Practical value $RC = 0.41\frac{L}{R}$

71. Which of the following statistical method can be used for a single sample data?

(a) Frequency distribution

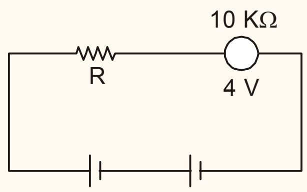
(b) Uncertainty distribution

(c) Standard deviation

(d) None of the above

Ans. **(b)**

72. In the shown figure, what is the value of unknown resistor R? The voltmeter reads 4V



(a) 110 KΩ (b) 290 KΩ

(c) 134 KΩ (d) 245 KΩ

Ans. **(*)**

73. Which of the following instrument is free from hysteresis and eddy current loss?

(a) Moving iron instruments

(b) PMMC instruments

(c) Electrostatic instruments

(d) Dynamometer type instruments

Ans. **(c)**

74. Match List-I with List-II and select the correct answer using the codes given below:

List-I

(A) Megger

(B) Spectrum Analyser

(C) Scherring Bridge

(D) Digital Counter Codes

List-II

(1) Measurement of loss angle in a dielectric

(2) Measurement of frequency

(3) Measurement of insulation resistance

(4) Measurement of harmonics

Codes:

	A	B	C	D
(a)	1	2	3	4
(b)	1	2	4	3
(c)	4	3	2	1
(d)	3	4	1	2

Ans. **(d)**

75. Load flow study is carried out for

(a) Fault calculations

(b) Stability studies

(c) System planning

(d) Load frequency control

Ans. **(c)**

76. The zero sequence current of a generator for line to ground faults is j3.0 p.u. Then the current through the neutral during the fault is

(a) j 3.0 p.u. (b) j 1.0 p.u.

(c) j 9.0 p.u. (d) j 0.3 p.u.

Ans. **(c)**

Sol. $I_n = 3I_{ao} = 3 \times (j3) = j9.0A$

77. Calculate the sag for a span of 200 m if the ultimate tensile strength of conductor is 6000 Kgf. Allow a factor of safety of 2.

(a) 1.0 m (b) 1.5 m

(c) 2.0 m (d) 2.5 m

Ans. (*)

78. A generating station has maximum demand of 30 MW, load factor 60% and plant capacity factor of 50%. The reserve capacity of the plant is

(a) 5 MW (b) 4 MW

(c) 6 MW (d) 10 MW

Ans. (c)

Sol. Maximum demand = 30MW

Load factor = 0.6

As we know,

$$\text{plant capacity factor} = \frac{\text{Average load}}{\text{Plant capacity}}$$

$$0.5 = \frac{\text{Load factor} \times \text{maximum demand}}{\text{Plant capacity}}$$

$$0.5 = \frac{0.6 \times 30}{\text{Plant capacity}}$$

$$\text{Plant capacity} = \frac{0.6 \times 30}{0.5} = 36\text{MW}$$

Reverse capacity = 36 – 30 = 6MW

79. Power consumption in moving iron instruments are

(a) Higher

(b) Lower

(c) Lossless

(d) None of the above

Ans. (a)

80. A Lassajous pattern on the oscilloscope is stationary and has 6 vertical maximum values and 5 horizontal maximum values. The frequency of horizontal input is 1500 Hz. The frequency of vertical input is

(a) 1800 Hz

(b) 1250 Hz

(c) 45000 Hz

(d) None of the above

Ans. (b)

Sol. $\frac{f_y}{f_x} = \frac{5}{6} \Rightarrow f_y = \frac{5}{6} \times 1500 = 1250 \text{ Hz}$

81. With an external multiplier setting of $20\ \text{K}\Omega$ an analog voltmeter reads 440 V and with multiplier setting of $80\ \text{K}\Omega$ it reads 352 V. Then for a multiplier setting of $40\ \text{K}\Omega$, the voltmeter will read

(a) 370 V (b) 402 V

(c) 406 V (d) 394 V

Ans. (c)

Sol. As we know, $R_s = R_m(m-1)$

$$20 = R_m\left(\frac{V}{440} - 1\right) \quad ...(1)$$

$$80 = R_m\left(\frac{V}{352} - 1\right) \quad ...(2)$$

Equation (1) divided by equation (2)

$$\frac{1}{4} = \frac{\frac{V}{440} - 1}{\frac{V}{352} - 1} \Rightarrow \frac{V}{352} - 1 = \frac{V}{110} - 4$$

V = 480V

From equation (1),

$$20 = R_m\left(\frac{480}{440} - 1\right)$$

$$R_m = 220\text{k}\Omega$$

At $R_s = 40\text{k}\Omega, V_m = ?$

$$40 = 220\left(\frac{480}{V_m} - 1\right)$$

$$\frac{480}{V_m} = (0.1818 + 1)$$

V_m = 406.153V

82. An indicating instrument is more sensitive if its torque to weight ratio is

(a) Much larger than unity

(b) Of the order of unity

(c) Much less than unity

(d) All of the above

Ans. (a)

83. Two wattmeter method can be used to measure the total power delivered to

(a) Star connected load only

(b) Delta connected load only

(c) Star or Delta connected load

(d) Star connected with neutral load

Ans. (c)

84. An overhead line with surge impedance 400 ohm is terminated through a cable of impedance Z_c. A surge travelling over the line does NOT suffer any reflection at the junction. The value of Z_c is

(a) 40 ohms (b) 500 ohms

(c) 450 ohms (d) None of these

Ans. (d)

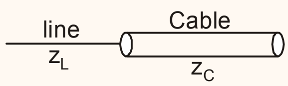
Sol. Reflection voltage

$R_V = 0$

$\because \quad R_V = T_V - 1$

$\therefore \quad T_V = 1$

as we know



$$T_V = \frac{2z_C}{z_L + z_C} = 1$$

$$2z_C = z_L + z_C$$

$$\boxed{z_L = z_C}$$

$$z_C = 400\Omega$$

85. In the HVDC system, the ac harmonics which get effectively eliminated with 12-pulse bridge converters are

(a) Triplen harmonics

(b) Triplen and 5th harmonics

(c) Triplen, 5th and 7th harmonics

(d) 5th and 7th harmonics

Ans. (d)

86. The capacitances of a 3-core belted cable are measured and found to be as (i) between 3-cores bunched together and the sheath is $15\,\mu F$ (ii) between a conductor and the other two connected together to the sheath is $10\,\mu F$. Then capacitance to neutral value in μF is

(a) 12.5 (b) 12.0

(c) 9.5 (d) 8.5

Ans. (a)

Sol.
$$C = \frac{9C_b - C_a}{6}$$

Here, C_a = when3-cores bunched together

$C_a = 15\ \mu F$

C_b = Between a conductor & the other two two connected together to the sheath

$= 10\ \mu F$

$$C = \frac{9 \times 10 - 15}{6} = 12.5\ \mu F$$

87. The incremental cost characteristics of the two generators delivering a total load of 200 MW are as follows:

$$\frac{dF_1}{dP_1} = 2.0 + 0.01 P_1$$

$$\frac{dF_2}{dP_2} = 1.6 + 0.02 P_2$$

What should be the values of P_1 and P_2 for economic operation?

(a) $P_1 = P_2 = 100$ MW

(b) $P_1 = 80$ MW, $P_2 = 120$ MW

(c) P_1 = 200 MW, P_2 = 0 MW

(d) P_1 = 120 MW, P_2 = 80 MW

Ans. **(d)**

Sol. At economic operation

$$(IC)_1 = (IC)_2$$

$$2 + 0.01 P_1 = 1.6 + 0.02 P_2$$

$$0.01 P_1 - 0.02 P_2 = -0.4 \quad ...(1)$$

$$P_1 + P_2 = 200 \quad ...(2)$$

From eq. (1) & (2)

$$P_1 = 120 \text{ MW}$$

$$P_2 = 80 \text{ MW}$$

88. The insulation of the modern EHV lines is designed based on

(a) Corona

(b) Radio interference

(c) The switching voltage

(d) The lightning voltage

Ans. **(c)**

89. The coefficient of reflection of voltage for short circuited line is

(a) – 1.0

(b) 1.0

(c) 0.0

(d) None of the above

Ans. **(a)**

Sol.

$$R_V = T_V - 1$$

$$T_V = \frac{2z_L}{z_1 + z_L} \qquad \because z_L = 0$$

$$T_v = 0$$

then $\boxed{R_V = -1}$

90. For line to line fault on an unloaded generator, then

(a) $Ia_1 = Ia_2$

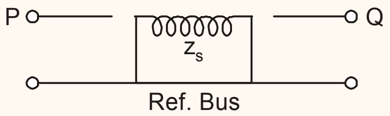
(b) $Ia_1 = -Ia_2$

(c) $Ia_1 + Ia_2 = Ia_0$

(d) None of the above

Ans. **(b)**

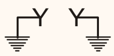
91. The following figure shows zero sequence equivalent circuits of



(a) $\Delta - \Delta$ Bank

(b) $Y - \Delta$ Bank

(c) Y – Y Bank

(d)  Bank

Ans. **(a)**

92. The maximum demand of a consumer is 2 kW and the corresponding daily energy consumption is 30 units. What is the corresponding load factor?

(a) 25%

(b) 50%

(c) 62.5%

(d) 75%

Ans. **(c)**

Sol. Maximum demand = 2 kW

Energy consumption = 30 kWh

$$\text{Load factor} = \frac{\text{Average load}}{\text{max. demand}}$$

$$\because \text{Average load} = \frac{\text{daily energy consumption}}{24}$$

$$\text{average load} = \frac{30}{24} = 1.25 \text{ kW}$$

$$\text{so, \% load factor} = \frac{1.25}{2} \times 100 = 62.5\%$$

93. The voltage regulation of a shunt transmission line will be maximum when the value of $\tan\phi_R$, for lagging power factor is

(a) Unity

(b) Zero

(c) $\frac{R}{X_2}$

(d) $\frac{X_2}{R}$

Ans. **(d)**

Sol. Maximum voltage regulation at

$$\phi = \theta$$

$$\cos\phi = \cos\theta = \frac{R}{Z}$$

So, $$\tan\phi = \frac{X_2}{R}$$

94. The –180° phase line of Bode diagram is equal to

(a) Positive imaginary axis in Nyquist plot

(b) Negative imaginary axis in Nyquist plot

(c) Positive real axis in Nyquist plot

(d) Negative real axis in Nyquist plot

Ans. **(d)**

95. Let $X' = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} U$

U = [b, 0]X

Where b is an unknown constant. This system is

(a) Observable for all values of b

(b) Unobservable for all values of b

(c) Observable for all non-zero values of b

(d) Unobservable for all non-zero values of b

Ans. **(c)**

Sol. Given, $A = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$

$$C = \begin{bmatrix} b & 0 \end{bmatrix}$$

Obserable if $[Q] = \begin{bmatrix} C^T & A^T C^T \end{bmatrix} \neq 0$

$$[C^T] = \begin{bmatrix} b \\ 0 \end{bmatrix}$$

$$A^T C^T = \begin{bmatrix} 1 & 0 \\ 2 & 1 \end{bmatrix} \begin{bmatrix} b \\ 0 \end{bmatrix} = \begin{bmatrix} b \\ 2b \end{bmatrix}$$

$$|Q| = \begin{bmatrix} b & b \\ 0 & 2b \end{bmatrix}$$

$$|Q| = 2b^2$$

Observable for all non-zero values of b.

96. Consider solar radiation of 200 J/m^2 and per unit time during daylight, find the area of Photo Voltaic (PV) cells needed to generate enough electric power to run (i) a desktop computer of 400 W (ii) an electric geyser of 1 kW and (iii) a toaster of 500 W. Assume the efficiency of PV to be 25%.

(a) 38 m^2 (b) 8 m^2

(c) 5 m^2 (d) 20 m^2

Ans. **(a)**

97. Sheaths are used in cables to

(a) Provide mechanical strength

(b) Provide proper insulation

(c) Prevent ingresss of moisture

(d) None of the above

Ans. **(c)**

98. A negative area control error means that

(a) The area is not generating enough power to send the desired amount out of the area

(b) The area is generating more power to send the desired amount out of the area

(c) The area is generating power to meet its own requirement

(d) None of the above

Ans. **(a)**

99. In a three-phase system the current in the return path through neutral is

(a) $3Ia_0$

(b) $3Ia_1$

(c) $3Ia_2$

(d) None of the above

Ans. **(a)**

100. At the swing bus specified are

(a) P, Q

(b) |V|, δ

(c) P, V

(d) None of the above

Ans. **(b)**

101. The efficiency of a transmission line

(a) Increases with decrease in load p.f.

(b) Is independent of load p.f.

(c) Increases with increase in load p.f.

(d) Decreases with increase in load p.f.

Ans. **(c)**

102. Feedback control system is basically

(a) Band pass filter (b) High pass filter

(c) Low pass filter (d) Band stop filter

Ans. **(c)**

Sol. Low pass filter is mainly as integral controller & it is used as the controller in the system so as to increase the accuracy by reducing or proper eliminating the steady state error of the control system.

103. The open-loop transfer function of a system is $T(S) = \dfrac{K}{(S+1)^3}$. The phase crossover takes place at $\omega_C = \sqrt{3}$. For the gain cross also occur at ω_C, the value of K should be

(a) 10 (b) 8

(c) 18 (d) 1

Ans. **(b)**

Sol.
$$T(s) = \frac{K}{(s+1)^3}$$

Gain cross over frequency

$$\omega_c = \sqrt{3}\ \text{rad/sec}$$

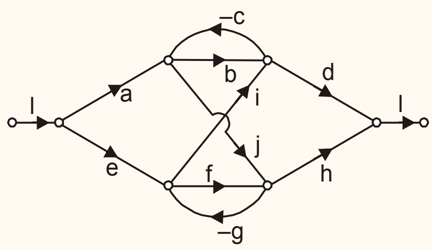
as we know,

$$\left|\frac{k}{(s+1)^3}\right|_{\text{at } \omega_c} = 1$$

$$\left|\frac{k}{(1+i\sqrt{3})^3}\right| = 1$$

$$\boxed{k = 8}$$

104. The determinant of graph Δ for the SFG shown below is



(a) 1 – bc – fg – bcfg – cigj

(b) 1 – bc – fg – cigj + bcfg

(c) 1 + bc + fg + cigj – bcfg

(d) 1 + bc + fg + bcfg – cigj

Ans. **(d)**

Sol. Δ = 1 – (loop gain) + (two non-touching loop gain)

$L_1 = -\,bc$

$L_2 = -\,fg$

$L_3 = cigj$

non touching loop gain = bcfg

$\Delta = 1 - (L_1 + L_2 + L_3)$ + (two non-touching loop gain

= 1 + bc + fg – cigj + bcfg

105. A second order control system is defined by the following differential equation.

$$4\frac{d^2c(t)}{dt^2} + 8\frac{dc(t)}{dt} + 16c(t) = 16r(t)$$

The damping ratio and natural frequency for this system are respectively

(a) 0.50 and 4 rad/sec
(b) 0.25 and 4 rad/sec
(c) 0.25 and 2 rad/sec
(d) 0.50 and 2 rad/sec

Ans. **(d)**

Sol. 2^{nd} order differential equation

$$4\frac{d^2c(t)}{dt^2}+8\frac{dc(t)}{dt}+16c(t) = 16\ r(t)$$

Take laplace transform

$C(s)\ [4s^2 + 8s + 16] = 16\ R(s)$

$$\frac{C(s)}{R(s)} = \frac{16}{4s^2+8s+16}$$

$$\frac{C(s)}{R(s)} = \frac{4}{s^2+2s+4}$$

Natural frequency, $\omega_n = \sqrt{4} = 2$ rad/sec

Compare with standard equation,

$\because \quad 2\xi\omega_n = 2$

$\xi\omega_n = 1$

$\xi = 0.5$

106. The break away point in the root loci plot for the loop transfer function

$$G(S) = \frac{K}{S(S+3)^2} \text{ is}$$

(a) –2.5 (b) –1.0
(c) –2.0 (d) –0.5

Ans. **(b)**

Sol. $$G(s) = \frac{k}{s(s+3)^2}$$

Characteristics equation,

$1 + G(s)\ H(s) = 0$

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

$s(s^2 + 6s + 9) + k = 0$

$k = -(s^3 + 6s^2 + 9s)$

For breakaway point

$$\frac{dk}{ds} = 0$$

$3s^2 + 12s + 9 = 0$

$s^2 + 4s + 3 = 0$

$s = -1$, $\textcircled{-3}$ → not valid

107. Consider the loop transfer function

$$G(S)\ H(S) = \frac{k(S+6)}{(S+3)(S+5)}$$

In root-locus diagram the centroid is located at

(a) –4 (b) –2
(c) –1 (d) –3

Ans. **(b)**

Sol. $$G(s)H(s) = \frac{k(s+6)}{(s+3)(s+5)}$$

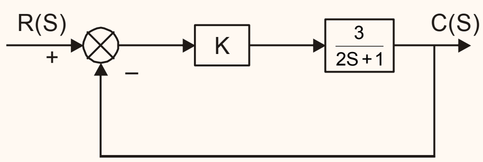
Poles = –3, –5

zeroes = –6

$$\text{Centroid} = \frac{\Sigma P - \Sigma Z}{P - Z}$$

$$= \frac{-8+6}{1} = -2$$

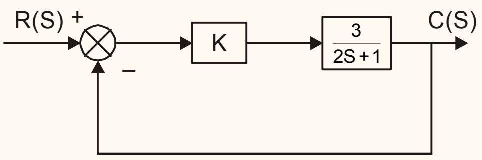
108. For what value of K is the time constant of the system of figure given below is less than 0.2 sec?



(a) K > 3 (b) K > 5
(c) K > 7 (d) K > 9

Ans. **(a)**

Sol.



Characteristic equation

$$q(s) = 1+\frac{3k}{2s+1} = 0$$

$$2s + 1 + 3k = 0$$

$$\frac{2s}{1+3k}+1 = 0$$

$$T = \frac{2}{1+3k} < 0.2$$

$$2 < 0.2 + 0.6\,k$$

$$1.8 < 0.6\,k$$

$$\boxed{k > 3}$$

109. The transfer function $G(S) = C(SI - A)^{-1}b$ of the system

$x' = Ax + bu$; $y = Cx + du$

has no pole-zero cancellation. The system

(a) is controllable and observable

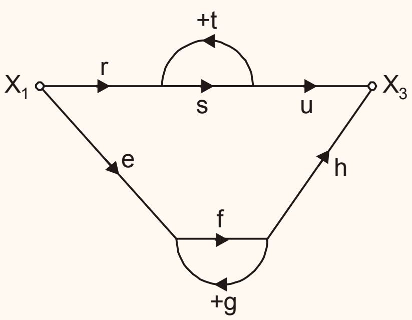
(b) is observable but uncontrollable

(c) is controllable but unobservable

(d) none of the above

Ans. (c)

110. For the signal flow diagram shown in figure, the transmittance between X_1 and X_2 is



(a) $\frac{rst}{1-eh}+\frac{rsu}{1-st}$ (b) $\frac{rsu}{1-fg}+\frac{efh}{1-st}$

(c) $\frac{efh}{1-ru}+\frac{rsu}{1-eh}$ (d) $\frac{rsu}{1-st}+\frac{efh}{1-fg}$

Ans. (d)

111. In a speed control system, output rate feedback is used to

(a) Limit the speed of motor

(b) Limit the acceleration of the motor

(c) Reduce the damping of the system

(d) Increase the gain margin

Ans. (c)

112. The purpose of of using oil in the transformer is

(a) Cooling

(b) Insulation

(c) Cooling and insulation

(d) Lubrication

Ans. (c)

113. The sparking at the brushes of a dc generator is due to

(a) Reactance voltage

(b) Armature reaction

(c) Light load

(d) High resistance of the brushes

Ans. (a)

114. If residual magnetism is NOT present in a d.c. generator the induced emf at zero speed

(a) 10% of rated voltage

(b) 50% of rated voltage

(c) Zero

(d) Same as the rated voltage

Ans. (c)

115. A single phase transformer on full load has an impedance drop of 20 V and resistance drop of 10 V. The value of power factor at zero voltage regulation would be

(a) 0.86 lagging (b) 0.86 leading

(c) 0.90 leading (d) 0.707 lagging

Ans. **(c)**

Sol. Voltage regulation is zero

$$V.R = 0 = \frac{I(R\cos\phi - X\sin\phi)}{V} \quad ...(i)$$

$$IX = \sqrt{(IZ)^2 - (IR)^2}$$

$$IX = \sqrt{400 - 100} = 17.32 \text{ V}$$

From equation (i)

$$IR\cos\phi = IX\sin\phi$$

$$\tan\phi = \frac{IR}{IX} = \frac{10}{17.32}$$

$$\phi = 30^\circ$$

So, $\cos\phi$ = 0.866 leading

116. Starting torque and maximum torque of 3-phase I.M. varies as respectively

(a) $\frac{1}{f^2}$ and $\frac{1}{f^3}$ (b) $\frac{1}{f^3}$ and $\frac{1}{f^2}$

(c) $\frac{1}{f}$ and $\frac{1}{f^2}$ (d) $\frac{1}{f^2}$ and $\frac{1}{f}$

Ans. **(b)**

117. The power factor of a synchronous motor

(a) Improves with increase in excitation and may even become leading at high excitation

(b) Decreases with decrease in excitation

(c) Is independent of its excitation

(d) Increases with loading for a given excitation

Ans. **(a)**

118. The impedance of a delta/star, 11000 V/400 V transformer of a capacity 100 kVa is (0.02 + j0.07) p.u. The ohmic impedance per phase referred to primary side is

(a) (0.02 + j0.07) ohm

(b) (0.55 + j1.925) ohm

(c) (42 + j147) ohm

(d) (72.6 + j254.1) ohm

Ans. **(d)**

Sol. Given : Z_{pu} = (0.02 + j0.07) pu

Primary side connected in delta

So Z_{base} in primary side is per phase

$$Z_{base} = \frac{(11000)^2}{\frac{100\times1000}{3}} = \frac{3\times(11000)^2}{100\times100} = 3630\Omega$$

$Z_{actual\ (per\ phase)} = Z_{base} \times Z_{pu}$

= 3630 ×(0.02 + j0.07)

= (72.6 + j254.1)Ω

119. An electric motor with constant-output powe will have torque-speed characteristics in the form of a

(a) Straight line through origin

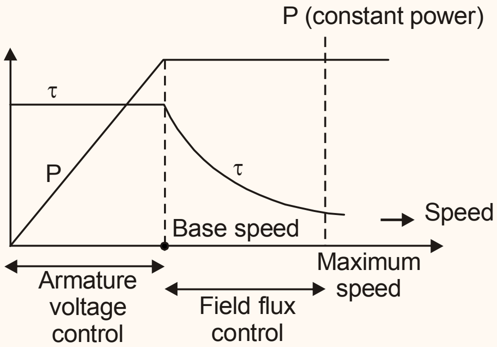
(b) Straight line parallel to the speed axis

(c) Circle about the origin

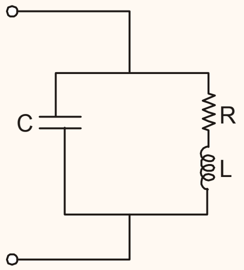
(d) Rectangular hyperbola

Ans. **(d)**

Sol.



120. In the given parallel tuned circuit at parallel resonance the impedance of the circuit is



(a) L/CR (b) LC/R

(c) $\frac{R}{LC}$ (d) LCR

Ans. **(a)**

Sol. $Z_{Dy} = \frac{L}{RC}$

121. Super position theorem is valid only for

(a) Linear circuits

(b) Non-linear circuits

(c) Both (a) and (b)

(d) Neither (a) nor (b)

Ans. **(a)**

Sol. Superposition theorem is valid only for linear circuit.

122. If an R-C driving point impedance function, z(s) has equal number of pole and zeros at finite locations, then

(a) $z(0) \le z(\infty)$

(b) $z(0) \ge z(\infty)$

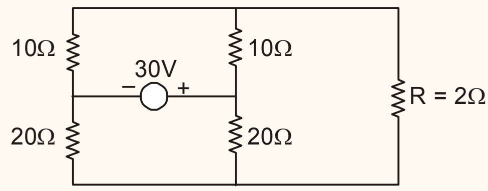
(c) $z(0) < z(\infty)$

(d) $z(0) > z(\infty)$

Ans. **(b)**

Sol. $z(0) \ge z(\infty)$

123. In the circuit shown below, what will be the value of current through resistance R?

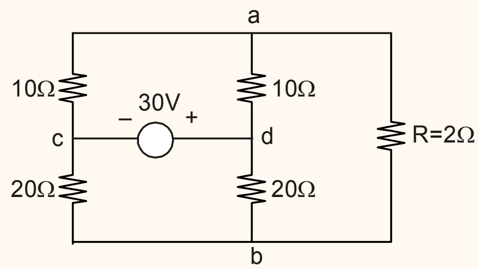


(a) $\frac{3}{2}$A (b) $\frac{3}{4}$A

(c) 0 A (d) $\frac{9}{4}$A

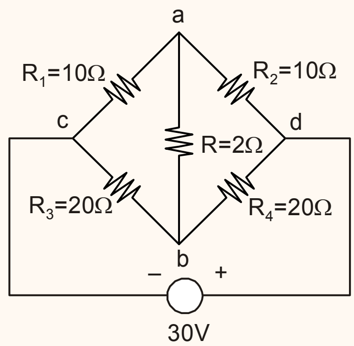
Ans. **(c)**

Sol.



Rearrange the circuit

$R_1R_4 = R_2R_3$



Above circuit is a balanced bridge, so current through resistance R is zero.

124. A Hartley oscillator is used for generating

(a) Very low frequency oscillations

(b) Radio frequency oscillations

(c) Microwave oscillations

(d) Audio frequency oscillations

Ans. (b)

Sol. Hartley oscillators are commonly used in radio frequency oscillator applications and the recommended frequency range is from 20 kHz to 30 MHz.

125. For the most accurate model the diode forward current is

(a) $I_D = I_S(e^{qV_D/nRT} - 1)$

(b) $I_D = I_S(1 - e^{qV_D/nRT})$

(c) $I_D = I_S(e^{-qV_D/nRT} - 1)$

(d) $I_D = I_S(1 - e^{-qV_D/nRT})$

Ans. (a)

Sol. As we know, $I_D = I_S\left(e^{\frac{V_D}{\eta V_T}} - 1\right)$

Here, V_T = Thermal voltage

$V_T = \frac{KT}{q}$; K = Boltzmann's constant (in question represented by R)

So, $V_T = \frac{RT}{q}$

$I_D = I_S\left(e^{\left(\frac{qV_D}{\eta RT}\right)} - 1\right)$