Gate -2015 Electrical Engineering(EE)

Section Name : General Aptitude

01. Which one of the following combinations is incorrect?

a) Acquiescence – Submission

b) Wheedle – Roundabout

c) Flippancy – Lightness

d) Profligate – Extravagant

Ans: b

02. Didn't you buy_________________ when you went shopping?

a) any paper b) much paper c) no paper d) a few paper

Ans: a

03. Based on the given statements, select the most appropriate option to solve the given question

If two floors in a certain building are 9 feet apart, how many steps are there in a set of stairs that extends from the first floor to the second floor of the building?

Statements :

i) Each step is ¾ foot high

ii) Each step is 1 foot wide

a) Statement I alone is sufficient, but statement II alone is not sufficient

b) Statement II alone is sufficient, but statement I alone is not sufficient

c) both statement together are sufficient, but neither statement alone is sufficient

d) Statement I and II together are not sufficient

Ans: a

04. Given set A = {2,3,4,5) and Set B = {11,12,13,14}. Two numbers are randomly selected one from each set. What is the probability that the sum of the two numbers equals 16?

a) 0.20 b) 0.25 c) 0.30 d) 0.33

Ans: a

05. Which of the following options is the closet in meaning to the sentence below?

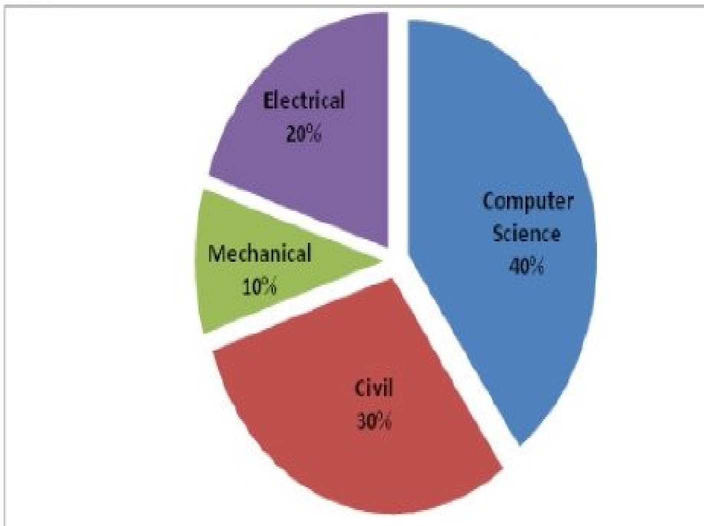
She enjoyed herself immensely at the party.

a) She had a terrible time at the party b) She had a horrible time at the party

c) She had a terrific time at the party d) she had a terrifying time at the party

Ans: d

06. The pie chart below has the breakup of the number of students from different departments in an engineering college for the year 2012. The proportion of male to female students in each department is 5:4. There are 40 males in Electrical Engineering. What is the difference between the numbers of female students in the civil department and the female students in the Mechanical department?



Ans : 32

07. The Probabilities that a student passes in Mathematics, Physics and Chemistry are m, p, and c respectively Of these subjects. The students has 75% chance of passing in at least one, a 50% chance of passing in at least two and a 40% chance of passing in exactly two. Following relations are drawn n m,p,c:

I) p+m+c = 27/20

II) p+m+c = 13/20

III) (p) x(m)x(c) = 1/10

a) Only relation I is true

b) Only relation II is true

c) Relations II and III are true

d) Relations I and III are true

Ans: a

08. The Number of students in a class who have answered correctly, or not attempted each questions in an exam, are listed in the table below. The marks for each question are also listed. There is no negative or partial marking.

Q. NO	Marks	Answered Correctly	Answered Wrongly	Not Attempted
1	2	21	17	6
2	3	15	27	2
3	1	11	29	4
4	2	23	18	3
5	5	31	12	1

What is the average of the marks obtained by the class in the examination?

a) 2.290 b) 2.970 c) 6.795 d) 8.795

Ans : c

09. Select the alternative meaning of the underlined part of the sentence.

The chain snatchers took to their heels when the policy party arrived

a) took shelter in a thick jungle

b) open indiscriminate fire

c) took to flight

d) Unconditionally surrendered

Ans : d

10. The given statement is followed by some courses of action. Assuming the statement to be true, decide the correct option

Statement :

There has been a significant drop in the water level in the lakes supplying water to the city.

Course of action:

I) The water supply authority impose a partial cut in supply to tackle the situation

II) The government should appeal to all the residents through mass media for minimal use of water.

III) The government should ban the water supply in lower areas.

a) Statements I and II follows

b) Statements I and III follow

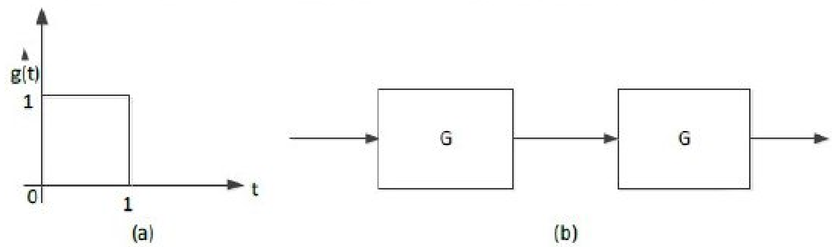
c) Statements II and III follow

d) All statements follow

Ans : a

ELECTRICAL ENGINEERING

01. The impulse response g(t) of a system, G , is as shown in Figure (a). What is the maximum value attained by the impulse response of two cascaded blocks of G as shown in Figure (b)?



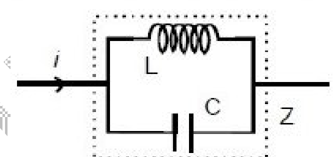
a) $\frac{2}{3}$ b) $\frac{3}{4}$ c) $\frac{4}{5}$ d) 1

Ans : d

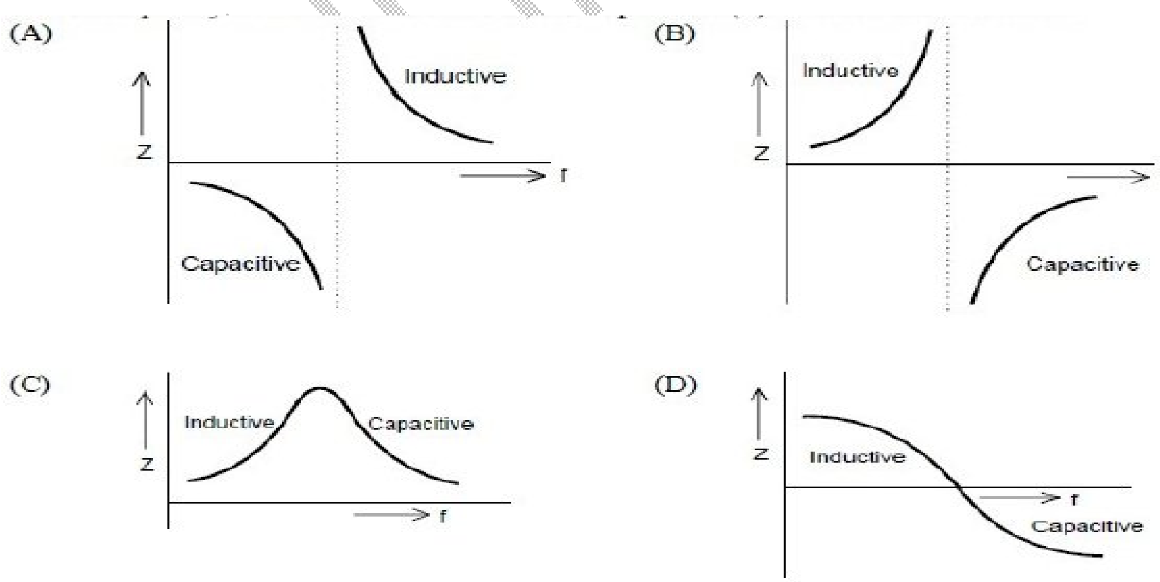
02. If the sum of the diagonal elements of a 2x2 matrix is -6, then the maximum possible value of determinant of the matrix is ________.

Ans :9

03. An inductor is connect in parallel with a capacitor as shown in the figure.



As the frequency of current i is increased, the impedance (Z) of the network varies as



Ans : b

04. Based load power plants are

P: wind farms

Q: run-of-river plants.

R: nuclear power plants

S: Diesel power plants

a) P, Q and S only b) P,R and S only

c) P, Q and R only d) Q and R only

Ans : d

05. If a continuous function $f(x)$ does not have a root in the interval [a,b], then which one of the following statements is TRUE?

a) $f(a) \cdot f(b) = 0$

b) $f(a) \cdot f(b) < 0$

c) $f(a) \cdot f(b) > 0$

d) $f(a)/f(b) \leq 0$

Ans : c

06. A separately excited DC generator has an armature resistance of 0.1Ω and negligible armature inductance. At rated field current and rated rotor speed, its open-circuit voltage is 200V. When this generator is operated at half the rated spend, with half the rated field current, an un-charged 1000μF capacitor is suddenly connected across the armature terminals. Assume that the speed remains unchanged during the transient. At what time (in microsecond) after the capacitor is connected will the voltage across it reach 25V?

a) 62.25 b) 69.3 c) 73.25 d) 77.3

Ans : *

07. A (0.50A) moving coil ammeter has a voltage drop of 0.1V across its terminals at full scale deflection. The external shunt resistance (in millions) needed to extend its range to (0-500A) is ___________.

Ans : 0.55

08. Consider a function $\vec{f} = \frac{1}{r^2}\hat{r}$, where r is the distance from the origin and $\hat{r}$ is the unit vector in the radial direction. The divergence of this function over a sphere of radius R, which includes the origin, is

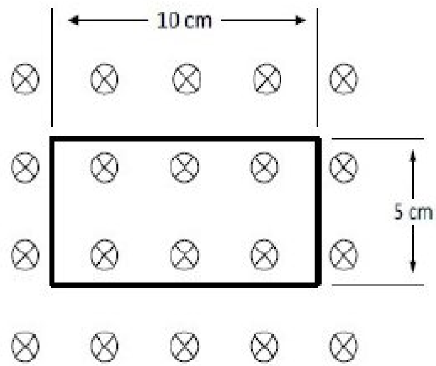
a) 0 b) 2π c) 4π d) Rπ

Ans : a

09. A random variable X has probability density function *f(x)* as given below $f(x)=\begin{cases} a+bx & for\ 0<x<1 \\ 0 & other\ wise \end{cases}$ if the expected value E[X] = 2/3, then Pr [X < 0.5] is __________.

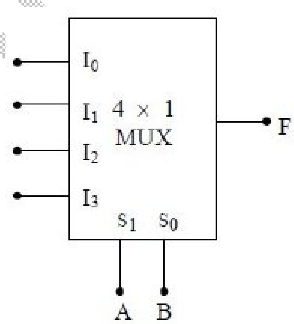
Ans : 0.25

10. Consider a one-turn rectangular loop of wire placed in a uniform magnetic field as shown in the figure. The plane of the loop is perpendicular to the field lines. The resistance of the loop is 0.4Ω, and its inductance is negligible. The magnetic flux density (in Tesla) is a function of time, and is given by B(t) = 0.25 sin ωt, where ωt, where ω = 2π x 50 radians/second. The power absorbed (in watt) by the loop from the magnetic field is_________.



Ans : 0.1969

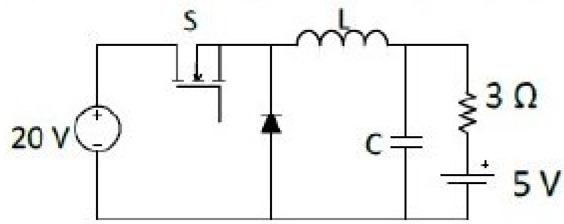
11. In the 4 x 1 multiplexer, the output F is given by F = A ⊗ B. Find the required input $'I_3I_2I_1I_0'$



a) 1010 b) 0110 c) 1000 d) 1110

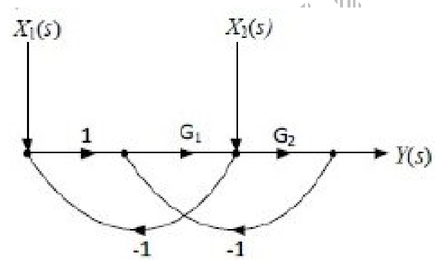
Ans : b

12. In the following chopper, the duty ratio of switch S is 0.4. If the inductor and capacitor are sufficiently large to ensure continuous inductor current and ripple free capacitor voltage, the charging current (in Ampere) of the 5V battery, under steady-state, is __________.



Ans : 1

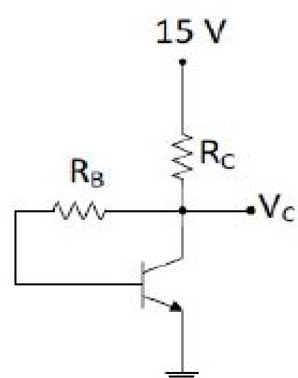
13.For the signal-flow graph shown in the figure, which one of the following expressions is equal to the transfer function $\left.\frac{Y(s)}{X_2(s)}\right|_{X_L(s)=0}$?



a) $\frac{G_1}{1+G_2(1+G_1)}$ b) $\frac{G_2}{1+G_1(1+G_2)}$ c) $\frac{G_1}{1+G_1G_2}$ d) $\frac{G_2}{1+G_1G_2}$

Ans : b

14. In the given circuit, the silicon transistor has β = 75 and a collector voltage V_C = 9V. Then the ratio of R_B and R_C is _______________.



Ans : 105.13

15. The self inductance of the primary winding of a single phase, 50Hz, transformer is 800 mH, and that of the secondary winding is 600mH. The mutual inductance between these two windings is 480mH. The secondary winding of this transformer is short circulated and the primary winding is connected to a 50Hz, single phase, sinusoidal voltage source. The current flowing in both the windings is less than their respective rated currents. The resistance of both windings can be neglected. In this condition, what is the effective inductance (in mH) seen by the source?

a) 416 b) 440 c) 200 d) 920

Ans : a

16. Of the four characteristics given below, which are the major requirements for an instrumentation amplifier?

P. High common mode rejection ratio

Q. High input impedance

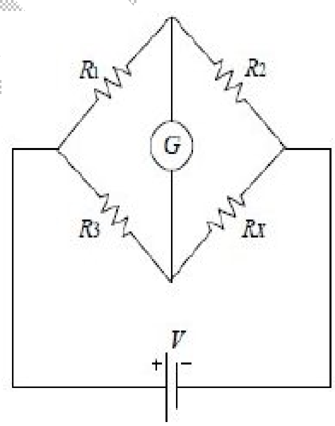
R. High linearity

S. High output impedance

a) P,Q and R only b) P and R only c) P,Q and S only d) Q,R and S only

Ans : a

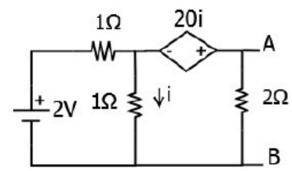
17. When the Wheatstone bridge shown in the figure is used to find the value of resistor R_X, the galvanometer G indicates zero current when $R_1 = 50\Omega$, $R_2 = 65\Omega$ and $R_3 = 100\Omega$. If R_3 is known with ±5% tolerance on its nominal value of 100Ω, what is the range of R_X in Ohms?



a) [123.50, 136.50] b) [125.89, 134.12] c) [117.00, 143.00] d) [120.25, 139.75]

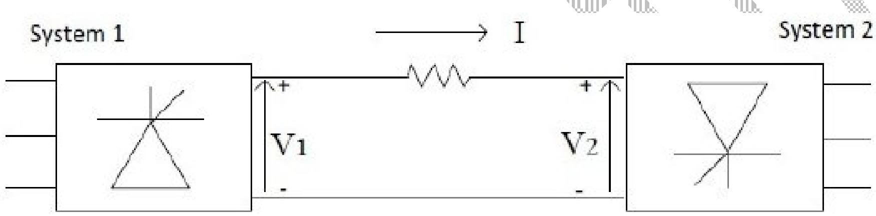
Ans : a

18. For the given circuit, The Thevenin equivalent is to be determined. The Thevenin voltage, V_{Th} (in Volt), seen from terminal AB is______________.



Ans : 3.36

19. Consider a HVDC link which uses thyristor based line – commutated converters as shown in the figure. For a power flow of 750 MW from system 1 to system 2, the voltage at the two ends, and the current, are given by: V_1=500 kV, V_2=485 kV and I= 1.5kA. IF the direction of power flow is to be reversed (that is, from system 2 to system 1) without changing the electrical connections, then which one of the following combinations is feasible?



a) $V_1 = -500kV,\ V_2 = -485kV and\ I = 1.5kA$

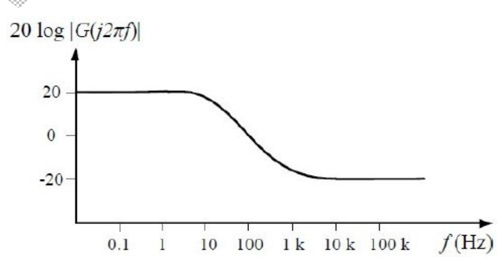
b) $V_1 = -485kV, V_2 = -500kV\ and\ I = 1.5kA$

c) $V_1 = 500kV,\ V_2 = 485kV\ and\ I = -1.5kA$

d) $V_1 = -500kV,\ V_2 = -485kV\ and\ I = -1.5kA$

Ans : b

20. A Bode magnitude plot for the transfer function G(s) of plant is shown in the figure. Which one of the following transfer functions best describes the plant?



a) $\frac{1000(s+10)}{s+1000}$ b) $\frac{10(s+10)}{s(s+1000)}$ c) $\frac{s+1000}{10s(s+1000)}$ d) $\frac{s+1000}{10(s+10)}$

Ans : d

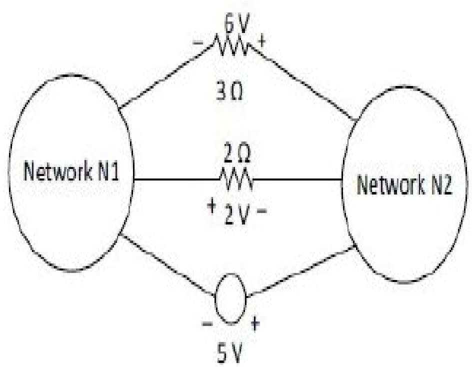
21. The primary mmf is affected by the secondary terminal conditions in a

a) Power transformer b) Potential transformer

c) Current transformer d) Distribution transformer

Ans : c

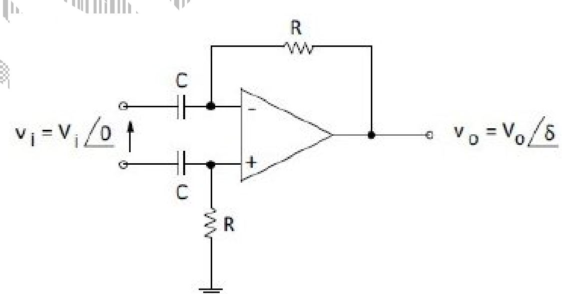
22. The voltage developed across the 3Ω and 2 Ω resistors shown in the figure are 6V and 2V respectively, with the polarity as marked. What is the power (in Watt) delivered by the V voltage source?



a) 5 b)7 c) 10 d)14

Ans : a

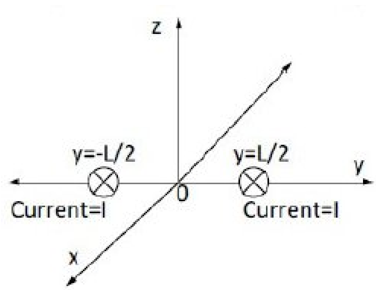
23. Consider the circuit shown in the figure. In this circuit R=1kΩ, and C=1, C=1μF. The input voltage is sinusoidal with a frequency of 50Hz, represented as a phasor with magnitude V_i and phase angle 0 radian as shown in the figure. The output voltage is represented as a phasor with magnitude V_0 and phase angle δ radian. What is the value of the output phase angle δ (in radian) relative to the phase angle of the input voltage ?



A) 0 b) π c) $\pi/2$ d) $-\pi/2$

Ans : d

24. A steady current I is flowing in the – x direction through each of two infinitely long wires at $y = \pm\frac{L}{2}$ as shown in the figure. The permeability of the medium is μ_0. The $\vec{B}$ -field at (0,L,0) is



a) $-\frac{4\mu_0 I}{3\pi L}$ b) $+\frac{4\mu_0 I}{3\pi L}\hat{z}$ c) 0 d) $-\frac{3\mu_0 I}{4\pi L}\hat{z}$

Ans : a

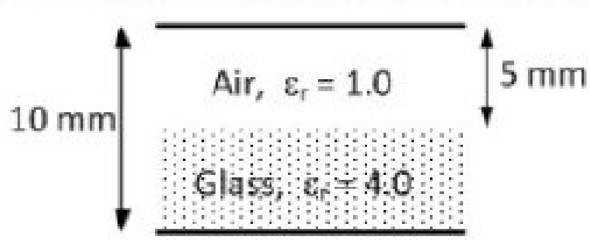
25. A moving average function is given by $y(t) = \frac{1}{\tau}\int_{\tau-T}^{\tau} u(\tau)\,d\tau$. If the input u is sinusoidal signal of frequency $\frac{1}{2T}Hz$, then in steady state, the output y will lag u (in degree) by _______.

Ans :90

26. Two single-phase transformers T_1 and T_2 each rated at 500 kVA are operated in parallel. Percentage impedances of T_1 and T_2 are (1+j6) and (0.8+j4.8), respectively. To share a load of 1000 KVA at 0.8 lagging power factor, the contribution of T_2 (in KVA) is ___________

Ans :555

27. A parallel plate capacitor is partially filled with glass of dielectric constant 4.0 as shown below. The dielectric strengths of air and glass are 30KV/cm and 300 KV/cm, respectively. The maximum voltage (in kilovolts), which can be applied across the capacitor with out any breakdown, is______



Ans :18.75

28.f(A,B,C,D) = Π M(0,1,3,4,5,7,9,11,12,13,14,15) is a maxterm representation of a Boolean function f(A,B,C,D) where A is the MSB and D is the LSB. The equivalent minimized representation of this function is___________

a) $(A+\overline{C}+D)(\overline{A}+B+D)$

b) $A\overline{C}D+\overline{A}BD$

b) $\overline{A}CD+A\overline{B}C\overline{D}+A\overline{B}\overline{C}\overline{D}$

d) $(B+\overline{C}+D)(A+\overline{B}+C+D)(\overline{A}+B+C+D)$

Ans : c

29.A 3-phase 50Hz square wave (6-step) VSI feeds a 3-phase, 4 pole induction motor. The VSI line voltage has a dominate 5^{th} harmonic component. If the operating slip of the motor with respect to fundamental component voltage is 0.04, the slip of the motor with respect to 5^{th} harmonic component of voltage is __________

Ans :0.808

30. consider a discrete time signal given by

$$x[n] = (-0.25)^n u[n] + (0.5)^n u[-n-1]$$

The region of convergence of its Z-transform would be

(A) The region inside the circle of radius 0.5 and centered at origin.

(B) The region outside the circle of radius 0.25 and centered at origin

(C) The annular region between the two circles, growth centered at origin and having radii o.25 and 0.5

(D) The entire Z plane

Ans :c

31. The signum function is given by

$$\operatorname{sgn}(x) = \begin{cases} \dfrac{x}{|x|}; x \neq 0 \\ 0; x = 0 \end{cases}$$

The Fourier series expansion of sgn(cos(t)) has

a) Only sine terms with all harmonics

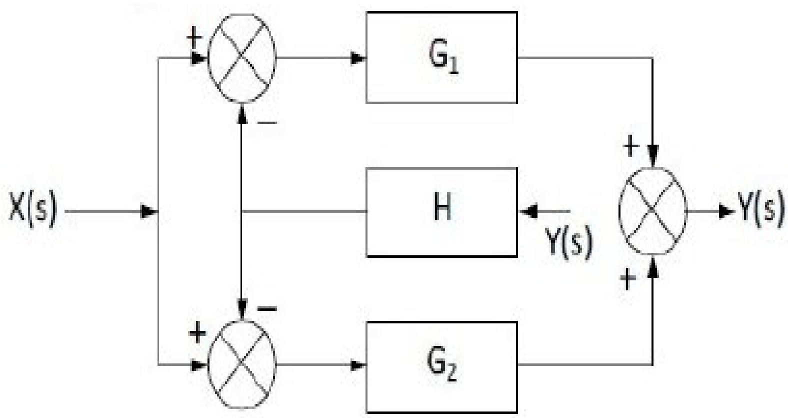
b) Only cosine terms with all harmonics

c) Only sine terms with even numbered harmonics

d) Only cosine terms with odd numbered harmonics

Ans : b

32. Find the transfer function $\frac{Y(s)}{X(s)}$ of the system given below.



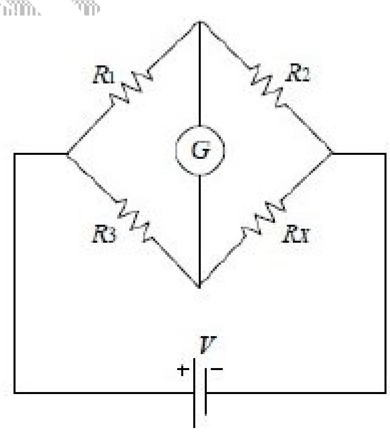
a) $\frac{G_1}{1\text{-}HG_1}+\frac{G_2}{1-HG_2}$ b) $\frac{G_1}{1+HG_1}+\frac{G_2}{1+HG_2}$ c) $\frac{G_1+G_2}{1+H(G_1+G_2)}$ d) $\frac{G_1+G_2}{1-H(G_1+G_2)}$

Ans : c

33. A 200/400V, 50 Hz, two-winding transformers is rated at 20kVA. Its windings are connected as an auto-transformer of rating 200/600V. A resistive load of 12Ω is connected to the high voltage (600V) side of the auto-transfer. The value of equivalent load resistance (in ohm) as seen from low voltage side is__________.

Ans :1.33

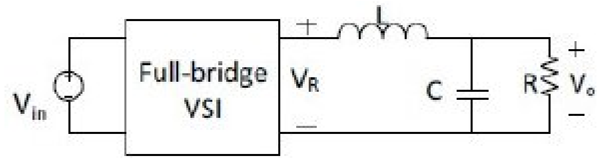
34. An unbalanced DC Wheatstone bridge is shown in the figure. At what value of p of the magnitude of V_0 be maximum?



a) $\sqrt{(1+x)}$ b) $(1+x)$ c) $1/\sqrt{(1+x)}$ d) $\sqrt{(1-x)}$

Ans :a

35. The single-phase full-bridge voltage source inverter (VSI), shown in figure, has an output frequency of 50Hz. It uses unipolar pulse with modulation with switching frequency of 50kHz and modulation index of 0.7. For V_{in} = 100V DC, L = 9.55mH, C=63.66μF, and R = 5Ω, the amplitude of the fundamental component in the output voltage V_0(in volt) under steady-state is _______________.



Ans :49.5

36. A DC motor has the following specifications; 10hp, 37.5A, 230V; flux/pole = 0.01 Wb, number of poles = 4, number of conductors = 666, number of parallel paths =2. Armature resistance = 0.267Ω. The armature reaction is negligible and rotational losses are 600W. The motor operates from a 230V DC supply. If the motor runs at 1000rpm, the output torque produced (in Nm) is ____________.

Ans :57.78

37. Two players, A and B, alternatively keep rolling a fair dice. The person to get a six first wins the game. Given that player A starts the game, the probability that A wins the game is

a) 5/11 b) ½ c) 7/13 d) 6/11

Ans :d

38. A 50Hz generating unit has *H*- constant of 2MJ/MVA. The machine is initially operating is steady state at synchronous speed, and producing 1[I pu of real power. The initial value of the rotor angle δ is 5'. When a bolted three phase to ground short circuit fault occurs at the terminal of the generator. Assuming the input mechanical power to remain at 1pu, the value of δ in degrees, 0.02 second after the fault is________.

Ans :5.9

39. Determine the correctness or otherwise of the following Assertion [a] and the Reason [r]

Assertion : Fast decoupled load flow method gives approximate load flow solution because it uses several assumptions.

Reason : Accuracy depends on the power mismatch vector tolerance.

a) Both [a] and [r] true and [r] is the correct reason for [a].

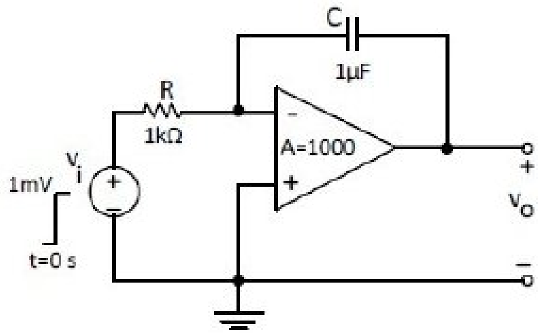
b) Both [a] and [r] are true but [r] is not the correct reason for [a]

c) Both [a] and [r] are false

d) [a] is false and [r] is true

Ans :b

40. The op-amp shown in the figure has finite gain A =1000 and infinite input resistance. A step-voltage V_1=1 mV is applied at the input at time t=0 as shown. Assuming that the operational amplifier is not saturated the time constant (n millisecond) of the output voltage V_0 is.



a) 1001 b) 101 c) 11 d) 1

Ans :d

41. Consider the economic dispatch problem for a power plant having two generating units. The fuel costs in Rs/MWh along with generation limits for the two units are given below.

$$c_1(P_1) = 0.01P_1^2 + 30P_1 + 10 \;:100\,MW \le P_1 \le 150\,MW$$

$$c_2(P_2) = 0.05P_2^2 + 10P_2 + 10 : 10\,MW \le P_2 \le 180\,MW$$

Ans :20Rs/MWhr

42. A solution of the ordinary different equation $\frac{d^2y}{d\tau^2} + 5\frac{dy}{d\tau} + 6y = 0$ is such that y(0) = 2 and $y(1) = \frac{1-3e}{e^3}$. The value of $\frac{dy}{d\tau}(0)\,is$ __________.

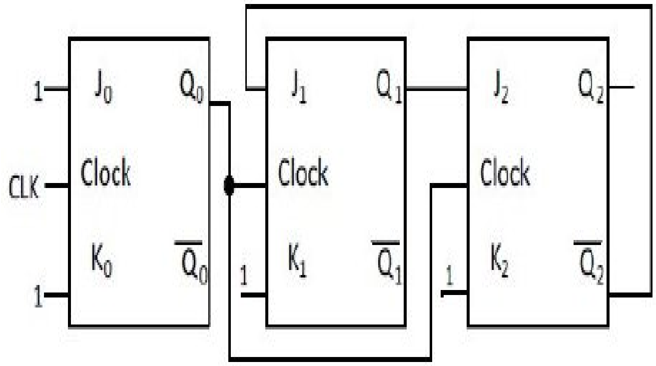
Ans : -3

43. An 8-bit, unipolar successive approximation Register type ADC is used to cnvert 3.5 V to digital equivalent output. The reference voltage is +5V. The output of the ADC, at the end of 3^{rd} clock pulse after the start conversion, is

a) 1010 0000 b) 1000 0000 c) 0000 0001 d) 0000 0011

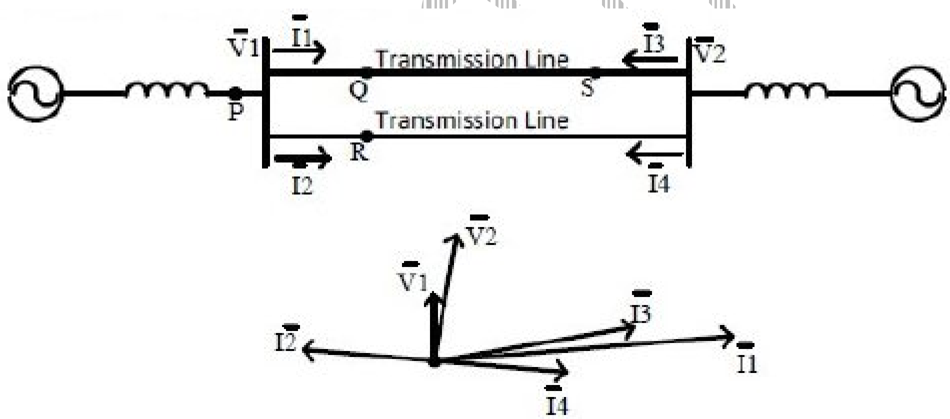
Ans : a

44. The figure shows a digital circuit constructed using negative edge triggered J-K flip flops. Assume a starting state of $Q_2Q_1Q_0$=000. This state $Q_2Q_1Q_0$ = 000 will repeat after ______ number of cycles of the clock CLK.



Ans : 6

45. A sustained three-phase fault occurs in the power system shown in the figure. The current and voltage phasors during the fault (on a common reference). After the natural transients have died down, are also shown, Where is the fault located?



a) Location P b) Location Q c) Location R d) Location S

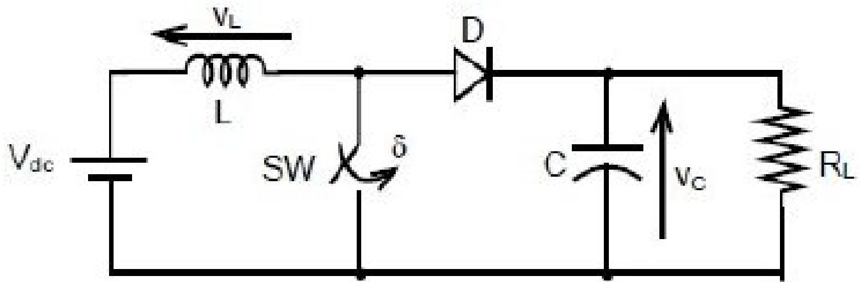
Ans : b

46. The maximum value of "a" such that the matrix $\begin{pmatrix} -3 & 0 & -2 \\ 1 & -1 & 0 \\ 0 & a & -2 \end{pmatrix}$ real eigenvector is

a) $\frac{2}{3\sqrt{3}}$ b) $\frac{1}{3\sqrt{3}}$ c) $\frac{1+2\sqrt{3}}{3\sqrt{3}}$ d) $\frac{1+\sqrt{3}}{3\sqrt{3}}$

Ans : b

47. A self commutating switch SW, operated at duty cycle δ is used to control the load voltage as shown in the figure.



Under steady state operating conditions, the average voltage across the inductor and the capacitor respectively, are

a) $V_L = 0$ and $V_C = \frac{1}{1-\delta}V_{dc}$ b) $V_L = \frac{\delta}{2}V_{dc}$ and $V_C = \frac{1}{1-\delta}V_{dc}$

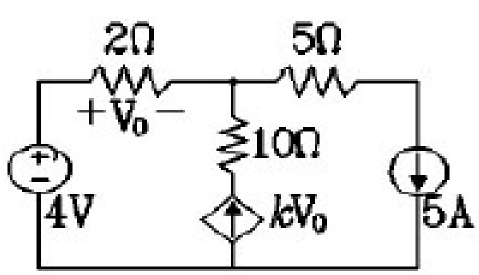
c) $V_L = 0$ and $V_C = \frac{\delta}{1-\delta}V_{dc}$ d) $V_L = \frac{\delta}{2}V_{dc}$ and $V_C = \frac{\delta}{1-\delta}V_{dc}$

Ans : a

48. A separately excited DC motor runs at 1000 rpm on no load when its armature terminals are connected to a 200V DC source and the rated voltage is applied to the filed winding. The armature resistance of this motor is 1Ω. The no-load armature current is negligible. With the motor developing its full load torque, the armature voltage is set so that the rotor speed is 500rpm. When the load torque is reduced to 50% of the full load value under the same armature voltage conditions, the speed rise to 520 rpm. Neglecting the rotational losses, the full load armature current (in ampere) is______.

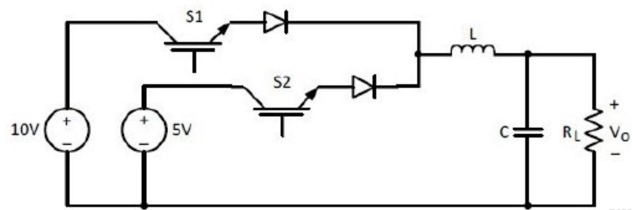
Ans :8

49. In the given circuit, the parameter *k* is positive, and the power dissipated in the 2Ω resistor is 12.5W. The value of *k* is_____.



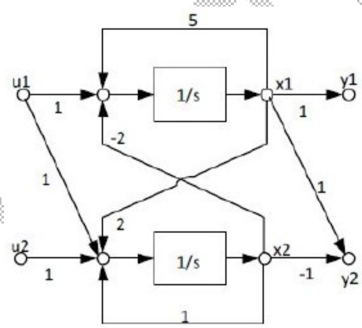
Ans :0.5

50. The circuit shown is meant to supply a resistive load R_L from two separate DC voltage sources. The switches S1 and S2 are controlled so that only one of then is ON at any instant. S1 is turned on for 0.2mas and S2 is turned on for 0.3m s in a 0.5 ms switching cycle time period. Assume continuous conduction of the inductor current and negligible ripple on the capacitor voltage, the output voltage V_0 (in volt) across R_L is________.



Ans :7

51. In the signal flow diagram given in the figure, u_1 and u_2 are possible inputs whereas y_1 and y_2 are possible outputs. When would the SISO system derived from this diagram be controllable and observable?



a) When u_1 is the only input and y_1 is the only output.

b) When u_2 is the only input and y_1 is the only input

c) When u_1 is the only input and y_2 is the only input

d) When u_2 is the only input and y_2 is the only output

Ans :b

52. The transfer function of a second order real system with a perfectly flat magnitude response of unit has pole at(2-j3). List all the poles and zeroes.

a) Poles at (2±j3), in zeroes

b) Poles at (±2-j3), one zero at origin

c) Poles at (2-j3), (-2+j3), zeroes at (-2-j3), (2+j3)

d) Poles at (2±j3), zeros at (-2±j3)

Ans :d

53. In a linear two-port network, when 10V is applied to Port 1, a current of 4A flows through Port2 when it is short-circuited. When 5V is applied to Port1, a current of 1.25 A flows through a 1Ω resistance connected across Port 2. When 3V is applied to Port1, the current (in Ampere) through a 2 Ω resistance connected across Port 2 is_________.

Ans :0.545

54. The open loop poles of a third order unity feedback system are at 0,-1,-2. Let the frequency corresponding to the point where the root locus of the system transits to unstable region be K. Now suppose we introduce a zero in the open loop transfer function at-3, while keeping all the earlier open loop poles intact. Which one of the following is TRUE about the point where pint where the root locus of the modified system transits to unstable region?

a) it corresponds to a frequency greater than K

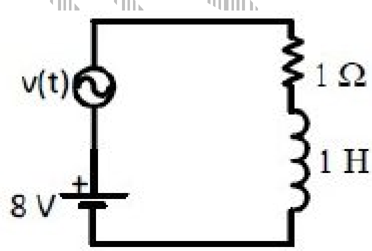
b) It corresponds to a frequency less than K

c) It corresponds to a frequency K

d) Root locus of modified system never transits to unstable region

Ans :d

55. The circuit shown in the figure has two sources connected in series. The instantaneous voltage of the AC source (in volt) is given by $v(t) = 12 \sin \tau$. If the circuit is in steady state, then the rms value of the current(in Ampere) flowing in the circuit is ______.



Ans :10