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SET-Y

A

M.Phil./Ph.D./URS-EE-2020

SUBJECT : Electrical Engineering

10009

Sr. No. .....

Time : **1¼ Hours** Max. Marks : **100** Total Questions : **100**

Roll No. (in figures)_____ (in words) _____

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SEAL

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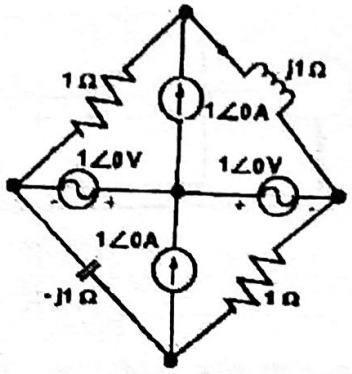
1. The slip of the induction motor does not depends on :
   (1) Rotor Speed (2) Synchronous Speed
   (3) Shaft Torque (4) Core-loss Component

2. A system with transfer function $G(s) = \dfrac{(s^2+9)(s+2)}{(s+1)(s+3)(s+4)}$ is excited by $\sin(\omega t)$. The steady-state output of the system is zero at :
   (1) $\omega = 1$ rad/s (2) $\omega = 2$ rad/s
   (3) $\omega = 3$ rad/s (4) $\omega = 4$ rad/s

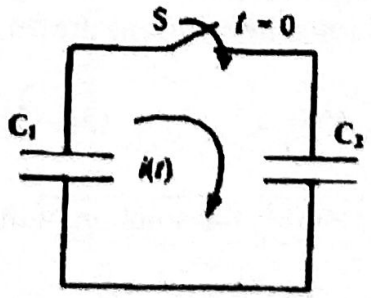
3. In the circuit shown below, the current through the inductor is :



   (1) $\dfrac{2}{1+j}A$ (2) $\dfrac{-1}{1+j}A$ (3) $\dfrac{1}{1+j}A$ (4) $0A$

4. The sequence components of the fault current are as follows :
   $I_{positive} = j1.5\ pu$, $I_{negative} = j0.5\ pu$, $I_{zero} = -j1\ pu$. The type of fault in the system is :
   (1) LG (2) LL (3) LLG (4) LLLG

5. In the following figure, C_1 and C_2 are ideal capacitors. C_1 has been charge to 12 V before the ideal switch S is closed at t = s. The current i(t) for all t is :



   (1) Zero (2) A step function
   (3) An exponentially decaying function (4) An impulse function

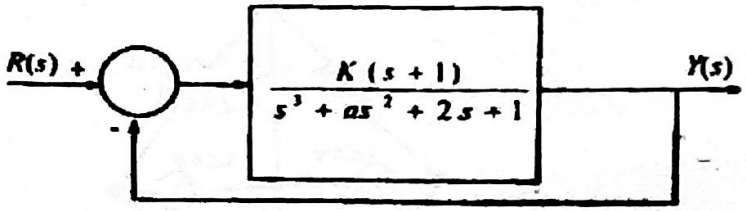
6. A 220 V, 15 kW, 1000 rpm shunt motor with armature resistance of 0.25Ω, has a rated line current of 68 A and a rated field current of 2.2 A. The change in field flux required to obtain a speed of 100 rpm while drawing a line current of 52.8 A and a field current of 1.8 A is :

(1) 18.18% increase
(2) 18.18% decrease
(3) 36.36% increase
(4) 36.36% decrease

7. If $V_A - V_B = 6V$, then $V_C - V_D$ is :

(1) −5V (2) 2V (3) 3V (4) 6V

8. The feedback system shown below oscillates at 2 rad/s when :



(1) K = 2 and a = 0.75
(2) K = 3 and a = 0.75
(3) K = 4 and a = 0.5
(4) K = 2 and a = 0.5

9. The bus admittance matrix of a three-phase three-line system is $Y = j\begin{bmatrix} -13 & 10 & 5 \\ 10 & -18 & 10 \\ 5 & 10 & -13 \end{bmatrix}$. If each transmission line between the two buses is represented by an equivalent π-network, the magnitude of the shunt susceptance of the line connecting bus 1 and 2 is :

(1) 4 (2) 2 (3) 1 (4) 0

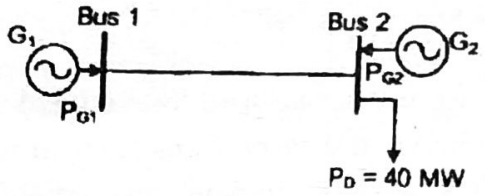
10. The locked rotor current in a 3-phase, star connected 15 kW, 4-pole, 230 V, 50 Hz induction motor at rated conditions is 50 A. Neglecting losses and magnetizing current, the approximate locked rotor line current drawn when the motor is connected to a 236 V, 57 Hz supply is :

(1) 58.5 A (2) 45.0 A (3) 45.7 A (4) 55.6 A

11. With initial condition $x(1) = 0.5$, the solution of the differential equation $t\frac{dx}{dt} + x = t$ is :

(1) $x = t - \frac{1}{2}$ (2) $x = t^2 - \frac{1}{2}$ (3) $x = \frac{t^2}{2}$ (4) $x = \frac{t}{2}$

12. The figure shows a two-generator system supplying a load of $P_0 = 40$MW, connected at bus 2.



The fuel cost of generators G_1 and G_2 are :
$C_1(P_{G1}) = 10{,}000$ Rs/MWh and $C_2(P_{G2}) = 12500$ Rs/MWh and the loss in the line is $P_{loss(pu)} = 0.5\ PG^2_{1(pu)}$, where the loss coefficient is specified in pu on a 100 MVA base. The most economic power generation schedule in MW is :

(1) $P_{G1} = 20,\ P_{G2} = 22$ (2) $P_{G1} = 22,\ P_{G2} = 20$

(3) $P_{G1} = 20,\ P_{G2} = 20$ (4) $P_{G1} = 0,\ P_{G2} = 40$

13. Leakage flux in an induction motor is :

(1) Flux that leaks through the machine

(2) Flux that links both stator and rotor windings

(3) Flux that links none of the windings

(4) Flux that links the stator winding or the rotor winding but not both

14. The angle δ in the swing equation of a synchronous generator is the :

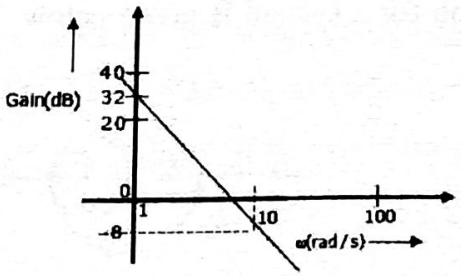
(1) angle between stator voltage and current

(2) angular displacement of the rotor with respect to the stator

(3) angular displacement of the stator mmf with respect to a synchronously rotating axis

(4) angular displacement of an axis fixed to the rotor with respect to a synchronously rotating axis

15. The Bode plot of a transfer function G(s) is shown in the figure below.



The gain ($20\log |G(s)|$) is 32 dB and –8 dB at 1 rad/s and 10 rad/s respectively. The phase is negative for all ω. The $G(s)$ is :

(1) 39.8/s (2) $39.8/s^2$ (3) 32/s (4) $32/s^2$

16. The flux density at a point in space is given by $B = 4xa_x + 2kya_y + 8a_z$Wb/m2. The value of constant k must be equal to :

(1) –2 (2) –0.5 (3) +0.5 (4) +2

17. A single-phase transformer has no-load loss of 64 W, as obtained from an open-circuit test. When a short-circuit test is performed on to it with 90% of the rated currents flowing in its both LV and HV windings, the measured loss is 81 W. The transformer has maximum efficiency when operated at :

(1) 50.0% of the rated current (2) 64.0% of the rated current

(3) 80.0% of the rated current (4) 88.8% of the rated current

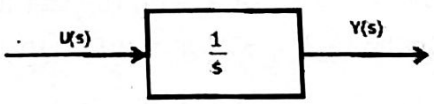
18. A source v_s = V cos 100πt has an internal impedance of $(4 + j3)\ \Omega$. If a purely resistive load connected to this source has to extract the maximum power out of the source, its value in Ω should be :

(1) 3 (2) 4 (3) 5 (4) 7

19. The impulse response of a system is $h(t) = tu(t)$. For an input $u(t-1)$, the output is :

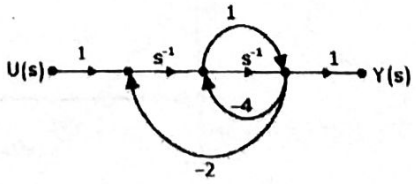
(1) $\frac{t^2}{2}u(t)$ (2) $\frac{t(t-1)}{2}u(t-1)$ (3) $\frac{t(t-1)^2}{2}u(t-1)$ (4) $\frac{(t^2-1)}{2}u(t-1)$

20. Assuming zero initial condition, the response $y(t)$ of the system given below to a unit step input $u(t)$ is :



(1) $u(t)$ (2) $tu(t)$ (3) $\frac{t^2}{2}u(t)$ (4) $e^{-t}u(t)$

21. The signal flow graph for a system is given below. The transfer function $\frac{Y(s)}{U(s)}$ for the system is :



(1) $\frac{s+1}{5s^2+6s+2}$ (2) $\frac{s+1}{s^2+6s+2}$ (3) $\frac{s+1}{s^2+4s+2}$ (4) $\frac{1}{5s^2+6s+2}$

22. The dielectric slab with 500 mm × 500 mm cross-section is 0.4 m long. The slab is subjected to a uniform electric field of E = 6a + 8a kV/mm. The relative permittivity of the dielectric material is equal to 2. The value of constant ε_0 is 8.85×10^{-12} F/m. The energy stored in the dielectric in Joules is :

(1) 8.85×10^{-11} (2) 8.85×10^{-5} (3) 88.5 (4) 885

23. For a power system network with n nodes, Z_{33} of its bus impedance matrix is j0.5 pu. The voltage at node 3 is 1.3 $\angle -10°$pu. If a capacitor having reactance of –j3.5 pu is now added to the network between node 3 and the reference node, the current drawn by the capacitor pu is :

(1) $0.325\angle -100°$ (2) $0.325\angle 80°$

(3) $0.371\angle -100°$ (4) $0.433\angle -80°$

24. The curl of the gradient of the scalar field defined by $V = 2x^2y + 3y^2z + 4z^2x$ is :

(1) $4xya_x + 6yza_y + 8zxa_z$

(2) $4a_x + 6a_y + 8a_z$

(3) $(4xy + 4z^2)a_x + (2x^2 + 6yz)a_y + (3y^2 + 8zx)a_z$

(4) 0

25. A single-phase load is supplied by a single-phase voltage source. If the current flowing from the load to the source is $10\angle -150°$A and if the voltage at the load terminals is $100\angle -60°$ V, then the :

(1) Load absorbs real power and delivers reactive power

(2) Load absorbs real power and absorbs reactive power

(3) Load delivers real power and delivers reactive power

(4) Load delivers real power and absorbs reactive power

26. The line A to neutral voltage is $10\angle -15°$ V for a balanced three-phase star-connected load with phase sequence ABC. The voltage of line B with respect to line C is given by :

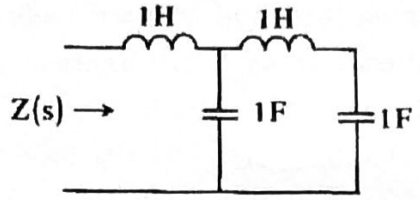
(1) $10\sqrt{3}\angle 105°$V (2) $10\angle 105°$ V

(3) $10\sqrt{3}\angle -75°$ V (4) $-10\sqrt{3}\angle 90°$ V

27. A hollow metallic sphere of radius r is kept at potential of 1 Volt. The total electric flux coming out of the concentric spherical surface of radius R ($>r$) is :

(1) $4\pi\varepsilon_0 r$ (2) $4\pi\varepsilon_0 r^2$ (3) $4\pi\varepsilon_0 R$ (4) $4\pi\varepsilon_0 R^2$

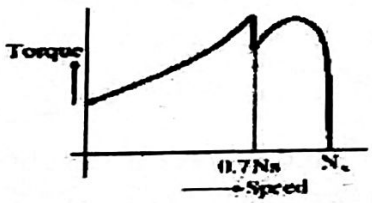
28. The driving point impedance Z(s) for the circuit shown below is :

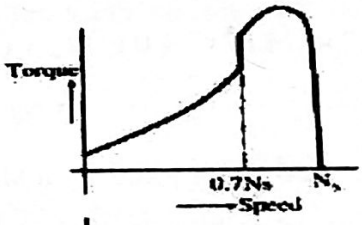


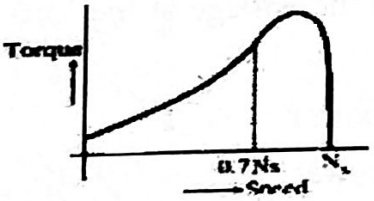
(1) $\frac{s^4+3s^2+1}{s^3+2s}$ (2) $\frac{s^4+2s^2+1}{s^2+2}$

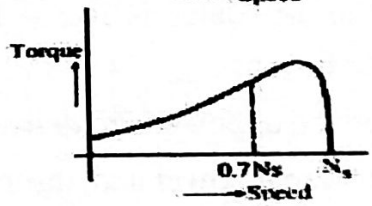
(3) $\frac{s^2+1}{s^4+s^2+1}$ (4) $\frac{s^3+1}{s^4+s^2+1}$

29. A single phase induction motor is provided with capacitor and centrifugal switch in series with auxiliary winding. The switch is expected to operate at a speed of 0.7 Ns, but due tomalfunctioning the switch fails to operate. The torque-speed characteristic of the motor is represented by :

(1) 

(2) 

(3) 

(4) 

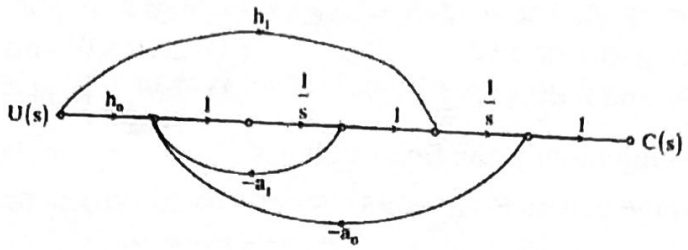
30. The no-load speed of a 230 V separately excited dc motor is 1400 rpm. The armature resistance drop and the brush drop are neglected. The field current is kept constant at ratedvalue. The torque of the motor in Nm for an armature current of 8 A is :

(1) 10 (2) 12.5 (3) 15 (4) 17.5

31. In a long transmission line with r, l, g and c are the resistance, inductance, shunt conductance and capacitance per unit length, respectively, the condition for distortionless transmission is :

(1) rc = lg (2) rc = $\sqrt{(l/c)}$ (3) rg = lc (4) g = $\sqrt{(c/l)}$

32. The signal flow graph of a system is shown below. $U(s)$ is the input and $C(s)$ is the output :



Assuming, $h_1 = b_1$ and $h_0 = b_0 - b_1a_1$, the input-output transfer function, $G(s) = \dfrac{C(s)}{U(s)}$ of the system is given by :

(1) $G(s) = \dfrac{b_0s + b_1}{s^2 + a_0s + a_1}$

(2) $G(s) = \dfrac{a_1s + a_0}{s^2 + b_1s + b_0}$

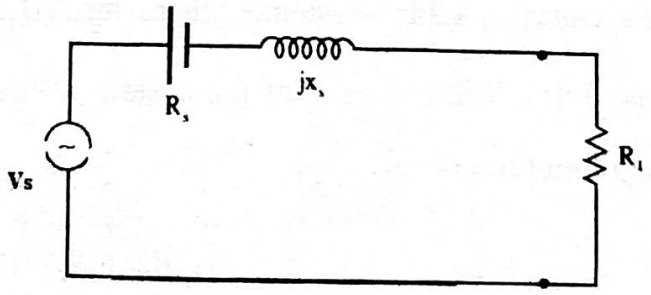
(3) $G(s) = \dfrac{b_1s + b_0}{s^2 + a_1s + a_0}$

(4) $G(s) = \dfrac{a_0s + a_1}{s^2 + b_0s + b_1}$

33. An LPF wattmeter of power factor 0.2 is having three voltage settings 300 V, 150 V and 75 V, and two current settings 5 A and 10 A. The full scale reading is 150. If the wattmeter is used with 150 V voltage setting and 10 A current setting, the multiplying factor of the wattmeter is :

(1) 2 (2) 4 (3) 6 (4) 8

34. A non-ideal voltage source V_s has an internal impedance of Z_s If a purely resistive load is tobe chosen that maximizes the power transferred to the load, its value must be :



(1) 0

(2) Real part of Zs

(3) Magnitude of Zs

(4) Complex conjugate of Zs

35. Integration of the complex function $f(z) = \dfrac{z^2}{z^2 - 1}$ in the counterclockwise direction, around $|z - 1| = 1$, is :

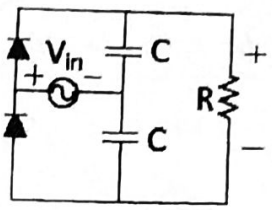
(1) $-\pi i$ (2) 0 (3) πi (4) $2\pi i$

36. A 3-phase balanced load which has a power factor of 0.707 is connected to a balanced supply. The power consumed by the load is 5 kW. The power is measured by two-wattmeter method. The reading of the two wattmeters are :

(1) 3.94 kW and 1.06 kW (2) 2.50 kW and 2.50 kW

(3) 5.00 kW and 0.00 kW (4) 2.96 kW and 2.04 kW

37. In the following circuit, the input voltage V_{in} is 100 sin(100 πt). For 100 πRC = 50, the average voltage across R (in volts) under steady-state is nearest to :

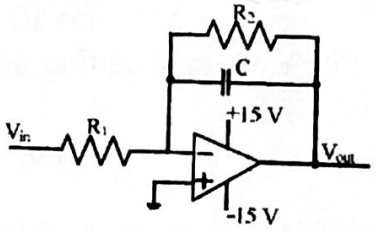


(1) 100 (2) 31.8 (3) 200 (4) 63.6

38. If $|9y - 6| = 3$, then $y^2 - 4y/3$ is :

(1) 0 (2) +1/3 (3) −1/3 (4) Undefined

39. The circuit shown below is an example of a :



(1) Low pass filter (2) Band pass filter (3) High pass filter (4) Notch filter

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

(1) $9e^{-\frac{t}{3}}u(t)$ (2) $9e^{-\frac{t}{6}}u(t)$

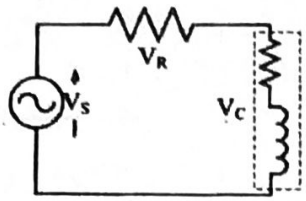
(3) $9e^{-\frac{t}{3}}u(t) - 6e^{-\frac{t}{6}}u(t)$ (4) $54e^{-\frac{t}{6}}u(t) - 54e^{-\frac{t}{3}}u(t)$

41. A 3×3 matrix P is such that, $p^3 = P$. Then the eigen values of P are :

(1) 1, 1, −1 (2) 1, 0.5 + j0.866, 0.5 − j0.866

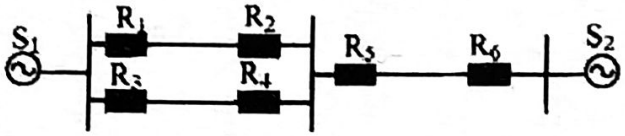
(3) 1, -0.5 + j0.866, −0.5 − j0.866 (4) 0, 1,−1

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



(1) 65,35 (2) 50,50 (3) 60,90 (4) 60, 80

43. A power system with two generators is shown in the figure below. The system (generators, buses and transmission lines) is protected by six overcurrent relays R_1 to R_6. Assuming a mix of directional and non-directional relays at appropriate locations, the remote backup relays for R_4 are :



(1) R_1, R_2 (2) R_2, R_6 (3) R_2, R_5 (4) R_1, R_6

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

(1) 189×189 (2) 100×100 (3) 90×90 (4) 180×180

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

(1) 1 (2) 2 (3) 4 (4) 16

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

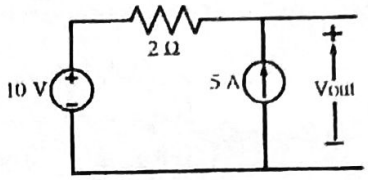
(1) Interchanging the terminals of the AC supply.

(2) Interchanging the terminals of the capacitor.

(3) Interchanging the terminals of the auxiliary winding.

(4) Interchanging the terminals of both the windings.

47. In the circuit shown below, the voltage and current sources are ideal. The voltage (V_{out}) across the current source, in volts, is :



(1) 0 (2) 5

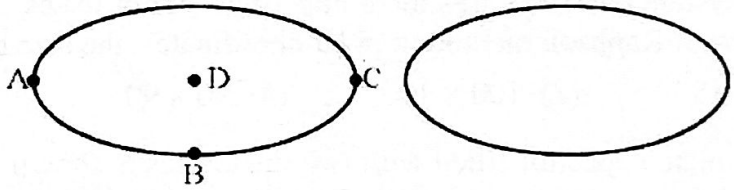
(3) 10 (4) 20

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

(1) 2 and 5 (2) 5 and 2

(3) 3 and 4 (4) 4 and 3

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



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

50. A single-phase 100 kVA, 1000 V / 100 V, 50 Hz transformer has a voltage drop of 5% across its series impedance at full load. Of this, 3% is due to resistance. The percentage regulation of the transformer at full load with 0.8 lagging power factor is :

(1) 4.8 (2) 6.8

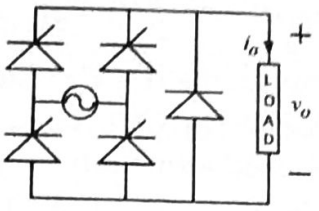
(3) 8.8 (4) 10.8

51. In a salient pole synchronous motor, the developed reluctance torque attains the maximum value when the load angle in electrical degrees is :

(1) 0 (2) 45

(3) 60 (4) 90

52. A single phase fully controlled rectifier is supplying a load with an anti-parallel diode as shown in the figure. All switches and diodes are ideal. Which one of the following is true for instantaneous load voltage and current ?



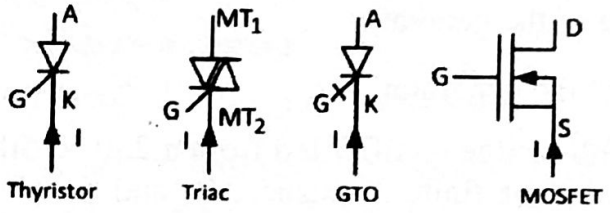
(1) $V_0 \geq 0$ and $i_0 < 0$

(2) $V_0 < 0$ and $i_0 < 0$

(3) $V_0 \geq 0$ and $i_0 \geq 0$

(4) $V_0 < 0$ and $i_0 \geq 0$

53. Four power semiconductor devices are shown in the figure along with their relevant terminals. The device(s) that can carry dc-current continuously in the direction shown whengated appropriately is (are) :



(1) Triac only

(2) Triac and MOSFET

(3) Triac and GTO

(4) Thyristor and Triac

54. The graph of a network has 8 nodes and 5 independent loops. The number of branches of the graph is :

(1) 11 (2) 12 (3) 13 (4) 14

55. M is a 2×2 matrix with eigen values 4 and 9. The eigen values of M^2 are :

(1) 4 and 9 (2) 2 and 3 (3) −2 and −3 (4) 16 and 81

56. A 5 KVA, 50 V /100V, single-phase transformer has a secondary terminal voltage of 95 V when loaded. The regulation of the transformer is :

(1) 4.5% (2) 9% (3) 5% (4) 1%

57. A six-pulse thyristor rectifier is connected to a balanced three-phase, 50 Hz AC source. Assuming that the DC output current of the rectifier is constant, the lowest harmonic component in the AC input current is :

(1) 100 Hz (2) 150 Hz (3) 250 Hz (4) 300 Hz

58. A three-phase synchronous motor draws 200 A from the line at unity power factor at rated load. Considering the same line voltage and load, the line current at a power factor of 0.5 leading is :

(1) 100 A (2) 200 A (3) 300 A (4) 400 A

59. A current controlled current source (CCCS) has an input impedance of 10Ω and output impedance of 100 kΩ. When this CCCS is used in a negative feedback closed loop with a loop gain of 9, the closed loop output impedance is :

(1) 10 Ω (2) 100 Ω (3) 100 kΩ (4) 1000 kΩ

60. Out of the following options, the most relevant information needed to specify the real power (P) at the PV buses in a load flow analysis is :

(1) Solution of the economic load dispatch

(2) Rated power output of the generator

(3) Rated voltage of the generator

(4) Base power of the generator

61. A single-phase, full-bridge rectifier fed from a 230 V, 50 Hz sinusoidal source supplies a series combination of finite resistance, R, and a very large inductance L. The two most dominant frequency components in the source current are :

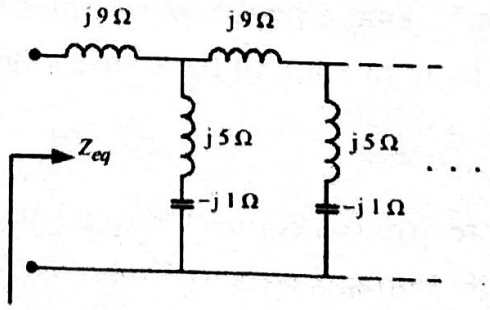
(1) 50 Hz, 0 Hz (2) 50 Hz, 100 Hz

(3) 50 Hz, 150 Hz (4) 150 Hz, 250 Hz

62. A 0-1 Ampere moving iron ammeter has an internal resistance of 50 mΩ and inductance of 0.1 mH. A shunt coil is connected to extend its range to 0-10 Ampere for all operating frequencies. The time constant in milliseconds and resistance in mΩ of the shunt coil respectively are :

(1) 2,5.55 (2) 2,1 (3) 2.18,0.55 (4) 11.1,2

63. The equivalent impedance Z_{eq} for the infinite ladder circuit shown in the figure is :



(1) J12Ω (2) – J12Ω (3) J13Ω (4) 13Ω

64. Consider two npn BJT devices, first device has base doping N_{B1} and second device has base doping N_{B2}. If N_{B2} is two times that of N_{B1} then (Here β_1 and β_2 are the common emitter current gain of device 1 and device 2 respectively) :

(1) $\beta_1 > \beta_2$ (2) $\beta_1 < \beta_2$ (3) $\beta_1 = \beta_2$ (4) None of the above

65. When the temperature decreases then the width of the depletion region in a PN junction diode ?

(1) Increases (2) Decreases

(3) Do not change (4) Increases and then decreases

66. A clamper circuit :

(i) adds or subtract a dc voltage to or from input waveform

(ii) does not change shape of the input waveform

(iii) amplifies the input waveform

Which of the above statements are correct ?

(1) (i) and (ii) (2) (i) and (iii) (3) (ii) and (iii) (4) (i), (ii) and (iii)

67. A CRO is operated with X and Y settings of 0.5 ms/cm and 100 mV/cm respectively. The screen of the CRO is 10 cm × 8 cm (X and Y). A sine wave of frequency 200 Hz and rms amplitude of 300 mV is applied to the Y input. The screen will show :

(1) one cycle of the undistorted sine wave

(2) two cycle of the undistorted sine wave

(3) one cycle sine wave with clipped amplitude

(4) two cycle of the sine wave with clipped amplitude

68. The voltmeter choice for measuring the emf of a 100 V dc source would be :

(1) 100 V, 1 mA (2) 100 V, 2 mA

(3) 100 V, 10 kΩ/V (4) 100 V, 100Ω/kV

69. A three phase transformer is supplied at 6000 V on the delta connected side. The terminal voltage on the star connected side when loaded at power factor 0.8 lagging is 415 V. The equivalent resistance and reactance drops are 1% and 5% respectively. The turn ratio is approximately equal to :

(1) 22 (2) 24 (3) 26 (4) 30

70. The number of samples is one period of signal $\sin(3.15\ \pi n)$ is :

(1) 80 (2) 40 (3) 315 (4) 63

71. The value of $z = \sqrt{i} + \sqrt{(-i)}$ is :

(1) $i + \sqrt{i}$ (2) 1 (3) 0 (4) $\sqrt{2}$

72. For which of the following method, the order of convergence is quadratic ?

(1) Bisection Method (2) Newton-Raphson Method

(3) Regula Falsi Method (4) Secant Method

73. For a slip ring Induction motor, if the rotor resistance is increased, then :

(1) starting torque decrease but efficiency increases

(2) starting torque and efficiency increase

(3) starting torque increase but efficiency decreases

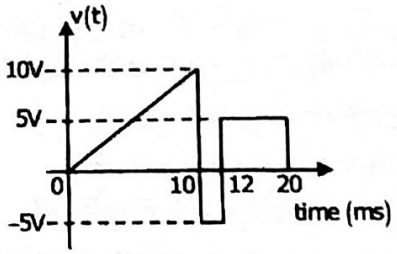
(4) starting torque and efficiency decreases

74. The bridge method commonly used for finding mutual inductance is :

(1) Heaviside Campbell bridge (2) Schering bridge

(3) De Sauty bridge (4) Wein bridge

75. A periodic voltage waveform observed on an oscilloscope across a load in shown. A permanent magnet moving coil (PMMC) meter connected across the same load reads :



(1) 4V (2) 5 V (3) 8 V (4) 10 V

76. An analog voltmeter uses external multiplier settings. With a multiplier setting of 20 KΩ, it reads 440V and with a multiplier setting of 80 KΩ it reads 352 V. for a multiplier setting of 40 KΩ, the voltmeter reads :

(1) 371 V (2) 383 V (3) 394 V (4) 406 V

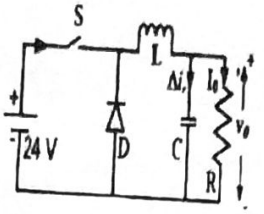
77. The typical ratio of latching current to holding in a 20A thyristor is :

(1) 5.0 (2) 2.0 (3) 1.0 (4) 0.5

78. A half-controlled single-phase bridge rectifier is supplying an R-L load. It is operated at a firing angle α and the load current is continuous. The fraction of cycle that the freewheeling diode conducts is :

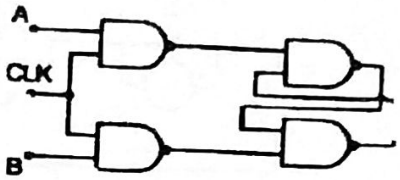
(1) 1/2 (2) $(1 - \alpha/\pi)$ (3) $\alpha/2\pi$ (4) α/π

79. In the circuit shown, an ideal switch S is operated at 100 KHz with a duty ratio 50%. Given that Δ_{ic} 1.6 A peak-to-peak and I_0 is 5A dc, the peak current in S is :



(1) 6.6A (2) 5.0 A (3) 5.8A (4) 4.2 A

80. Consider the given circuit :



In this circuit, the race around :

(1) Does not occur

(2) Occurs when CLK = 0

(3) Occurs when CLK =1 and A= B = 1

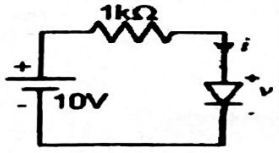
(4) Occurs when CLK =1 and A = B = 0

81. The output Y of a 2-bit comparator is logic 1 whenever the 2-bit input a is greater than the 2-bit input 8. The number of combinations for which the output is logic 1, is :

(1) 4 (2) 6 (3) 8 (4) 10

82. The i-v characteristics of the diode in the circuit given below are :

$$i = \begin{cases} (v-0.7)/500A & , \quad v \geq 0 \\ 0A & , \quad v < 0 \end{cases}$$



The current in the circuit is

(1) 10 mA (2) 9.3 mA (3) 6.67 mA (4) 6.2 mA

83. Two independent random variables X and Y are uniformly distributed in the interval [–1, 1]. The probability that max [X,Y) is less than 1/2 is :

(1) 3/4 (2) 9/16 (3) 1/4 (4) 2/3

84. If $x = \sqrt{-1}$, then the value of X^X is :

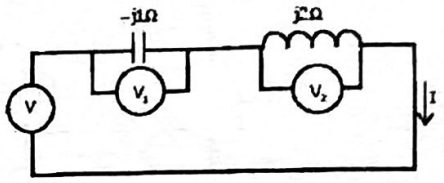
(1) $e^{-\pi/2}$ (2) $e^{\pi/2}$ (3) x (4) 1

85. With initial condition x(1) = 0.5, the solution of the differential equation $t\frac{dx}{dt} + x = t$ is :

(1) $x = t - \frac{1}{2}$ (2) $x = t^2 - \frac{1}{2}$

(3) $x = t^2/2$ (4) $x = t/2$

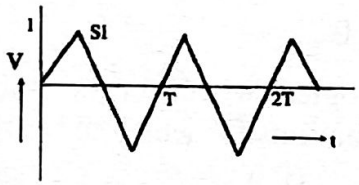
86. Three moving iron type voltmeter are connected as shown below. Voltmeter readings are V, V_1, V_2 are indicated. The correct relation among the voltmeter readings is :

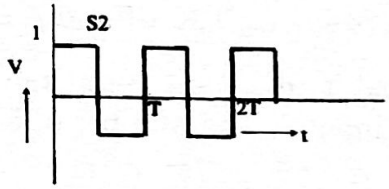


(1) $V = V_1/\sqrt{2} + V_2/\sqrt{2}$ (2) $V = V_1 + V_2$

(3) $V = V_1, V_2$ (4) $V = V_1 - V_2$

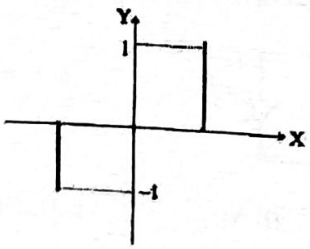
87. The two signals S1 and S2, shown in figure, are applied to Y and X deflection plates of an oscilloscope :



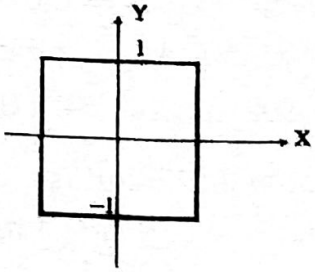


The waveform displayed on the screen is :

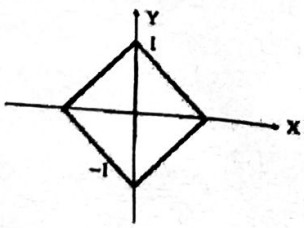
(1)



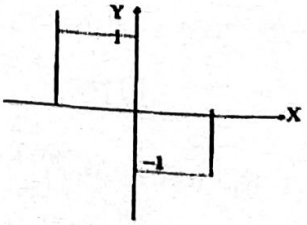
(2)



(3)



(4)



88. A periodic waveform observed across a load is represented by :

$$V(t) = \begin{cases} 1 + \sin wt & , \quad 0 \le wt < 6\pi \\ -1 + \sin wt & , \quad 6\pi \le wt < 12\pi \end{cases}$$

The measured value, using moving iron voltmeter connected across the load, is :

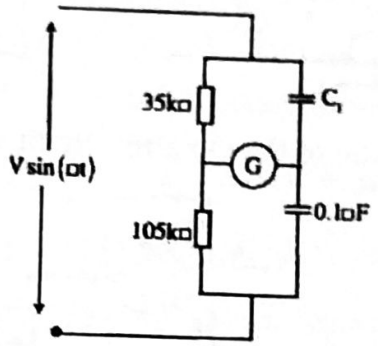
(1) $\sqrt{3}/2$

(2) $\sqrt{2}/3$

(3) 3/2

(4) 2/3

89. In the bridge circuit shown, the capacitors are loss free. At balance, the value of capacitance C_1 in microfarad is :



(1) 0.3 μF

(2) 0.5 μF

(3) 0.8 μF

(4) 1 μF

90. Let $\Delta(fv) = x^2y + y^2z + z^2x$; where f and v are scalar and vector fields respectively. If $v = yi + zj + xk$, then $v = \Delta f$ is :

(1) $x^2y + y^2z + z^2x$

(2) $2xy + 2yz + 2zx$

(3) $x + y + z$

(4) 0

91. Integration of the complex function $f(z) = z^2 / z^2 - 1$, in the counter clockwise direction, around $|z - 1| = 1$, is :

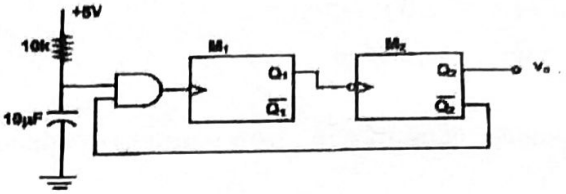
(1) $-\pi i$

(2) 0

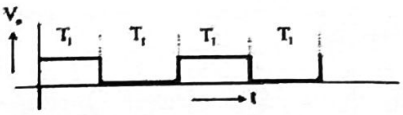
(3) πi

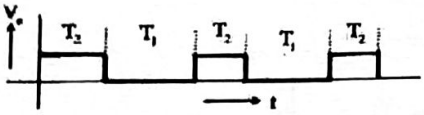
(4) $2\pi i$

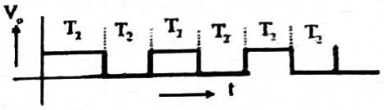
92. Two monoshot multivibrators, one positive edge triggered (M_1) and another negative edge triggered (M_2), are connected as shown in figure :



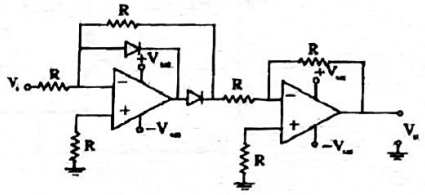
(1) 

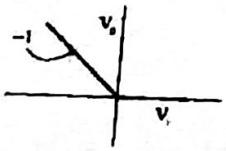
(2) 

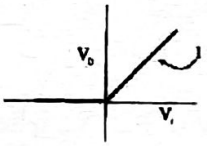
(3) 

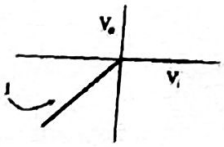
(4) 

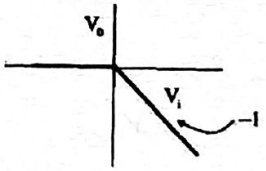
93. The transfer characteristic of the Op-amp circuit shown in figure is :



(1) 

(2) 

(3) 

(4) 

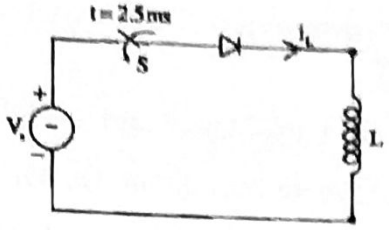
94. Two matrices A and B are given below :

$$A = \begin{bmatrix} p & q \\ r & s \end{bmatrix}; B = \begin{bmatrix} p^2+q^2 & pr+qs \\ pr+qs & r^2+s^2 \end{bmatrix}$$

If the rank of matrix A is N, then the rank of matrix B is :

(1) $N/2$ (2) $N-1$ (3) N (4) $2N$

95. A diode circuit feeds an ideal inductor as shown in the figure. Given Vs = 100 sin(wt) V, where w= 100πrad/s, and L = 31.83 mH. The initial value of inductor current is zero. Switch S is closed at t = 2.5 ms. The peak value of inductor i_L (in A) in the first cycle is :



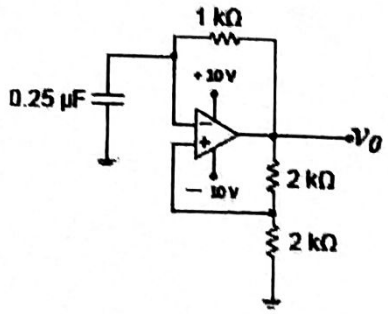
(1) 12 A (2) 17 A (3) 25 A (4) 30A

96. A 3-phase balanced load which has a power factor of 0.707 is connected to a balanced supply. The power consumed by the load is 5 KW. The power is measured by the two-wattmeter method. The readings of the two wattmeters are :

(1) 3.94 KW and 1.06 KW (2) 2.50 KW and 2.50 KW

(3) 5.00 KW and 0.00 KW (4) 2.96 KW and 2.04 KW

97. The saturation voltage of the ideal op-amp shown below is ±10 V. The output voltage Vo of the following circuit in the steady-state is :



(1) Square wave of period 0.55 ms (2) Triangular wave of period 0.55ms

(3) Square wave of period 0.25 ms (4) Triangular wave of period 0.25 ms

98. Consider a function $f(x) = 1 - [x]$ on $-1 \le x \le 1$. The value of x at which the function attains a maximum, and the maximum value of the function are :

(1) 0, −1 (2) −1, 0

(3) 0, 1 (4) −1, 2

99. The Laplace transform of $f(t) = 2\sqrt{(t/\pi)}$ is $s^{-3/2}$. The Laplace transform of $g(t) = \sqrt{(1/\pi t)}$ is :

(1) $3s^{-5/2}/2$ (2) $s^{-1/2}$ (3) $s^{1/2}$ (4) $s^{3/2}$

100. When a bipolar junction transistor is operating in the saturation mode, which one of the following statements is true about the state of its collector-base (CB) and the base-emitter (BE) junctions ?

(1) The CB junction is forward biased and the BE junction is reverse biased.

(2) The CB junction is reverse biased and the BE junction is forward biased.

(3) Both the CB and BE junctions are forward biased.

(4) Both the CB and BE junctions are reversed biased.

Total No. of Printed Pages : 21

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5. The candidate ***must not*** do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question booklet itself. Answers ***must not*** be ticked in the question booklet.
6. ***There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.***
7. Use only **Black** or **Blue Ball Point Pen** of good quality in the OMR Answer-Sheet.
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SEAL

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1. The value of $z = \sqrt{i} + \sqrt{(-i)}$ is :
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2. For which of the following method, the order of convergence is quadratic ?
   (1) Bisection Method (2) Newton-Raphson Method
   (3) Regula Falsi Method (4) Secant Method

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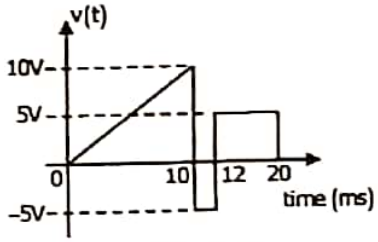
   (2) starting torque and efficiency increase
   (3) starting torque increase but efficiency decreases
   (4) starting torque and efficiency decreases

4. The bridge method commonly used for finding mutual inductance is :
   (1) Heaviside Campbell bridge (2) Schering bridge
   (3) De Sauty bridge (4) Wein bridge

5. A periodic voltage waveform observed on an oscilloscope across a load in shown. A permanent magnet moving coil (PMMC) meter connected across the same load reads :



   (1) 4V (2) 5 V (3) 8 V (4) 10 V

6. An analog voltmeter uses external multiplier settings. With a multiplier setting of 20 KΩ, it reads 440V and with a multiplier setting of 80 KΩ it reads 352 V. for a multiplier setting of 40 KΩ, the voltmeter reads :
   (1) 371 V (2) 383 V (3) 394 V (4) 406 V

7. The typical ratio of latching current to holding in a 20A thyristor is :
   (1) 5.0 (2) 2.0 (3) 1.0 (4) 0.5

8. A half-controlled single-phase bridge rectifier is supplying an R-L load. It is operated at a firing angle α and the load current is continuous. The fraction of cycle that the freewheeling diode conducts is :
   (1) 1/2 (2) $(1 - \alpha/\pi)$ (3) $\alpha/2\pi$ (4) α/π

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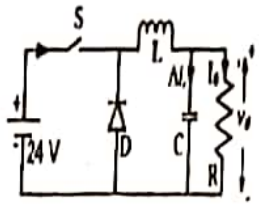
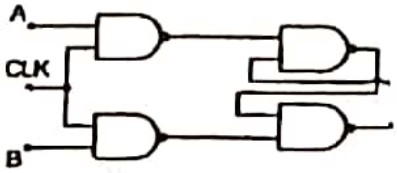
9. In the circuit shown, an ideal switch S is operated at 100 KHz with a duty ratio 50%. Given that Δ_{iL} 1.6 A peak-to-peak and I_0 is 5A dc, the peak current in S is :



(1) 6.6A (2) 5.0 A (3) 5.8A (4) 4.2 A

10. Consider the given circuit :



In this circuit, the race around :

(1) Does not occur

(2) Occurs when CLK = 0

(3) Occurs when CLK =1 and A= B = 1

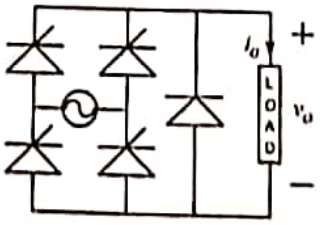
(4) Occurs when CLK =1 and A = B = 0

11. In a salient pole synchronous motor, the developed reluctance torque attains the maximum value when the load angle in electrical degrees is :

(1) 0 (2) 45

(3) 60 (4) 90

12. A single phase fully controlled rectifier is supplying a load with an anti-parallel diode as shown in the figure. All switches and diodes are ideal. Which one of the following is true for instantaneous load voltage and current ?



(1) $V_0 \geq 0$ and $i_0 < 0$ (2) $V_0 < 0$ and $i_0 < 0$

(3) $V_0 \geq 0$ and $i_0 \geq 0$ (4) $V_0 < 0$ and $i_0 \geq 0$

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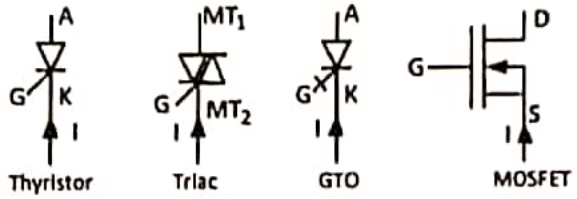
13. Four power semiconductor devices are shown in the figure along with their relevant terminals. The device(s) that can carry dc-current continuously in the direction shown whengated appropriately is (are) :



(1) Triac only
(2) Triac and MOSFET
(3) Triac and GTO
(4) Thyristor and Triac

14. The graph of a network has 8 nodes and 5 independent loops. The number of branches of the graph is :

(1) 11 (2) 12 (3) 13 (4) 14

15. M is a 2×2 matrix with eigen values 4 and 9. The eigen values of M^2 are :

(1) 4 and 9 (2) 2 and 3 (3) –2 and –3 (4) 16 and 81

16. A 5 KVA, 50 V /100V, single-phase transformer has a secondary terminal voltage of 95 V when loaded. The regulation of the transformer is :

(1) 4.5% (2) 9% (3) 5% (4) 1%

17. A six-pulse thyristor rectifier is connected to a balanced three-phase, 50 Hz AC source. Assuming that the DC output current of the rectifier is constant, the lowest harmonic component in the AC input current is :

(1) 100 Hz (2) 150 Hz (3) 250 Hz (4) 300 Hz

18. A three-phase synchronous motor draws 200 A from the line at unity power factor at rated load. Considering the same line voltage and load, the line current at a power factor of 0.5 leading is :

(1) 100 A (2) 200 A (3) 300 A (4) 400 A

19. A current controlled current source (CCCS) has an input impedance of 10Ω and output impedance of 100 kΩ. When this CCCS is used in a negative feedback closed loop with a loop gain of 9, the closed loop output impedance is :

(1) 10 Ω (2) 100 Ω (3) 100 kΩ (4) 1000 kΩ

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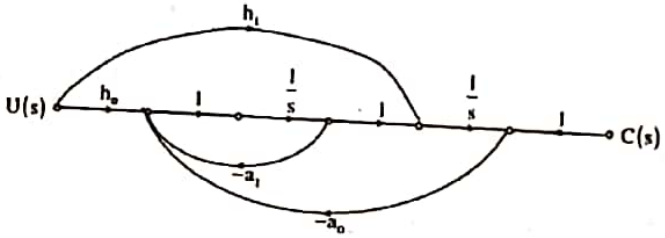
20. Out of the following options, the most relevant information needed to specify the real power (P) at the PV buses in a load flow analysis is :
(1) Solution of the economic load dispatch
(2) Rated power output of the generator
(3) Rated voltage of the generator
(4) Base power of the generator

21. In a long transmission line with r, l, g and c are the resistance, inductance, shunt conductance and capacitance per unit length, respectively, the condition for distortionless transmission is :

(1) rc = lg (2) rc = $\sqrt{(l/c)}$ (3) rg = lc (4) g = $\sqrt{(c/l)}$

22. The signal flow graph of a system is shown below. $U(s)$ is the input and $C(s)$ is the output :



Assuming, $h_1 = b_1$ and $h_0 = b_0 - b_1a_1$, the input-output transfer function, $G(s) = \frac{C(s)}{U(s)}$ of the system is given by :

(1) $G(s) = \frac{b_0 s + b_1}{s^2 + a_0 s + a_1}$

(2) $G(s) = \frac{a_1 s + a_0}{s^2 + b_1 s + b_0}$

(3) $G(s) = \frac{b_1 s + b_0}{s^2 + a_1 s + a_0}$

(4) $G(s) = \frac{a_0 s + a_1}{s^2 + b_0 s + b_1}$

23. An LPF wattmeter of power factor 0.2 is having three voltage settings 300 V, 150 V and 75 V, and two current settings 5 A and 10 A. The full scale reading is 150. If the wattmeter is used with 150 V voltage setting and 10 A current setting, the multiplying factor of the wattmeter is :

(1) 2 (2) 4 (3) 6 (4) 8

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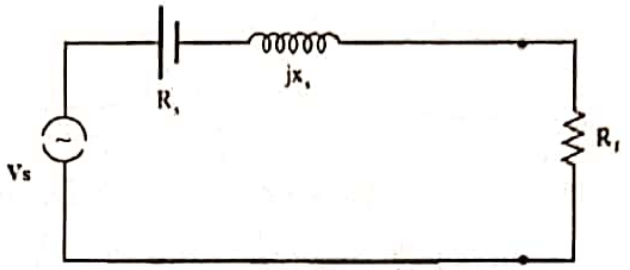
24. A non-ideal voltage source V_s has an internal impedance of Z_s If a purely resistive load is tobe chosen that maximizes the power transferred to the load, its value must be :



(1) 0
(2) Real part of Zs
(3) Magnitude of Zs
(4) Complex conjugate of Zs

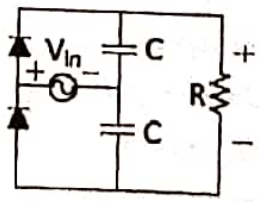
25. Integration of the complex function $f(z)=\frac{z^2}{z^2-1}$ in the counterclockwise direction, around $|z-1|=1$, is :

(1) $-\pi i$ (2) 0 (3) πi (4) $2\pi i$

26. A 3-phase balanced load which has a power factor of 0.707 is connected to a balanced supply. The power consumed by the load is 5 kW. The power is measured by two-wattmeter method. The reading of the two wattmeters are :

(1) 3.94 kW and 1.06 kW
(2) 2.50 kW and 2.50 kW
(3) 5.00 kW and 0.00 kW
(4) 2.96 kW and 2.04 kW

27. In the following circuit, the input voltage V_{in} is 100 sin(100 πt). For 100 $\pi RC = 50$, the average voltage across R (in volts) under steady-state is nearest to :



(1) 100 (2) 31.8 (3) 200 (4) 63.6

28. If $|9y-6|=3$, then $y^2-4y/3$ is :

(1) 0 (2) +1/3 (3) −1/3 (4) Undefined

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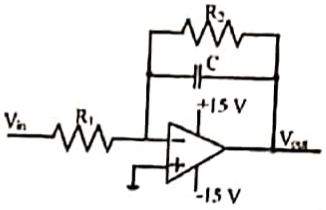
29. The circuit shown below is an example of a :



(1) Low pass filter (2) Band pass filter (3) High pass filter (4) Notch filter

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

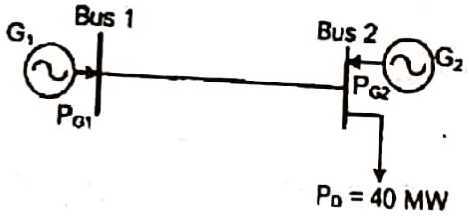
(1) $9e^{-\frac{t}{3}}u(t)$ (2) $9e^{-\frac{t}{6}}u(t)$

(3) $9e^{-\frac{t}{3}}u(t)-6e^{-\frac{t}{6}}u(t)$ (4) $54e^{-\frac{t}{6}}u(t)-54e^{-\frac{t}{3}}u(t)$

31. With initial condition $x(1)=0.5$, the solution of the differential equation $t\frac{dx}{dt}+x=t$ is :

(1) $x=t-\frac{1}{2}$ (2) $x=t^2-\frac{1}{2}$ (3) $x=\frac{t^2}{2}$ (4) $x=\frac{t}{2}$

32. The figure shows a two-generator system supplying a load of $P_0 = 40$MW, connected at bus 2.



The fuel cost of generators G_1 and G_2 are :
$C_1(P_{G1})$ = 10,000 Rs/MWh and $C_2(P_{G2})$ = 12500 Rs/MWh and the loss in the line is $P_{loss(pu)}$ = 0.5 $PG^2_{1(pu)}$, where the loss coefficient is specified in pu on a 100 MVA base. The most economic power generation schedule in MW is :

(1) $P_{G1} = 20,\ P_{G2} = 22$ (2) $P_{G1} = 22,\ P_{G2} = 20$

(3) $P_{G1} = 20,\ P_{G2} = 20$ (4) $P_{G1} = 0,\ P_{G2} = 40$

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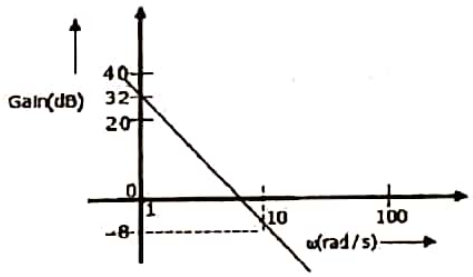
33. Leakage flux in an induction motor is :
(1) Flux that leaks through the machine
(2) Flux that links both stator and rotor windings
(3) Flux that links none of the windings
(4) Flux that links the stator winding or the rotor winding but not both

34. The angle δ in the swing equation of a synchronous generator is the :
(1) angle between stator voltage and current
(2) angular displacement of the rotor with respect to the stator
(3) angular displacement of the stator mmf with respect to a synchronously rotating axis
(4) angular displacement of an axis fixed to the rotor with respect to a synchronously rotating axis

35. The Bode plot of a transfer function G(s) is shown in the figure below.



The gain (20log |$G(s)$|) is 32 dB and −8 dB at 1 rad/s and 10 rad/s respectively. The phase is negative for all ω. The $G(s)$ is :

(1) 39.8/s (2) $39.8/s^2$ (3) 32/s (4) $32/s^2$

36. The flux density at a point in space is given by $B = 4xa_x + 2kya_y + 8a_z$Wb/m2. The value of constant k must be equal to :

(1) −2 (2) −0.5 (3) +0.5 (4) +2

37. A single-phase transformer has no-load loss of 64 W, as obtained from an open-circuit test. When a short-circuit test is performed on to it with 90% of the rated currents flowing in its both LV and HV windings, the measured loss is 81 W. The transformer has maximum efficiency when operated at :
(1) 50.0% of the rated current
(2) 64.0% of the rated current
(3) 80.0% of the rated current
(4) 88.8% of the rated current

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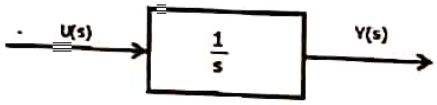
38. A source $v_s = V \cos 100\pi t$ has an internal impedance of $(4 + j3)\ \Omega$. If a purely resistive load connected to this source has to extract the maximum power out of the source, its value in Ω should be :

(1) 3 (2) 4 (3) 5 (4) 7

39. The impulse response of a system is $h(t) = tu(t)$. For an input $u(t-1)$, the output is :

(1) $\frac{t^2}{2}u(t)$ (2) $\frac{t(t-1)}{2}u(t-1)$ (3) $\frac{t(t-1)^2}{2}u(t-1)$ (4) $\frac{(t^2-1)}{2}u(t-1)$

40. Assuming zero initial condition, the response $y(t)$ of the system given below to a unit step input $u(t)$ is :



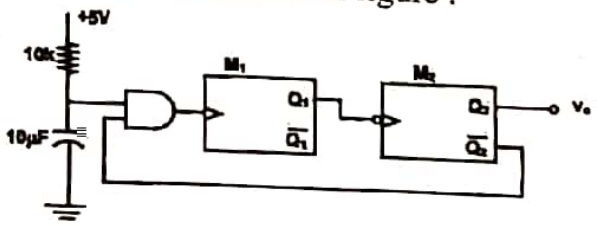
(1) $u(t)$ (2) $tu(t)$ (3) $\frac{t^2}{2}u(t)$ (4) $e^{-t}u(t)$

41. Integration of the complex function $f(z) = z^2 / z^2 - 1$, in the counter clockwise direction, around $|z - 1| = 1$, is :

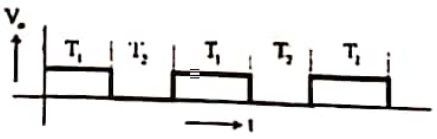
(1) $-\pi i$ (2) 0

(3) πi (4) $2\pi i$

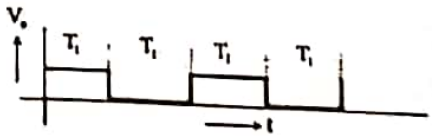
42. Two monoshot multivibrators, one positive edge triggered (M_1) and another negative edge triggered (M_2), are connected as shown in figure :



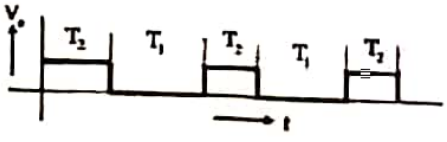
(1)



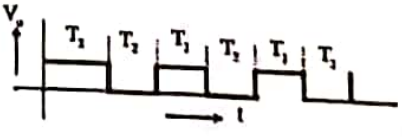
(2)



(3)



(4)



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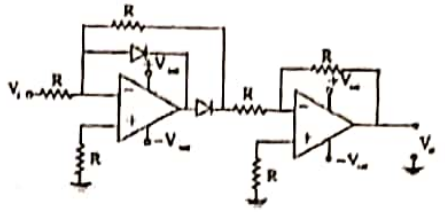
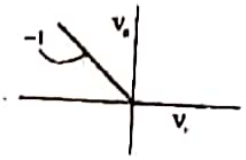
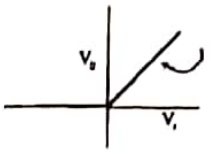
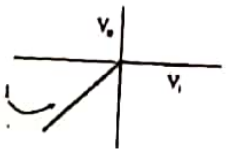
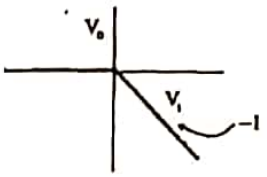
43. The transfer characteristic of the Op-amp circuit shown in figure is :



(1) 

(2) 

(3) 

(4) 

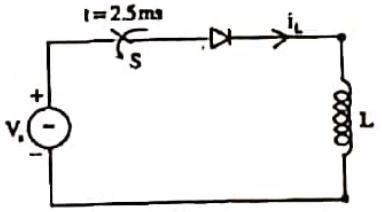
44. Two matrices A and B are given below :

$$A=\begin{bmatrix} p & q \\ r & s \end{bmatrix}; B=\begin{bmatrix} p^2+q^2 & pr+qs \\ pr+qs & r^2+s^2 \end{bmatrix}$$

If the rank of matrix A is N, then the rank of matrix B is :

(1) $N/2$ (2) $N-1$ (3) N (4) $2N$

45. A diode circuit feeds an ideal inductor as shown in the figure. Given Vs = 100 sin(wt) V, where w= 100πrad/s, and L = 31.83 mH. The initial value of inductor current is zero. Switch S is closed at t = 2.5 ms. The peak value of inductor i_L (in A) in the first cycle is :



(1) 12 A (2) 17 A (3) 25 A (4) 30A

46. A 3-phase balanced load which has a power factor of 0.707 is connected to a balanced supply. The power consumed by the load is 5 KW. The power is measured by the two-wattmeter method. The readings of the two wattmeters are :

(1) 3.94 KW and 1.06 KW (2) 2.50 KW and 2.50 KW
(3) 5.00 KW and 0.00 KW (4) 2.96 KW and 2.04 KW

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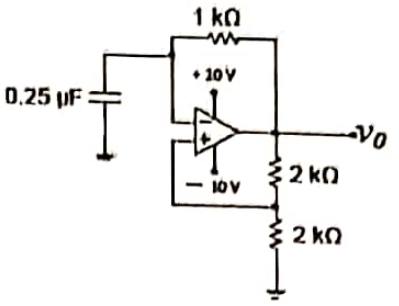
47. The saturation voltage of the ideal op-amp shown below is ±10 V. The output voltage Vo of the following circuit in the steady-state is :

B



(1) Square wave of period 0.55 ms

(2) Triangular wave of period 0.55ms

(3) Square wave of period 0.25 ms

(4) Triangular wave of period 0.25 ms

48. Consider a function $f(x) = 1 - [x]$ on $-1 \le x \le 1$. The value of x at which the function attains a maximum, and the maximum value of the function are :

(1) $0, -1$

(2) $-1, 0$

(3) $0, 1$

(4) $-1, 2$

49. The Laplace transform of $f(t) = 2\sqrt{(t/\pi)}$ is $s^{-3/2}$. The Laplace transform of $g(t) = \sqrt{(1/\pi t)}$ is :

(1) $3s^{-5/2}/2$

(2) $s^{-1/2}$

(3) $s^{1/2}$

(4) $s^{3/2}$

50. When a bipolar junction transistor is operating in the saturation mode, which one of the following statements is true about the state of its collector-base (CB) and the base-emitter (BE) junctions ?

(1) The CB junction is forward biased and the BE junction is reverse biased.

(2) The CB junction is reverse biased and the BE junction is forward biased.

(3) Both the CB and BE junctions are forward biased.

(4) Both the CB and BE junctions are reversed biased.

51. A single-phase, full-bridge rectifier fed from a 230 V, 50 Hz sinusoidal source supplies a series combination of finite resistance, R, and a very large inductance L. The two most dominant frequency components in the source current are :

(1) 50 Hz, 0 Hz

(2) 50 Hz, 100 Hz

(3) 50 Hz, 150 Hz

(4) 150 Hz, 250 Hz

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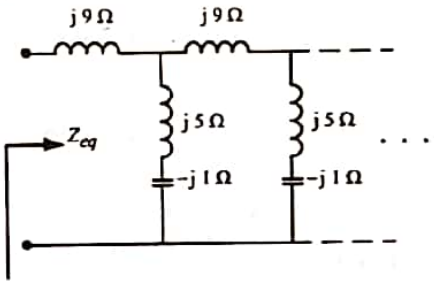
52. A 0-1 Ampere moving iron ammeter has an internal resistance of 50 mΩ and inductance of 0.1 mH. A shunt coil is connected to extend its range to 0-10 Ampere for all operating frequencies. The time constant in milliseconds and resistance in mΩ of the shunt coil respectively are :

(1) 2,5.55 (2) 2,1 (3) 2.18,0.55 (4) 11.1,2

53. The equivalent impedance Z_{eq} for the infinite ladder circuit shown in the figure is :



(1) J12Ω (2) – J12Ω (3) J13Ω (4) 13Ω

54. Consider two npn BJT devices, first device has base doping N_{B1} and second device has base doping N_{B2}. If N_{B2} is two times that of N_{B1} then (Here β_1 and β_2 are the common emitter current gain of device 1 and device 2 respectively) :

(1) $\beta_1 > \beta_2$ (2) $\beta_1 < \beta_2$ (3) $\beta_1 = \beta_2$ (4) None of the above

55. When the temperature decreases then the width of the depletion region in a PN junction diode ?

(1) Increases (2) Decreases
(3) Do not change (4) Increases and then decreases

56. A clamper circuit :

(i) adds or subtract a dc voltage to or from input waveform
(ii) does not change shape of the input waveform
(iii) amplifies the input waveform
Which of the above statements are correct ?

(1) (i) and (ii) (2) (i) and (iii) (3) (ii) and (iii) (4) (i), (ii) and (iii)

57. A CRO is operated with X and Y settings of 0.5 ms/cm and 100 mV/cm respectively. The screen of the CRO is 10 cm × 8 cm (X and Y). A sine wave of frequency 200 Hz and rms amplitude of 300 mV is applied to the Y input. The screen will show :

(1) one cycle of the undistorted sine wave
(2) two cycle of the undistorted sine wave
(3) one cycle sine wave with clipped amplitude
(4) two cycle of the sine wave with clipped amplitude

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58. The voltmeter choice for measuring the emf of a 100 V dc source would be :

(1) 100 V, 1 mA (2) 100 V, 2 mA

(3) 100 V, 10 kΩ/V (4) 100 V, 100Ω/kV

59. A three phase transformer is supplied at 6000 V on the delta connected side. The terminal voltage on the star connected side when loaded at power factor 0.8 lagging is 415 V. The equivalent resistance and reactance drops are 1% and 5% respectively. The turn ratio is approximately equal to :

(1) 22 (2) 24 (3) 26 (4) 30

60. The number of samples is one period of signal $\sin(3.15\,\pi n)$ is :

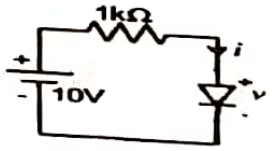
(1) 80 (2) 40 (3) 315 (4) 63

61. The output Y of a 2-bit comparator is logic 1 whenever the 2-bit input a is greater than the 2-bit input 8. The number of combinations for which the output is logic 1, is :

(1) 4 (2) 6 (3) 8 (4) 10

62. The i-v characteristics of the diode in the circuit given below are :

$$i = \begin{cases} (v-0.7)/500A & , \quad v \geq 0 \\ 0A & , \quad v < 0 \end{cases}$$



The current in the circuit is

(1) 10 mA (2) 9.3 mA (3) 6.67 mA (4) 6.2 mA

63. Two independent random variables X and Y are uniformly distributed in the interval [−1, 1]. The probability that max [X,Y] is less than 1/2 is :

(1) 3/4 (2) 9/16 (3) 1/4 (4) 2/3

64. If $x = \sqrt{-1}$, then the value of X^X is :

(1) $e^{-\pi/2}$ (2) $e^{\pi/2}$ (3) x (4) 1

65. With initial condition x(1) = 0.5, the solution of the differential equation $t\frac{dx}{dt} + x = t$ is :

(1) $x = t - \frac{1}{2}$ (2) $x = t^2 - \frac{1}{2}$

(3) $x = t^2/2$ (4) $x = t/2$

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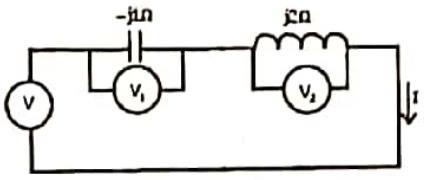
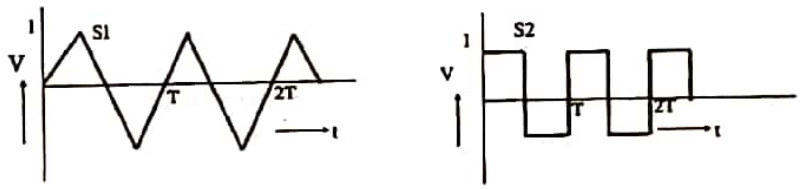
66. Three moving iron type voltmeter are connected as shown below. Voltmeter readings are V, V_1, V_2 are indicated. The correct relation among the voltmeter readings is :



(1) $V = V_1/\sqrt{2} + V_2/\sqrt{2}$ (2) $V = V_1 + V_2$

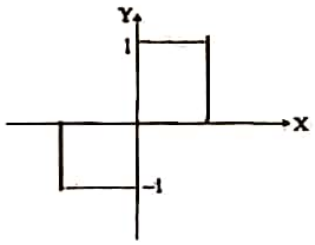
(3) $V = V_1, V_2$ (4) $V = V_1 - V_2$

67. The two signals S1 and S2, shown in figure, are applied to Y and X deflection plates of an oscilloscope :

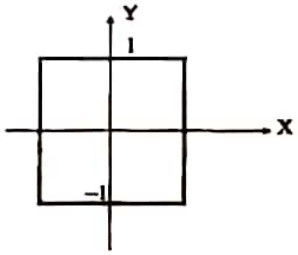


The waveform displayed on the screen is :

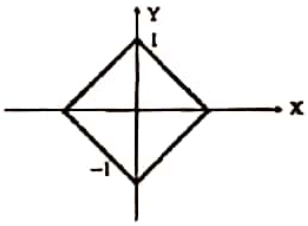
(1)



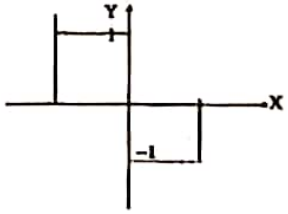
(2)



(3)



(4)



68. A periodic waveform observed across a load is represented by :

$$V(t) = \begin{cases} 1 + \sin wt & , \quad 0 \le wt < 6\pi \\ -1 + \sin wt & , \quad 6\pi \le wt < 12\pi \end{cases}$$

The measured value, using moving iron voltmeter connected across the load, is :

(1) $\sqrt{3}/2$ (2) $\sqrt{2}/3$

(3) 3/2 (4) 2/3

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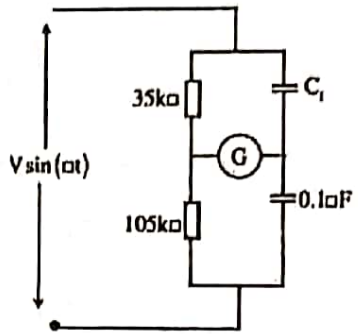
69. In the bridge circuit shown, the capacitors are loss free. At balance, the value of capacitance C_1 in microfarad is :



(1) 0.3 μF

(2) 0.5 μF

(3) 0.8 μF

(4) 1 μF

70. Let $\Delta(fv) = x^2y + y^2z + z^2x$; where f and v are scalar and vector fields respectively. If $v = yi + zj + xk$, then $v = \Delta f$ is :

(1) $x^2y + y^2z + z^2x$

(2) $2xy + 2yz + 2zx$

(3) $x + y + z$

(4) 0

71. A 3×3 matrix P is such that, $p^3 = P$. Then the eigen values of P are :

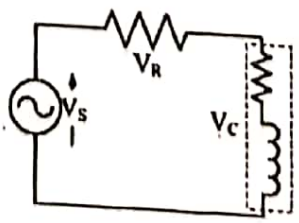
(1) 1, 1, –1

(2) 1, 0.5 + j0.866, 0.5 – j0.866

(3) 1, -0.5 + j0.866, –0.5 – j0.866

(4) 0, 1,–1

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



(1) 65,35

(2) 50,50

(3) 60,90

(4) 60, 80

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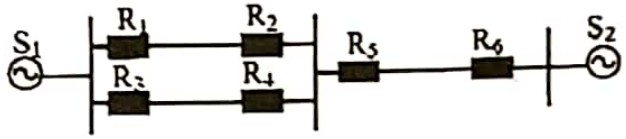
73. A power system with two generators is shown in the figure below. The system (generators, buses and transmission lines) is protected by six overcurrent relays R_1 to R_6. Assuming a mix of directional and non-directional relays at appropriate locations, the remote backup relays for R_4 are :



(1) R_1, R_2 (2) R_2, R_6 (3) R_2, R_5 (4) R_1, R_6

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

(1) 189×189 (2) 100×100 (3) 90×90 (4) 180×180

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

(1) 1 (2) 2 (3) 4 (4) 16

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

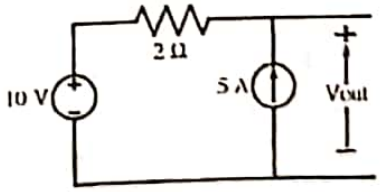
(1) Interchanging the terminals of the AC supply.

(2) Interchanging the terminals of the capacitor.

(3) Interchanging the terminals of the auxiliary winding.

(4) Interchanging the terminals of both the windings.

77. In the circuit shown below, the voltage and current sources are ideal. The voltage (V_{out}) across the current source, in volts, is :



(1) 0 (2) 5

(3) 10 (4) 20

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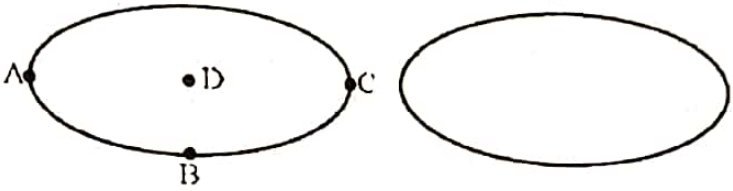
78. The graph associated with an electrical network has 7 branches and 5 nodes. The number of independent KCL equations and the number of independent KVL equations, respectively, are :

(1) 2 and 5
(2) 5 and 2
(3) 3 and 4
(4) 4 and 3

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

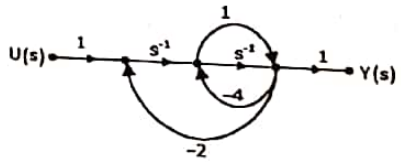


(1) A
(2) B
(3) C
(4) D

80. A single-phase 100 kVA, 1000 V / 100 V, 50 Hz transformer has a voltage drop of 5% across its series impedance at full load. Of this, 3% is due to resistance. The percentage regulation of the transformer at full load with 0.8 lagging power factor is :

(1) 4.8
(2) 6.8
(3) 8.8
(4) 10.8

81. The signal flow graph for a system is given below. The transfer function $\frac{Y(s)}{U(s)}$ for the system is :



(1) $\frac{s+1}{5s^2+6s+2}$
(2) $\frac{s+1}{s^2+6s+2}$
(3) $\frac{s+1}{s^2+4s+2}$
(4) $\frac{1}{5s^2+6s+2}$

82. The dielectric slab with 500 mm × 500 mm cross-section is 0.4 m long. The slab is subjected to a uniform electric field of E = 6a + 8a kV/mm. The relative permittivity of the dielectric material is equal to 2. The value of constant ε_0 is 8.85×10^{-12} F/m. The energy stored in the dielectric in Joules is :

(1) 8.85×10^{-11}
(2) 8.85×10^{-5}
(3) 88.5
(4) 885

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83. For a power system network with n nodes, Z_{33} of its bus impedance matrix is j0.5 pu. The voltage at node 3 is 1.3 $\angle -10°$pu. If a capacitor having reactance of –j3.5 pu is now added to the network between node 3 and the reference node, the current drawn by the capacitor pu is :

(1) $0.325\angle -100°$ (2) $0.325\angle 80°$

(3) $0.371\angle -100°$ (4) $0.433\angle -80°$

84. The curl of the gradient of the scalar field defined by $V = 2x^2y + 3y^2z + 4z^2x$ is :

(1) $4xya_x + 6yza_y + 8zxa_z$

(2) $4a_x + 6a_y + 8a_z$

(3) $(4xy + 4z^2)a_x + (2x^2 + 6yz)a_y + (3y^2 + 8zx)a_z$

(4) 0

85. A single-phase load is supplied by a single-phase voltage source. If the current flowing from the load to the source is $10\angle -150°$A and if the voltage at the load terminals is $100\angle -60°$ V, then the :

(1) Load absorbs real power and delivers reactive power

(2) Load absorbs real power and absorbs reactive power

(3) Load delivers real power and delivers reactive power

(4) Load delivers real power and absorbs reactive power

86. The line A to neutral voltage is $10\angle -15°$ V for a balanced three-phase star-connected load with phase sequence ABC. The voltage of line B with respect to line C is given by :

(1) $10\sqrt{3}\angle 105°$V (2) $10\angle 105°$ V

(3) $10\sqrt{3}\angle -75°$ V (4) $-10\sqrt{3}\angle 90°$ V

87. A hollow metallic sphere of radius r is kept at potential of 1 Volt. The total electric flux coming out of the concentric spherical surface of radius R ($>r$) is :

(1) $4\pi\varepsilon_0 r$ (2) $4\pi\varepsilon_0 r^2$ (3) $4\pi\varepsilon_0 R$ (4) $4\pi\varepsilon_0 R^2$

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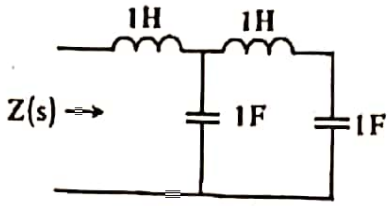
88. The driving point impedance Z(s) for the circuit shown below is :



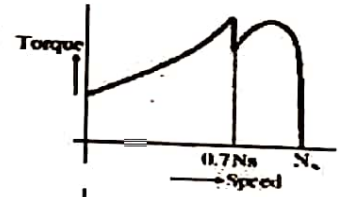
(1) $\frac{s^4+3s^2+1}{s^3+2s}$

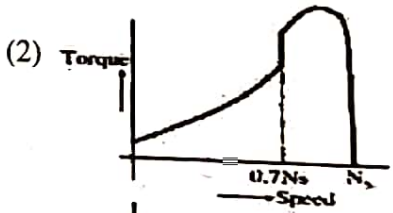
(2) $\frac{s^4+2s^2+1}{s^2+2}$

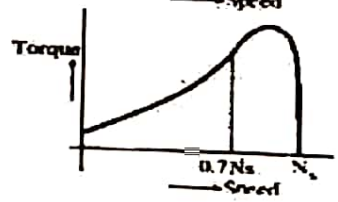
(3) $\frac{s^2+1}{s^4+s^2+1}$

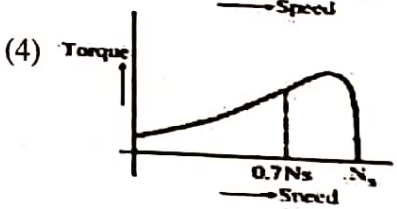
(4) $\frac{s^3+1}{s^4+s^2+1}$

89. A single phase induction motor is provided with capacitor and centrifugal switch in series with auxiliary winding. The switch is expected to operate at a speed of 0.7 Ns, but due tomalfunctioning the switch fails to operate. The torque-speed characteristic of the motor is represented by :

(1) 

(2) 

(3) 

(4) 

90. The no-load speed of a 230 V separately excited dc motor is 1400 rpm. The armature resistance drop and the brush drop are neglected. The field current is kept constant at ratedvalue. The torque of the motor in Nm for an armature current of 8 A is :

(1) 10 (2) 12.5 (3) 15 (4) 17.5

91. The slip of the induction motor does not depends on :

(1) Rotor Speed
(2) Synchronous Speed
(3) Shaft Torque
(4) Core-loss Component

92. A system with transfer function $G(s)=\frac{(s^2+9)(s+2)}{(s+1)(s+3)(s+4)}$ is excited by $\sin(\omega t)$. The steady-state output of the system is zero at :

(1) $\omega = 1$ rad/s (2) $\omega = 2$ rad/s (3) $\omega = 3$ rad/s (4) $\omega = 4$ rad/s

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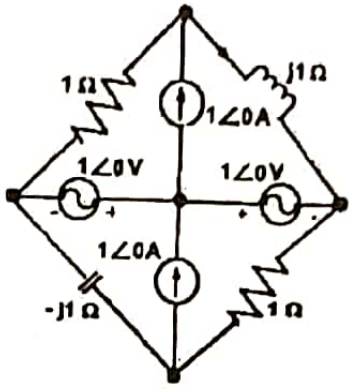
93. In the circuit shown below, the current through the inductor is :

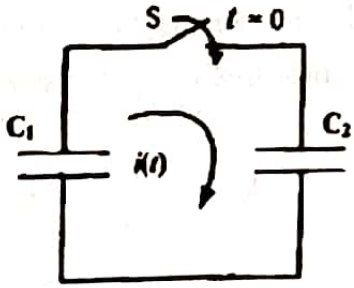


(1) $\frac{2}{1+j}A$ (2) $\frac{-1}{1+j}A$ (3) $\frac{1}{1+j}A$ (4) $0A$

94. The sequence components of the fault current are as follows :
$I_{positive} = j1.5\ pu$, $I_{negative} = j0.5\ pu$, $I_{zero} = -j1\ pu$. The type of fault in the system is :

(1) LG (2) LL (3) LLG (4) LLLG

95. In the following figure, C_1 and C_2 are ideal capacitors. C_1 has been charge to 12 V before the ideal switch S is closed at t = s. The current i(t) for all t is :



(1) Zero (2) A step function
(3) An exponentially decaying function (4) An impulse function

96. A 220 V, 15 kW, 1000 rpm shunt motor with armature resistance of 0.25Ω, has a rated line current of 68 A and a rated field current of 2.2 A. The change in field flux required to obtain a speed of 100 rpm while drawing a line current of 52.8 A and a field current of 1.8 A is :

(1) 18.18% increase (2) 18.18% decrease
(3) 36.36% increase (4) 36.36% decrease

97. If $V_A - V_B = 6V$, then $V_C - V_D$ is :

(1) −5V (2) 2V (3) 3V (4) 6V

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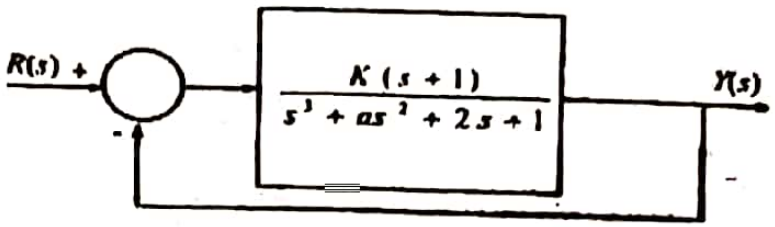
98. The feedback system shown below oscillates at 2 rad/s when :



(1) K = 2 and a = 0.75 (2) K = 3 and a = 0.75

(3) K = 4 and a = 0.5 (4) K = 2 and a = 0.5

99. The bus admittance matrix of a three-phase three-line system is $Y = j\begin{bmatrix} -13 & 10 & 5 \\ 10 & -18 & 10 \\ 5 & 10 & -13 \end{bmatrix}$. If each transmission line between the two buses is represented by an equivalent π-network, the magnitude of the shunt susceptance of the line connecting bus 1 and 2 is :

(1) 4 (2) 2 (3) 1 (4) 0

100. The locked rotor current in a 3-phase, star connected 15 kW, 4-pole, 230 V, 50 Hz induction motor at rated conditions is 50 A. Neglecting losses and magnetizing current, the approximate locked rotor line current drawn when the motor is connected to a 236 V, 57 Hz supply is :

(1) 58.5 A (2) 45.0 A (3) 45.7 A (4) 55.6 A

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C

SET-Y

M.Phil./Ph.D./URS-EE-2020

SUBJECT : Electrical Engineering

10007

Sr. No. .....

Time : **1¼ Hours** Max. Marks : **100** Total Questions : **100**

Roll No. (in figures)_____ (in words) _____

Name _____ Father's Name _____

Mother's Name _____ Date of Examination _____

_____ _____

(Signature of the Candidate) (Signature of the Invigilator)

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2. The candidates ***must return*** the question booklet as well as OMR Answer-Sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.
3. Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that a copy of OMR Sheet may be kept by the candidate.
4. Question Booklet along with answer key of all the A, B, C & D code will be got uploaded on the University website after the conduct of Entrance Examination. In case there is any discrepancy in the Question Booklet/Answer Key, the same may be brought to the notice of the Controller of Examination in writing/through E.Mail within 24 hours of uploading the same on the University Website. Thereafter, no complaint in any case, will be considered.
5. The candidate ***must not*** do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question booklet itself. Answers ***must not*** be ticked in the question booklet.
6. ***There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.***
7. Use only **Black** or **Blue Ball Point Pen** of good quality in the OMR Answer-Sheet.
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SEAL

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1. A 3×3 matrix P is such that, $p^3 = P$. Then the eigenvalues of P are :

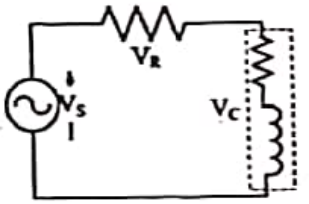
   (1) 1, 1, –1

   (2) 1, 0.5 ÷ j0.866, 0.5 – j0.866

   (3) 1, –0.5 ÷ j0.866, –0.5 – j0.866

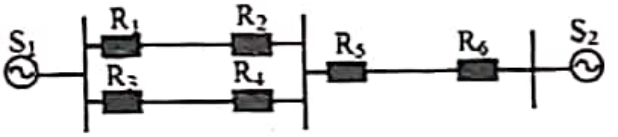
   (4) 0, 1, –1

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



   (1) 65,35 (2) 50,50 (3) 60,90 (4) 60, 80

3. A power system with two generators is shown in the figure below. The system (generators, buses and transmission lines) is protected by six overcurrent relays R_1 to R_6. Assuming a mix of directional and non-directional relays at appropriate locations, the remote backup relays for R_4 are :

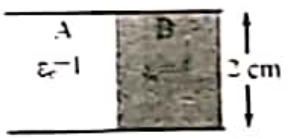


   (1) R_1, R_2 (2) R_2, R_6 (3) R_2, R_5 (4) R_1, R_6

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

   (1) 189×189 (2) 100×100 (3) 90×90 (4) 180×180

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



   (1) 1 (2) 2 (3) 4 (4) 16

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

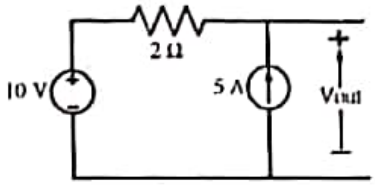
(1) Interchanging the terminals of the AC supply.

(2) Interchanging the terminals of the capacitor.

(3) Interchanging the terminals of the auxiliary winding.

(4) Interchanging the terminals of both the windings.

7. In the circuit shown below, the voltage and current sources are ideal. The voltage (V_{out}) across the current source, in volts, is :



(1) 0 (2) 5

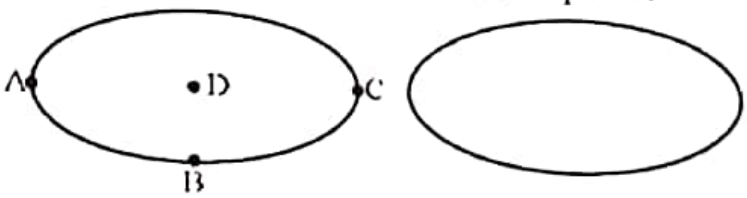
(3) 10 (4) 20

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

(1) 2 and 5 (2) 5 and 2

(3) 3 and 4 (4) 4 and 3

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



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

10. A single-phase 100 kVA, 1000 V / 100 V, 50 Hz transformer has a voltage drop of 5% across its series impedance at full load. Of this, 3% is due to resistance. The percentage regulation of the transformer at full load with 0.8 lagging power factor is :

(1) 4.8 (2) 6.8 (3) 8.8 (4) 10.8

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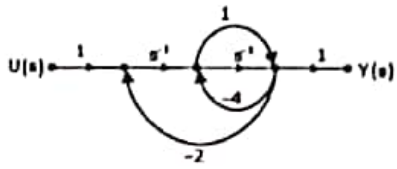
11. The signal flow graph for a system is given below. The transfer function $\frac{Y(s)}{U(s)}$ for the system is :



(1) $\frac{s+1}{5s^2+6s+2}$ (2) $\frac{s+1}{s^2+6s+2}$ (3) $\frac{s+1}{s^2+4s+2}$ (4) $\frac{1}{5s^2+6s+2}$

12. The dielectric slab with 500 mm × 500 mm cross-section is 0.4 m long. The slab is subjected to a uniform electric field of E = 6a + 8a kV/mm. The relative permittivity of the dielectric material is equal to 2. The value of constant ε_0 is 8.85×10^{-12} F/m. The energy stored in the dielectric in Joules is :

(1) 8.85×10^{-11} (2) 8.85×10^{-5} (3) 88.5 (4) 885

13. For a power system network with n nodes, Z_{33} of its bus impedance matrix is j0.5 pu. The voltage at node 3 is 1.3 $\angle -10°$pu. If a capacitor having reactance of –j3.5 pu is now added to the network between node 3 and the reference node, the current drawn by the capacitor pu is :

(1) $0.325\angle -100°$ (2) $0.325\angle 80°$

(3) $0.371\angle -100°$ (4) $0.433\angle -80°$

14. The curl of the gradient of the scalar field defined by $V = 2x^2y + 3y^2z + 4z^2x$ is :

(1) $4xya_x + 6yza_y + 8zxa_z$

(2) $4a_x + 6a_y + 8a_z$

(3) $(4xy + 4z^2)a_x + (2x^2 + 6yz)a_y + (3y^2 + 8zx)a_z$

(4) 0

15. A single-phase load is supplied by a single-phase voltage source. If the current flowing from the load to the source is $10\angle -150°$A and if the voltage at the load terminals is $100\angle -60°$ V, then the :

(1) Load absorbs real power and delivers reactive power

(2) Load absorbs real power and absorbs reactive power

(3) Load delivers real power and delivers reactive power

(4) Load delivers real power and absorbs reactive power

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16. The line A to neutral voltage is $10\angle -15^\circ$ V for a balanced three-phase star-connected load with phase sequence ABC. The voltage of line B with respect to line C is given by :

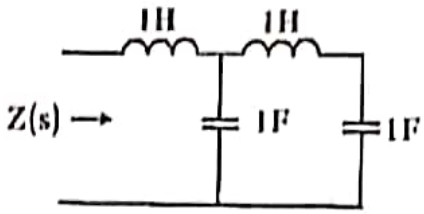
(1) $10\sqrt{3}\angle 105^\circ$V (2) $10\angle 105^\circ$ V

(3) $10\sqrt{3}\angle -75^\circ$ V (4) $-10\sqrt{3}\angle 90^\circ$ V

17. A hollow metallic sphere of radius r is kept at potential of 1 Volt. The total electric flux coming out of the concentric spherical surface of radius R ($>r$) is :

(1) $4\pi\varepsilon_0 r$ (2) $4\pi\varepsilon_0 r^2$ (3) $4\pi\varepsilon_0 R$ (4) $4\pi\varepsilon_0 R^2$

18. The driving point impedance Z(s) for the circuit shown below is :

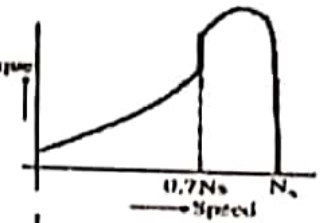


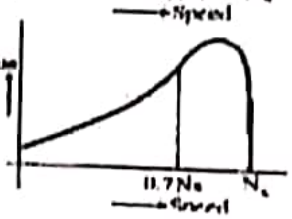
(1) $\frac{s^4+3s^2+1}{s^3+2s}$ (2) $\frac{s^4+2s^2+1}{s^2+2}$

(3) $\frac{s^2+1}{s^4+s^2+1}$ (4) $\frac{s^3+1}{s^4+s^2+1}$

19. A single phase induction motor is provided with capacitor and centrifugal switch in series with auxiliary winding. The switch is expected to operate at a speed of 0.7 Ns, but due tomalfunctioning the switch fails to operate. The torque-speed characteristic of the motor is represented by :

(1) 

(2) 

(3) 

(4) 

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20. The no-load speed of a 230 V separately excited dc motor is 1400 rpm. The armature resistance drop and the brush drop are neglected. The field current is kept constant at ratedvalue. The torque of the motor in Nm for an armature current of 8 A is :

(1) 10 (2) 12.5 (3) 15 (4) 17.5

21. The slip of the induction motor does not depends on :

(1) Rotor Speed (2) Synchronous Speed

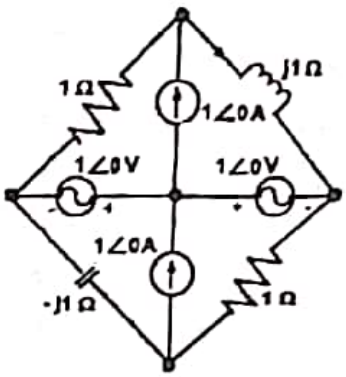
(3) Shaft Torque (4) Core-loss Component

22. A system with transfer function $G(s)=\frac{(s^2+9)(s+2)}{(s+1)(s+3)(s+4)}$ is excited by $\sin(\omega t)$. The steady-state output of the system is zero at :

(1) $\omega = 1$ rad/s (2) $\omega = 2$ rad/s

(3) $\omega = 3$ rad/s (4) $\omega = 4$ rad/s

23. In the circuit shown below, the current through the inductor is :



(1) $\frac{2}{1+j}A$ (2) $\frac{-1}{1+j}A$ (3) $\frac{1}{1+j}A$ (4) $0A$

24. The sequence components of the fault current are as follows :

$I_{positive} = j1.5\ pu$, $I_{negative} = j0.5\ pu$, $I_{zero} = -j1\ pu$. The type of fault in the system is :

(1) LG (2) LL (3) LLG (4) LLLG

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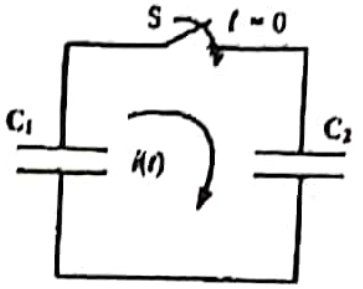
25. In the following figure, C_1 and C_2 are ideal capacitors. C_1 has been charge to 12 V before the ideal switch S is closed at t = s. The current i(t) for all t is :



(1) Zero (2) A step function
(3) An exponentially decaying function (4) An impulse function

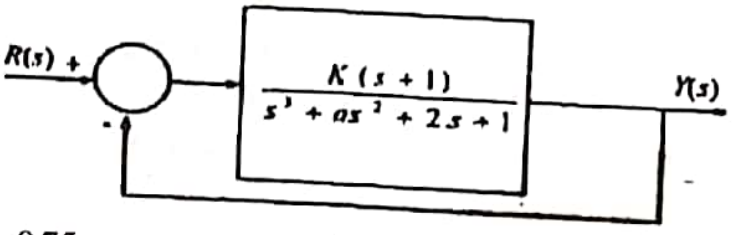
26. A 220 V, 15 kW, 1000 rpm shunt motor with armature resistance of 0.25Ω, has a rated line current of 68 A and a rated field current of 2.2 A. The change in field flux required to obtain a speed of 100 rpm while drawing a line current of 52.8 A and a field current of 1.8 A is :

(1) 18.18% increase (2) 18.18% decrease
(3) 36.36% increase (4) 36.36% decrease

27. If $V_A - V_B = 6V$, then $V_C - V_D$ is :

(1) −5V (2) 2V (3) 3V (4) 6V

28. The feedback system shown below oscillates at 2 rad/s when :



(1) K = 2 and a = 0.75 (2) K = 3 and a = 0.75
(3) K = 4 and a = 0.5 (4) K = 2 and a = 0.5

29. The bus admittance matrix of a three-phase three-line system is $Y = j\begin{bmatrix} -13 & 10 & 5 \\ 10 & -18 & 10 \\ 5 & 10 & -13 \end{bmatrix}$. If each transmission line between the two buses is represented by an equivalent π-network, the magnitude of the shunt susceptance of the line connecting bus 1 and 2 is :

(1) 4 (2) 2 (3) 1 (4) 0

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30. The locked rotor current in a 3-phase, star connected 15 kW, 4-pole, 230 V, 50 Hz induction motor at rated conditions is 50 A. Neglecting losses and magnetizing current, the approximate locked rotor line current drawn when the motor is connected to a 236 V, 57 Hz supply is :

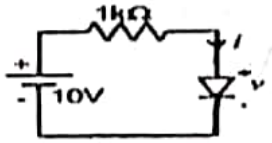
(1) 58.5 A (2) 45.0 A (3) 45.7 A (4) 55.6 A

31. The output Y of a 2-bit comparator is logic 1 whenever the 2-bit input a is greater than the 2-bit input 8. The number of combinations for which the output is logic 1, is :

(1) 4 (2) 6 (3) 8 (4) 10

32. The i-v characteristics of the diode in the circuit given below are :

$$i = \begin{cases} (v-0.7)/500A & , \quad v \geq 0 \\ 0A & , \quad v < 0 \end{cases}$$



The current in the circuit is

(1) 10 mA (2) 9.3 mA

(3) 6.67 mA (4) 6.2 mA

33. Two independent random variables X and Y are uniformly distributed in the interval [−1, 1]. The probability that max [X,Y] is less than 1/2 is :

(1) 3/4 (2) 9/16 (3) 1/4 (4) 2/3

34. If $x = \sqrt{-1}$, then the value of X^X is :

(1) $e^{-\pi/2}$ (2) $e^{\pi/2}$ (3) x (4) 1

35. With initial condition x(1) = 0.5, the solution of the differential equation $t\frac{dx}{dt} + x = t$ is :

(1) $x = t - \frac{1}{2}$ (2) $x = t^2 - \frac{1}{2}$

(3) $x = t^2/2$ (4) $x = t/2$

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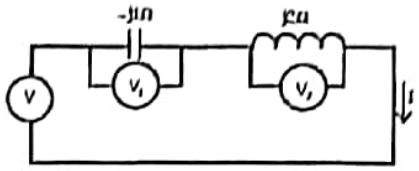
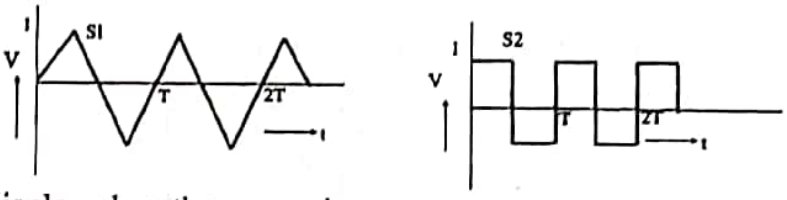
36. Three moving iron type voltmeter are connected as shown below. Voltmeter readings are V, V_1, V_2 are indicated. The correct relation among the voltmeter readings is :



(1) $V = V_1/\sqrt{2} + V_2/\sqrt{2}$ (2) $V = V_1 + V_2$

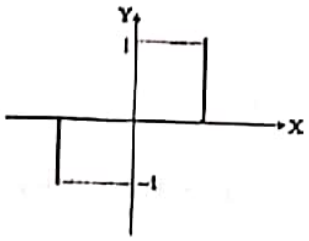
(3) $V = V_1, V_2$ (4) $V = V_1 - V_2$

37. The two signals S1 and S2, shown in figure, are applied to Y and X deflection plates of an oscilloscope :

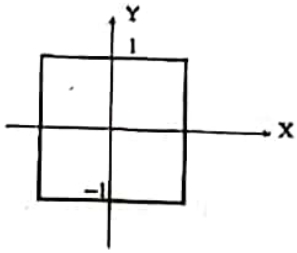


The waveform displayed on the screen is :

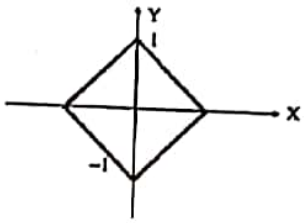
(1)



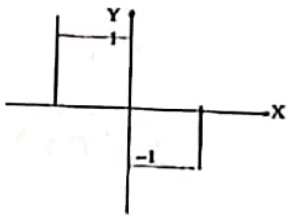
(2)



(3)



(4)



38. A periodic waveform observed across a load is represented by :

$$V(t) = \begin{cases} 1 + \sin wt & , \quad 0 \le wt < 6\pi \\ -1 + \sin wt & , \quad 6\pi \le wt < 12\pi \end{cases}$$

The measured value, using moving iron voltmeter connected across the load, is :

(1) $\sqrt{3}/2$ (2) $\sqrt{2}/3$

(3) 3/2 (4) 2/3

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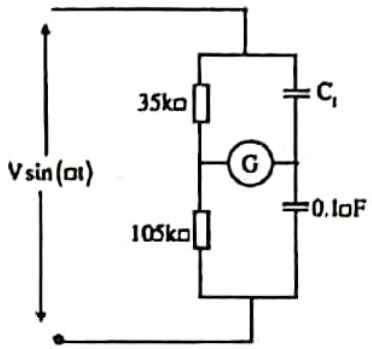
39. In the bridge circuit shown, the capacitors are loss free. At balance, the value of capacitance C_1 in microfarad is :



(1) 0.3 μF (2) 0.5 μF

(3) 0.8 μF (4) 1 μF

40. Let $\Delta(fv) = x^2y + y^2z + z^2x$; where f and v are scalar and vector fields respectively. If $v = yi + zj + xk$, then $v = \Delta f$ is :

(1) $x^2y + y^2z + z^2x$ (2) $2xy + 2yz + 2zx$

(3) $x + y + z$ (4) 0

41. A single-phase, full-bridge rectifier fed from a 230 V, 50 Hz sinusoidal source supplies a series combination of finite resistance, R, and a very large inductance L. The two most dominant frequency components in the source current are :

(1) 50 Hz, 0 Hz (2) 50 Hz, 100 Hz

(3) 50 Hz, 150 Hz (4) 150 Hz, 250 Hz

42. A 0-1 Ampere moving iron ammeter has an internal resistance of 50 mΩ and inductance of 0.1 mH. A shunt coil is connected to extend its range to 0-10 Ampere for all operating frequencies. The time constant in milliseconds and resistance in mΩ of the shunt coil respectively are :

(1) 2,5.55 (2) 2,1 (3) 2.18,0.55 (4) 11.1,2

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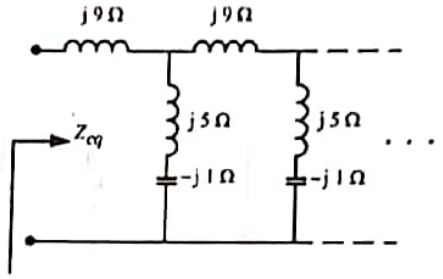
43. The equivalent impedance Z_{eq} for the infinite ladder circuit shown in the figure is :



(1) J12Ω (2) – J12Ω (3) J13Ω (4) 13Ω

44. Consider two npn BJT devices, first device has base doping N_{B1} and second device has base doping N_{B2}. If N_{B2} is two times that of N_{B1} then (Here β_1 and β_2 are the common emitter current gain of device 1 and device 2 respectively) :

(1) $\beta_1 > \beta_2$ (2) $\beta_1 < \beta_2$ (3) $\beta_1 = \beta_2$ (4) None of the above

45. When the temperature decreases then the width of the depletion region in a PN junction diode ?

(1) Increases (2) Decreases
(3) Do not change (4) Increases and then decreases

46. A clamper circuit :

(i) adds or subtract a dc voltage to or from input waveform
(ii) does not change shape of the input waveform
(iii) amplifies the input waveform
Which of the above statements are correct ?

(1) (i) and (ii) (2) (i) and (iii) (3) (ii) and (iii) (4) (i), (ii) and (iii)

47. A CRO is operated with X and Y settings of 0.5 ms/cm and 100 mV/cm respectively. The screen of the CRO is 10 cm × 8 cm (X and Y). A sine wave of frequency 200 Hz and rms amplitude of 300 mV is applied to the Y input. The screen will show :

(1) one cycle of the undistorted sine wave
(2) two cycle of the undistorted sine wave
(3) one cycle sine wave with clipped amplitude
(4) two cycle of the sine wave with clipped amplitude

48. The voltmeter choice for measuring the emf of a 100 V dc source would be :

(1) 100 V, 1 mA (2) 100 V, 2 mA
(3) 100 V, 10 kΩ/V (4) 100 V, 100Ω/kV

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49. A three phase transformer is supplied at 6000 V on the delta connected side. The terminal voltage on the star connected side when loaded at power factor 0.8 lagging is 415 V. The equivalent resistance and reactance drops are 1% and 5% respectively. The turn ratio is approximately equal to :

(1) 22 (2) 24 (3) 26 (4) 30

50. The number of samples in one period of signal $\sin(3.15\pi n)$ is :

(1) 80 (2) 40 (3) 315 (4) 63

51. In a long transmission line with r, l, g and c are the resistance, inductance, shunt conductance and capacitance per unit length, respectively, the condition for distortionless transmission is :

(1) $rc = lg$ (2) $rc = \sqrt{(l/c)}$ (3) $rg = lc$ (4) $g = \sqrt{(c/l)}$

52. The signal flow graph of a system is shown below. $U(s)$ is the input and $C(s)$ is the output :

Assuming, $h_1 = b_1$ and $h_0 = b_0 - b_1a_1$, the input-output transfer function, $G(s) = \dfrac{C(s)}{U(s)}$ of the system is given by :

(1) $G(s) = \dfrac{b_0s + b_1}{s^2 + a_0s + a_1}$

(2) $G(s) = \dfrac{a_1s + a_0}{s^2 + b_1s + b_0}$

(3) $G(s) = \dfrac{b_1s + b_0}{s^2 + a_1s + a_0}$

(4) $G(s) = \dfrac{a_0s + a_1}{s^2 + b_0s + b_1}$

53. An LPF wattmeter of power factor 0.2 is having three voltage settings 300 V, 150 V and 75 V, and two current settings 5 A and 10 A. The full scale reading is 150. If the wattmeter is used with 150 V voltage setting and 10 A current setting, the multiplying factor of the wattmeter is :

(1) 2 (2) 4 (3) 6 (4) 8

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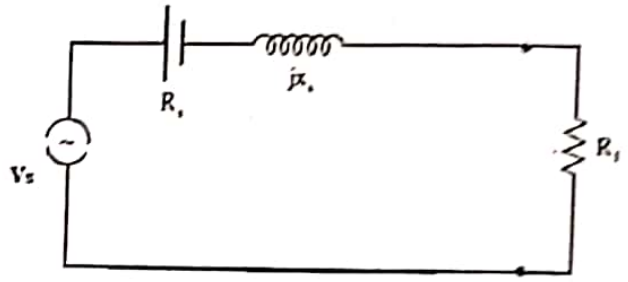
54. A non-ideal voltage source V_s has an internal impedance of Z_s. If a purely resistive load is tobe chosen that maximizes the power transferred to the load, its value must be :



(1) 0
(2) Real part of Zs
(3) Magnitude of Zs
(4) Complex conjugate of Zs

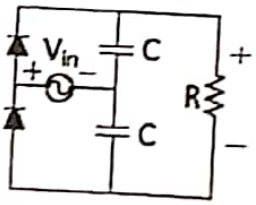
55. Integration of the complex function $f(z)=\frac{z^2}{z^2-1}$ in the counterclockwise direction, around $|z-1|=1$, is :

(1) $-\pi i$ (2) 0 (3) πi (4) $2\pi i$

56. A 3-phase balanced load which has a power factor of 0.707 is connected to a balanced supply. The power consumed by the load is 5 kW. The power is measured by two-wattmeter method. The reading of the two wattmeters are :

(1) 3.94 kW and 1.06 kW
(2) 2.50 kW and 2.50 kW
(3) 5.00 kW and 0.00 kW
(4) 2.96 kW and 2.04 kW

57. In the following circuit, the input voltage V_{in} is 100 sin(100 πt). For 100 πRC = 50, the average voltage across R (in volts) under steady-state is nearest to :

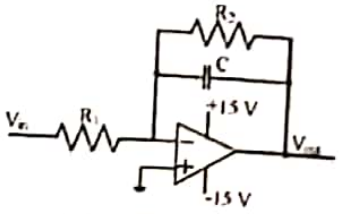


(1) 100 (2) 31.8 (3) 200 (4) 63.6

58. If $|9y-6|=3$, then $y^2-4y/3$ is :

(1) 0 (2) +1/3 (3) −1/3 (4) Undefined

59. The circuit shown below is an example of a :



(1) Low pass filter (2) Band pass filter (3) High pass filter (4) Notch filter

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

(1) $9e^{-\frac{t}{3}}u(t)$ (2) $9e^{-\frac{t}{6}}u(t)$

(3) $9e^{-\frac{t}{3}}u(t)-6e^{-\frac{t}{6}}u(t)$ (4) $54e^{-\frac{t}{6}}u(t)-54e^{-\frac{t}{3}}u(t)$

61. The value of $z=\sqrt{i}+\sqrt{(-i)}$ is :

(1) $i+\sqrt{i}$ (2) 1 (3) 0 (4) $\sqrt{2}$

62. For which of the following method, the order of convergence is quadratic ?

(1) Bisection Method (2) Newton-Raphson Method

(3) Regula Falsi Method (4) Secant Method

63. For a slip ring Induction motor, if the rotor resistance is increased, then :

(1) starting torque decrease but efficiency increases

(2) starting torque and efficiency increase

(3) starting torque increase but efficiency decreases

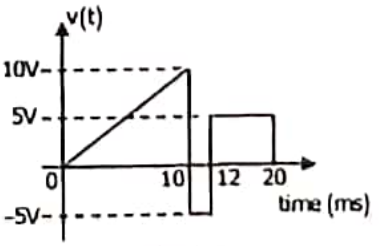
(4) starting torque and efficiency decreases

64. The bridge method commonly used for finding mutual inductance is :

(1) Heaviside Campbell bridge (2) Schering bridge

(3) De Sauty bridge (4) Wein bridge

65. A periodic voltage waveform observed on an oscilloscope across a load in shown. A permanent magnet moving coil (PMMC) meter connected across the same load reads :



(1) 4V (2) 5 V (3) 8 V (4) 10 V

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66. An analog voltmeter uses external multiplier settings. With a multiplier setting of 20 KΩ, it reads 440V and with a multiplier setting of 80 KΩ it reads 352 V. for a multiplier setting of 40 KΩ, the voltmeter reads :

(1) 371 V (2) 383 V (3) 394 V (4) 406 V

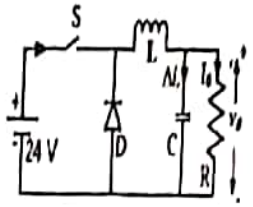
67. The typical ratio of latching current to holding in a 20A thyristor is :

(1) 5.0 (2) 2.0 (3) 1.0 (4) 0.5

68. A half-controlled single-phase bridge rectifier is supplying an R-L load. It is operated at a firing angle α and the load current is continuous. The fraction of cycle that the freewheeling diode conducts is :

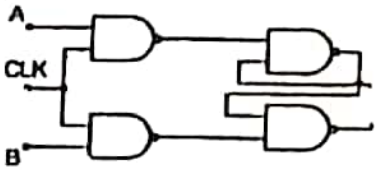
(1) 1/2 (2) $(1 - \alpha/\pi)$ (3) $\alpha/2\pi$ (4) α/π

69. In the circuit shown, an ideal switch S is operated at 100 KHz with a duty ratio 50%. Given that Δ_{ic} 1.6 A peak-to-peak and I_0 is 5A dc, the peak current in S is :



(1) 6.6A (2) 5.0 A (3) 5.8A (4) 4.2 A

70. Consider the given circuit :



In this circuit, the race around :

(1) Does not occur

(2) Occurs when CLK = 0

(3) Occurs when CLK =1 and A= B = 1

(4) Occurs when CLK =1 and A = B = 0

71. Integration of the complex function $f(z) = z^2 / z^2 - 1$, in the counter clockwise direction, around $|z - 1| = 1$, is :

(1) $-\pi i$ (2) 0 (3) πi (4) $2\pi i$

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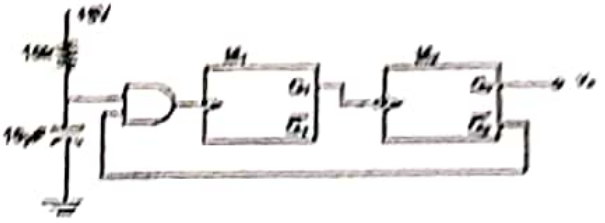
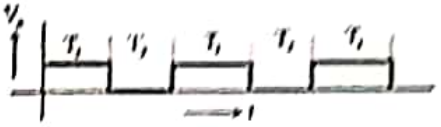
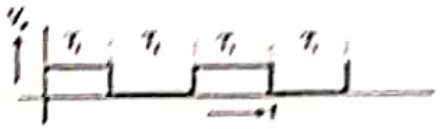
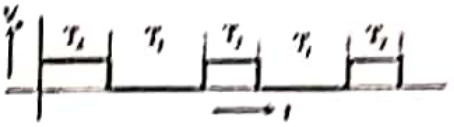
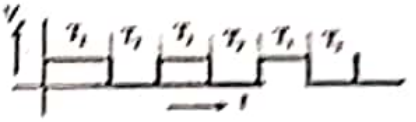
72. Two monoshot multivibrators, one positive edge triggered (M_1) and another negative edge triggered (M_2), are connected as shown in figure :



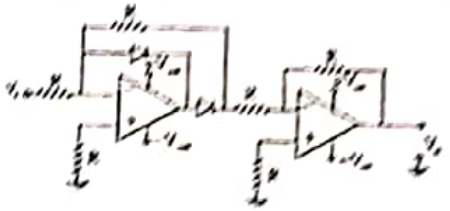
(1) 

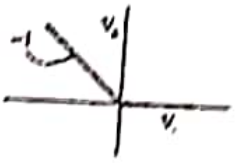
(2) 

(3) 

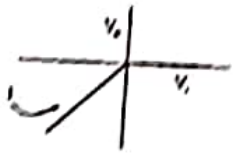
(4) 

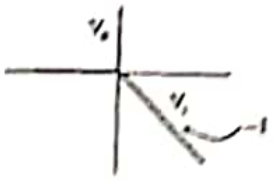
73. The transfer characteristic of the Op-amp circuit shown in figure is :



(1) 

(2) 

(3) 

(4) 

74. Two matrices A and B are given below :

$$A = \begin{bmatrix} p & q \\ r & s \end{bmatrix}; B = \begin{bmatrix} p^2+q^2 & pr+qs \\ pr+qs & r^2+s^2 \end{bmatrix}$$

If the rank of matrix A is N, then the rank of matrix B is :

(1) $N/2$ (2) $N-1$ (3) N (4) $2N$

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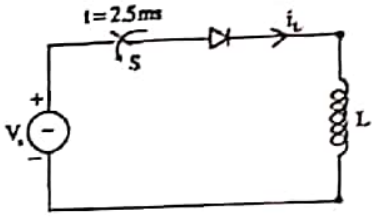
75. A diode circuit feeds an ideal inductor as shown in the figure. Given $V_S = 100 \sin(\omega t)$ V, where $\omega = 100\pi$ rad/s, and L = 31.83 mH. The initial value of inductor current is zero. Switch S is closed at t = 2.5 ms. The peak value of inductor i_L (in A) in the first cycle is :



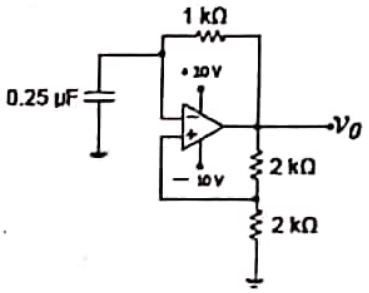
(1) 12 A (2) 17 A (3) 25 A (4) 30A

76. A 3-phase balanced load which has a power factor of 0.707 is connected to a balanced supply. The power consumed by the load is 5 KW. The power is measured by the two-wattmeter method. The readings of the two wattmeters are :

(1) 3.94 KW and 1.06 KW (2) 2.50 KW and 2.50 KW

(3) 5.00 KW and 0.00 KW (4) 2.96 KW and 2.04 KW

77. The saturation voltage of the ideal op-amp shown below is ±10 V. The output voltage Vo of the following circuit in the steady-state is :



(1) Square wave of period 0.55 ms (2) Triangular wave of period 0.55ms

(3) Square wave of period 0.25 ms (4) Triangular wave of period 0.25 ms

78. Consider a function $f(x) = 1 - [x]$ on $-1 \le x \le 1$. The value of x at which the function attains a maximum, and the maximum value of the function are :

(1) 0, −1 (2) −1, 0

(3) 0, 1 (4) −1, 2

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79. The Laplace transform of $f(t) = 2\sqrt{(t/\pi)}$ is $s^{-3/2}$. The Laplace transform of $g(t) = \sqrt{(1/\pi t)}$ is :

(1) $3s^{-5/2}/2$ (2) $s^{-1/2}$ (3) $s^{1/2}$ (4) $s^{3/2}$

80. When a bipolar junction transistor is operating in the saturation mode, which one of the following statements is true about the state of its collector-base (CB) and the base-emitter (BE) junctions ?

(1) The CB junction is forward biased and the BE junction is reverse biased.

(2) The CB junction is reverse biased and the BE junction is forward biased.

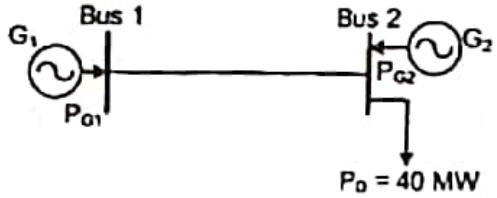
(3) Both the CB and BE junctions are forward biased.

(4) Both the CB and BE junctions are reversed biased.

81. With initial condition $x(1) = 0.5$, the solution of the differential equation $t\frac{dx}{dt} + x = t$ is :

(1) $x = t - \frac{1}{2}$ (2) $x = t^2 - \frac{1}{2}$ (3) $x = \frac{t^2}{2}$ (4) $x = \frac{t}{2}$

82. The figure shows a two-generator system supplying a load of $P_0 = 40$MW, connected at bus 2.



The fuel cost of generators G_1 and G_2 are :
$C_1(P_{G1}) = 10{,}000$ Rs/MWh and $C_2(P_{G2}) = 12500$ Rs/MWh and the loss in the line is $P_{loss(pu)} = 0.5\ PG^2_{1(pu)}$, where the loss coefficient is specified in pu on a 100 MVA base. The most economic power generation schedule in MW is :

(1) $P_{G1} = 20,\ P_{G2} = 22$ (2) $P_{G1} = 22,\ P_{G2} = 20$

(3) $P_{G1} = 20,\ P_{G2} = 20$ (4) $P_{G1} = 0,\ P_{G2} = 40$

83. Leakage flux in an induction motor is :

(1) Flux that leaks through the machine

(2) Flux that links both stator and rotor windings

(3) Flux that links none of the windings

(4) Flux that links the stator winding or the rotor winding but not both

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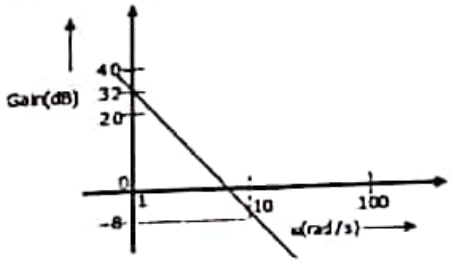
84. The angle δ in the swing equation of a synchronous generator is the :
(1) angle between stator voltage and current
(2) angular displacement of the rotor with respect to the stator
(3) angular displacement of the stator mmf with respect to a synchronously rotating axis
(4) angular displacement of an axis fixed to the rotor with respect to a synchronously rotating axis

85. The Bode plot of a transfer function G(s) is shown in the figure below.



The gain (20log |$G(s)$ |) is 32 dB and −8 dB at 1 rad/s and 10 rad/s respectively. The phase is negative for all ω. The $G(s)$ is :
(1) 39.8/s (2) $39.8/s^2$ (3) 32/s (4) $32/s^2$

86. The flux density at a point in space is given by $B = 4xa_x + 2kya_y + 8a_z$Wb/m2. The value of constant k must be equal to :
(1) −2 (2) −0.5 (3) +0.5 (4) +2

87. A single-phase transformer has no-load loss of 64 W, as obtained from an open-circuit test. When a short-circuit test is performed on to it with 90% of the rated currents flowing in its both LV and HV windings, the measured loss is 81 W. The transformer has maximum efficiency when operated at :
(1) 50.0% of the rated current (2) 64.0% of the rated current
(3) 80.0% of the rated current (4) 88.8% of the rated current

88. A source v_s = V cos 100πt has an internal impedance of (4 + j3) Ω. If a purely resistive load connected to this source has to extract the maximum power out of the source, its value in Ω should be :
(1) 3 (2) 4 (3) 5 (4) 7

89. The impulse response of a system is $h(t) = tu(t)$. For an input $u(t-1)$, the output is :
(1) $\frac{t^2}{2}u(t)$ (2) $\frac{t(t-1)}{2}u(t-1)$ (3) $\frac{t(t-1)^2}{2}u(t-1)$ (4) $\frac{(t^2-1)}{2}u(t-1)$

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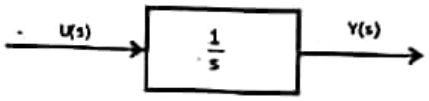
90. Assuming zero initial condition, the response $y(t)$ of the system given below to a unit step input $u(t)$ is :



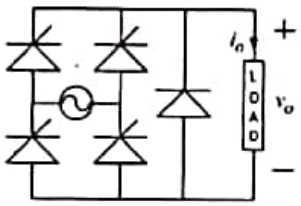
(1) $u(t)$ (2) $tu(t)$ (3) $\frac{t^2}{2}u(t)$ (4) $e^{-t}u(t)$

91. In a salient pole synchronous motor, the developed reluctance torque attains the maximum value when the load angle in electrical degrees is :

(1) 0 (2) 45

(3) 60 (4) 90

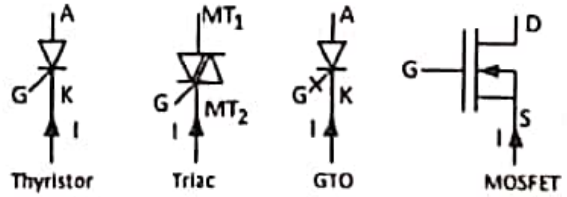
92. A single phase fully controlled rectifier is supplying a load with an anti-parallel diode as shown in the figure. All switches and diodes are ideal. Which one of the following is true for instantaneous load voltage and current ?



(1) $V_0 \geq 0$ and $i_0 < 0$ (2) $V_0 < 0$ and $i_0 < 0$

(3) $V_0 \geq 0$ and $i_0 \geq 0$ (4) $V_0 < 0$ and $i_0 \geq 0$

93. Four power semiconductor devices are shown in the figure along with their relevant terminals. The device(s) that can carry dc current continuously in the direction shown whengated appropriately is (are) :



(1) Triac only (2) Triac and MOSFET

(3) Triac and GTO (4) Thyristor and Triac

94. The graph of a network has 8 nodes and 5 independent loops. The number of branches of the graph is :

(1) 11 (2) 12 (3) 13 (4) 14

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95. M is a 2×2 matrix with eigen values 4 and 9. The eigen values of M^2 are :

(1) 4 and 9 (2) 2 and 3 (3) -2 and -3 (4) 16 and 81

96. A 5 KVA, 50 V / 400V, single-phase transformer has a secondary terminal voltage of 95 V when loaded. The regulation of the transformer is :

(1) 4.5% (2) 9% (3) 5% (4) 1%

97. A six-pulse thyristor rectifier is connected to a balanced three-phase, 50 Hz AC source. Assuming that the DC output current of the rectifier is constant, the lowest harmonic component in the AC input current is :

(1) 100 Hz (2) 150 Hz (3) 250 Hz (4) 300 Hz

98. A three-phase synchronous motor draws 200 A from the line at unity power factor at rated load. Considering the same line voltage and load, the line current at a power factor of 0.5 leading is :

(1) 100 A (2) 200 A (3) 300 A (4) 400 A

99. A current controlled current source (CCCS) has an input impedance of 10Ω and output impedance of 100 kΩ. When this CCCS is used in a negative feedback closed loop with a loop gain of 9, the closed loop output impedance is :

(1) 10 Ω (2) 100 Ω (3) 100 kΩ (4) 1000 kΩ

100. Out of the following options, the most relevant information needed to specify the real power (P) at the PV buses in a load flow analysis is :

(1) Solution of the economic load dispatch

(2) Rated power output of the generator

(3) Rated voltage of the generator

(4) Base power of the generator

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D

M.Phil./Ph.D./URS-EE-2020

SUBJECT : Electrical Engineering

SET-Y

10004

Sr. No. .....

Time : **1¼ Hours** Max. Marks : **100** Total Questions : **100**

Roll No. (In figures)_____ (in words) _____

Name _____ Father's Name _____

Mother's Name _____ Date of Examination _____

_____ _____

(Signature of the Candidate) (Signature of the Invigilator)

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1. ***All questions are compulsory.***
2. The candidates ***must return*** the question booklet as well as OMR Answer-Sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.
3. Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that a copy of OMR Sheet may be kept by the candidate.
4. Question Booklet along with answer key of all the A, B, C & D code will be got uploaded on the University website after the conduct of Entrance Examination. In case there is any discrepancy in the Question Booklet/Answer Key, the same may be brought to the notice of the Controller of Examination in writing/through E.Mail within 24 hours of uploading the same on the University Website. Thereafter, no complaint in any case, will be considered.
5. The candidate ***must not*** do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question booklet itself. Answers ***must not*** be ticked in the question booklet.
6. ***There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.***
7. Use only **Black** or **Blue Ball Point Pen** of good quality in the OMR Answer-Sheet.
8. *Before answering the questions, the candidates should ensure that they have been supplied correct and complete booklet. Complaints, if any, regarding misprinting etc. will not be entertained* **30** *minutes after starting of the examination.*

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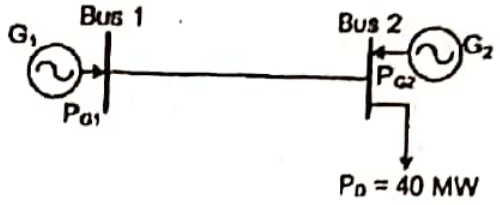
1. With initial condition $x(1) = 0.5$, the solution of the differential equation $t\frac{dx}{dt} + x = t$ is :

(1) $x = t - \frac{1}{2}$ (2) $x = t^2 - \frac{1}{2}$

(3) $x = \frac{t^2}{2}$ (4) $x = \frac{t}{2}$

2. The figure shows a two-generator system supplying a load of $P_0 = 40$MW, connected at bus 2.



The fuel cost of generators G_1 and G_2 are :
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3. Leakage flux in an induction motor is :

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(1) angle between stator voltage and current

(2) angular displacement of the rotor with respect to the stator

(3) angular displacement of the stator mmf with respect to a synchronously rotating axis

(4) angular displacement of an axis fixed to the rotor with respect to a synchronously rotating axis

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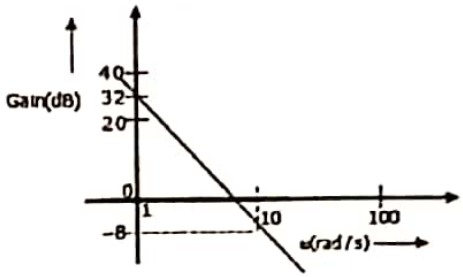
5. The Bode plot of a transfer function G(s) is shown in the figure below.



The gain (20log $|G(s)|$) is 32 dB and –8 dB at 1 rad/s and 10 rad/s respectively. The phase is negative for all ω. The $G(s)$ is :

(1) 39.8/s (2) $39.8/s^2$ (3) 32/s (4) $32/s^2$

6. The flux density at a point in space is given by $B = 4xa_x + 2kya_y + 8a_z$Wb/m2. The value of constant k must be equal to :

(1) –2 (2) –0.5 (3) +0.5 (4) +2

7. A single-phase transformer has no-load loss of 64 W, as obtained from an open-circuit test. When a short-circuit test is performed on to it with 90% of the rated currents flowing in its both LV and HV windings, the measured loss is 81 W. The transformer has maximum efficiency when operated at :

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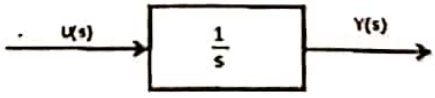
8. A source v_s = V cos 100πt has an internal impedance of $(4 + j3)$ Ω. If a purely resistive load connected to this source has to extract the maximum power out of the source, its value in Ω should be :

(1) 3 (2) 4 (3) 5 (4) 7

9. The impulse response of a system is $h(t) = tu(t)$. For an input $u(t-1)$, the output is :

(1) $\frac{t^2}{2}u(t)$ (2) $\frac{t(t-1)}{2}u(t-1)$ (3) $\frac{t(t-1)^2}{2}u(t-1)$ (4) $\frac{(t^2-1)}{2}u(t-1)$

10. Assuming zero initial condition, the response $y(t)$ of the system given below to a unit step input $u(t)$ is :



(1) $u(t)$ (2) $tu(t)$ (3) $\frac{t^2}{2}u(t)$ (4) $e^{-t}u(t)$

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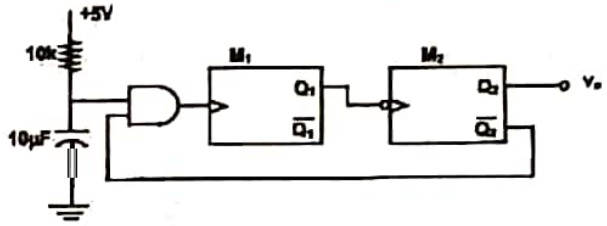
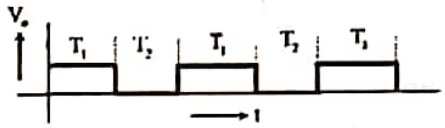
11. Integration of the complex function $f(z) = z^2 / z^2 - 1$, in the counter clockwise direction, around $|z - 1| = 1$, is :

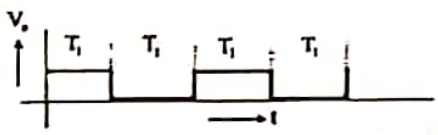
(1) $-\pi i$ (2) 0

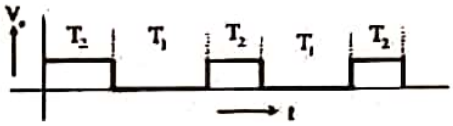
(3) πi (4) $2\pi i$

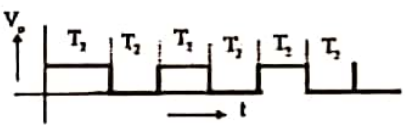
12. Two monoshot multivibrators, one positive edge triggered (M_1) and another negative edge triggered (M_2), are connected as shown in figure :



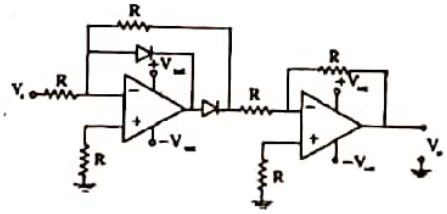
(1) 

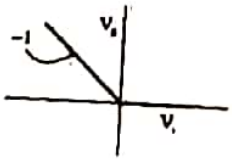
(2) 

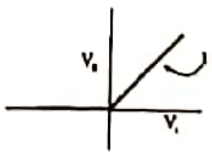
(3) 

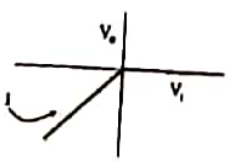
(4) 

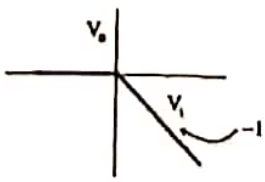
13. The transfer characteristic of the Op-amp circuit shown in figure is :



(1) 

(2) 

(3) 

(4) 

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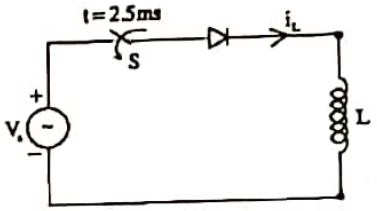
14. Two matrices A and B are given below :

$$A=\begin{bmatrix} p & q \\ r & s \end{bmatrix}; B=\begin{bmatrix} p^2+q^2 & pr+qs \\ pr+qs & r^2+s^2 \end{bmatrix}$$

If the rank of matrix A is N, then the rank of matrix B is :

(1) $N/2$ (2) $N-1$ (3) N (4) $2N$

15. A diode circuit feeds an ideal inductor as shown in the figure. Given Vs = 100 sin(wt) V, where w= 100πrad/s, and L = 31.83 mH. The initial value of inductor current is zero. Switch S is closed at t = 2.5 ms. The peak value of inductor i_L (in A) in the first cycle is :



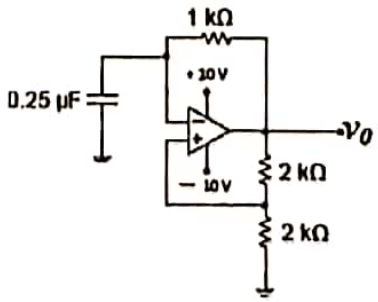
(1) 12 A (2) 17 A (3) 25 A (4) 30A

16. A 3-phase balanced load which has a power factor of 0.707 is connected to a balanced supply. The power consumed by the load is 5 KW. The power is measured by the two-wattmeter method. The readings of the two wattmeters are :

(1) 3.94 KW and 1.06 KW (2) 2.50 KW and 2.50 KW

(3) 5.00 KW and 0.00 KW (4) 2.96 KW and 2.04 KW

17. The saturation voltage of the ideal op-amp shown below is ±10 V. The output voltage Vo of the following circuit in the steady-state is :



(1) Square wave of period 0.55 ms (2) Triangular wave of period 0.55ms

(3) Square wave of period 0.25 ms (4) Triangular wave of period 0.25 ms

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18. Consider a function $f(x) = 1 - [x]$ on $-1 \leq x \leq 1$. The value of x at which the function attains a maximum, and the maximum value of the function are :

(1) $0, -1$ (2) $-1, 0$

(3) $0, 1$ (4) $-1, 2$

19. The Laplace transform of $f(t) = 2\sqrt{(t/\pi)}$ is $s^{-3/2}$. The Laplace transform of $g(t) = \sqrt{(1/\pi t)}$ is :

(1) $3s^{-5/2}/2$ (2) $s^{-1/2}$ (3) $s^{1/2}$ (4) $s^{3/2}$

20. When a bipolar junction transistor is operating in the saturation mode, which one of the following statements is true about the state of its collector-base (CB) and the base-emitter (BE) junctions ?

(1) The CB junction is forward biased and the BE junction is reverse biased.

(2) The CB junction is reverse biased and the BE junction is forward biased.

(3) Both the CB and BE junctions are forward biased.

(4) Both the CB and BE junctions are reversed biased.

21. The value of $z = \sqrt{i} + \sqrt{(-i)}$ is :

(1) $i + \sqrt{i}$ (2) 1 (3) 0 (4) $\sqrt{2}$

22. For which of the following method, the order of convergence is quadratic ?

(1) Bisection Method (2) Newton-Raphson Method

(3) Regula Falsi Method (4) Secant Method

23. For a slip ring Induction motor, if the rotor resistance is increased, then :

(1) starting torque decrease but efficiency increases

(2) starting torque and efficiency increase

(3) starting torque increase but efficiency decreases

(4) starting torque and efficiency decreases

24. The bridge method commonly used for finding mutual inductance is :

(1) Heaviside Campbell bridge (2) Schering bridge

(3) De Sauty bridge (4) Wein bridge

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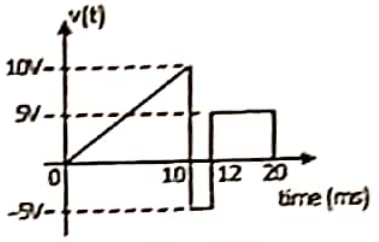
25. A periodic voltage waveform observed on an oscilloscope across a load in shown. A permanent magnet moving coil (PMMC) meter connected across the same load reads :



(1) 4V (2) 5 V (3) 8 V (4) 10 V

26. An analog voltmeter uses external multiplier settings. With a multiplier setting of 20 KΩ, it reads 440V and with a multiplier setting of 80 KΩ it reads 352 V. for a multiplier setting of 40 KΩ, the voltmeter reads :

(1) 371 V (2) 383 V (3) 394 V (4) 406 V

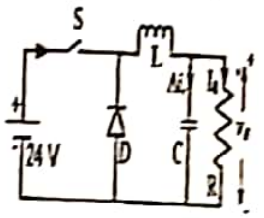
27. The typical ratio of latching current to holding in a 20A thyristor is :

(1) 5.0 (2) 2.0 (3) 1.0 (4) 0.5

28. A half-controlled single-phase bridge rectifier is supplying an R-L load. It is operated at a firing angle α and the load current is continuous. The fraction of cycle that the freewheeling diode conducts is :

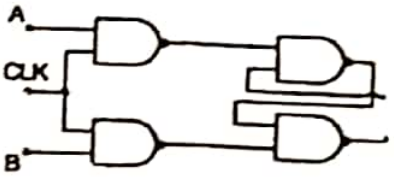
(1) 1/2 (2) $(1 - \alpha/\pi)$ (3) $\alpha/2\pi$ (4) α/π

29. In the circuit shown, an ideal switch S is operated at 100 KHz with a duty ratio 50%. Given that Δ_{ic} 1.6 A peak-to-peak and I_0 is 5A dc, the peak current in S is :



(1) 6.6A (2) 5.0 A (3) 5.8A (4) 4.2 A

30. Consider the given circuit :



In this circuit, the race around :

(1) Does not occur (2) Occurs when CLK = 0

(3) Occurs when CLK =1 and A= B = 1 (4) Occurs when CLK =1 and A = B = 0

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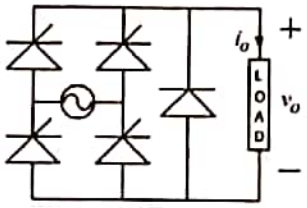
31. In a salient pole synchronous motor, the developed reluctance torque attains the maximum value when the load angle in electrical degrees is :

(1) 0 (2) 45

(3) 60 (4) 90

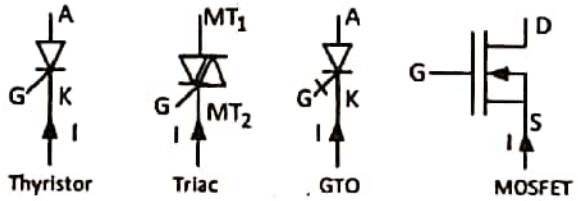
32. A single phase fully controlled rectifier is supplying a load with an anti-parallel diode as shown in the figure. All switches and diodes are ideal. Which one of the following is true for instantaneous load voltage and current ?



(1) $V_0 \geq 0$ and $i_0 < 0$ (2) $V_0 < 0$ and $i_0 < 0$

(3) $V_0 \geq 0$ and $i_0 \geq 0$ (4) $V_0 < 0$ and $i_0 \geq 0$

33. Four power semiconductor devices are shown in the figure along with their relevant terminals. The device(s) that can carry dc current continuously in the direction shown when gated appropriately is (are) :



(1) Triac only (2) Triac and MOSFET

(3) Triac and GTO (4) Thyristor and Triac

34. The graph of a network has 8 nodes and 5 independent loops. The number of branches of the graph is :

(1) 11 (2) 12 (3) 13 (4) 14

35. M is a 2×2 matrix with eigen values 4 and 9. The eigen values of M^2 are :

(1) 4 and 9 (2) 2 and 3

(3) −2 and −3 (4) 16 and 81

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36. A 5 KVA, 50 V /100V, single-phase transformer has a secondary terminal voltage of 95 V when loaded. The regulation of the transformer is :

(1) 4.5% (2) 9% (3) 5% (4) 1%

37. A six-pulse thyristor rectifier is connected to a balanced three-phase, 50 Hz AC source. Assuming that the DC output current of the rectifier is constant, the lowest harmonic component in the AC input current is :

(1) 100 Hz (2) 150 Hz (3) 250 Hz (4) 300 Hz

38. A three-phase synchronous motor draws 200 A from the line at unity power factor at rated load. Considering the same line voltage and load, the line current at a power factor of 0.5 leading is :

(1) 100 A (2) 200 A (3) 300 A (4) 400 A

39. A current controlled current source (CCCS) has an input impedance of 10Ω and output impedance of 100 kΩ. When this CCCS is used in a negative feedback closed loop with a loop gain of 9, the closed loop output impedance is :

(1) 10 Ω (2) 100 Ω (3) 100 kΩ (4) 1000 kΩ

40. Out of the following options, the most relevant information needed to specify the real power (P) at the PV buses in a load flow analysis is :

(1) Solution of the economic load dispatch

(2) Rated power output of the generator

(3) Rated voltage of the generator

(4) Base power of the generator

41. In a long transmission line with r, l, g and c are the resistance, inductance, shunt conductance and capacitance per unit length, respectively, the condition for distortionless transmission is :

(1) $rc = lg$ (2) $rc = \sqrt{(l/c)}$ (3) $rg = Ic$ (4) $g = \sqrt{(c/l)}$

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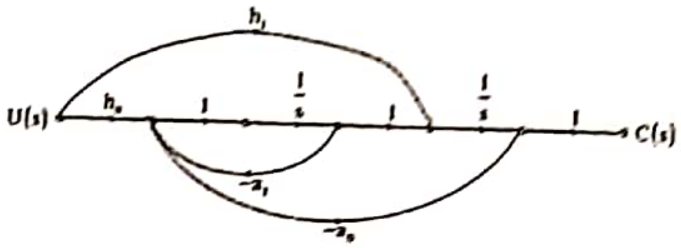
42. The signal flow graph of a system is shown below. $U(s)$ is the input and $C(s)$ is the output :



Assuming, $h_1 = b_1$ and $h_0 = b_0 - b_1a_1$, the input-output transfer function, $G(s) = \frac{C(s)}{U(s)}$ of the system is given by :

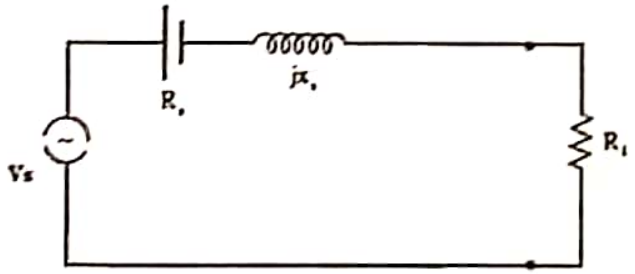
(1) $G(s) = \frac{b_0 s + b_1}{s^2 + a_0 s + a_1}$ (2) $G(s) = \frac{a_1 s + a_0}{s^2 + b_1 s + b_0}$

(3) $G(s) = \frac{b_1 s + b_0}{s^2 + a_1 s + a_0}$ (4) $G(s) = \frac{a_0 s + a_1}{s^2 + b_0 s + b_1}$

43. An LPF wattmeter of power factor 0.2 is having three voltage settings 300 V, 150 V and 75 V, and two current settings 5 A and 10 A. The full scale reading is 150. If the wattmeter is used with 150 V voltage setting and 10 A current setting, the multiplying factor of the wattmeter is :

(1) 2 (2) 4 (3) 6 (4) 8

44. A non-ideal voltage source V_s has an internal impedance of Z_s. If a purely resistive load is tobe chosen that maximizes the power transferred to the load, its value must be :



(1) 0 (2) Real part of Zs

(3) Magnitude of Zs (4) Complex conjugate of Zs

45. Integration of the complex function $f(z) = \frac{z^2}{z^2 - 1}$ in the counterclockwise direction, around $|z - 1| = 1$, is :

(1) $-\pi i$ (2) 0 (3) πi (4) $2\pi i$

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46. A 3-phase balanced load which has a power factor of 0.707 is connected to a balanced supply. The power consumed by the load is 5 kW. The power is measured by two-wattmeter method. The reading of the two wattmeters are :

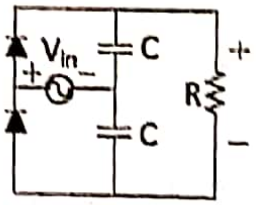
(1) 3.94 kW and 1.06 kW

(2) 2.50 kW and 2.50 kW

(3) 5.00 kW and 0.00 kW

(4) 2.96 kW and 2.04 kW

47. In the following circuit, the input voltage V_{in} is $100 \sin(100 \pi t)$. For $100 \pi RC = 50$, the average voltage across R (in volts) under steady-state is nearest to :

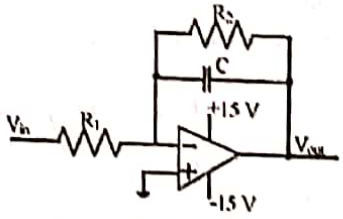


(1) 100 (2) 31.8 (3) 200 (4) 63.6

48. If $|9y - 6| = 3$, then $y^2 - 4y/3$ is :

(1) 0 (2) +1/3 (3) −1/3 (4) Undefined

49. The circuit shown below is an example of a :



(1) Low pass filter (2) Band pass filter (3) High pass filter (4) Notch filter

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

(1) $9e^{-\frac{t}{3}} u(t)$

(2) $9e^{-\frac{t}{6}} u(t)$

(3) $9e^{-\frac{t}{3}} u(t) - 6e^{-\frac{t}{6}} u(t)$

(4) $54e^{-\frac{t}{6}} u(t) - 54e^{-\frac{t}{3}} u(t)$

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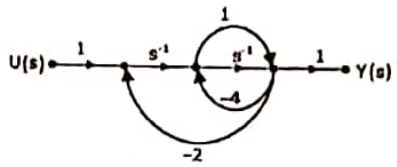
51. The signal flow graph for a system is given below. The transfer function $\frac{Y(s)}{U(s)}$ for the system is :



(1) $\frac{s+1}{5s^2+6s+2}$ (2) $\frac{s+1}{s^2+6s+2}$ (3) $\frac{s+1}{s^2+4s+2}$ (4) $\frac{1}{5s^2+6s+2}$

52. The dielectric slab with 500 mm × 500 mm cross-section is 0.4 m long. The slab is subjected to a uniform electric field of E = 6a + 8a kV/mm. The relative permittivity of the dielectric material is equal to 2. The value of constant ε_0 is 8.85×10^{-12} F/m. The energy stored in the dielectric in Joules is :

(1) 8.85×10^{-11} (2) 8.85×10^{-5} (3) 88.5 (4) 885

53. For a power system network with n nodes, Z_{33} of its bus impedance matrix is j0.5 pu. The voltage at node 3 is 1.3 $\angle -10°$pu. If a capacitor having reactance of –j3.5 pu is now added to the network between node 3 and the reference node, the current drawn by the capacitor pu is :

(1) $0.325\angle -100°$ (2) $0.325\angle 80°$

(3) $0.371\angle -100°$ (4) $0.433\angle -80°$

54. The curl of the gradient of the scalar field defined by $V = 2x^2y + 3y^2z + 4z^2x$ is :

(1) $4xya_x + 6yza_y + 8zxa_z$

(2) $4a_x + 6a_y + 8a_z$

(3) $(4xy + 4z^2)a_x + (2x^2 + 6yz)a_y + (3y^2 + 8zx)a_z$

(4) 0

55. A single-phase load is supplied by a single-phase voltage source. If the current flowing from the load to the source is $10\angle -150°$A and if the voltage at the load terminals is $100\angle -60°$ V, then the :

(1) Load absorbs real power and delivers reactive power

(2) Load absorbs real power and absorbs reactive power

(3) Load delivers real power and delivers reactive power

(4) Load delivers real power and absorbs reactive power

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56. The line A to neutral voltage is $10\angle -15°$ V for a balanced three-phase star-connected load with phase sequence ABC. The voltage of line B with respect to line C is given by :

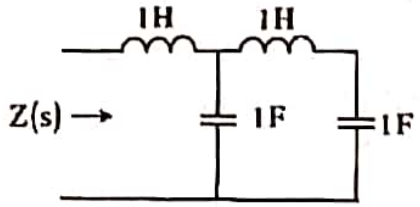
(1) $10\sqrt{3}\angle 105°$V (2) $10\angle 105°$ V

(3) $10\sqrt{3}\angle -75°$ V (4) $-10\sqrt{3}\angle 90°$ V

57. A hollow metallic sphere of radius r is kept at potential of 1 Volt. The total electric flux coming out of the concentric spherical surface of radius R ($>r$) is :

(1) $4\pi\varepsilon_0 r$ (2) $4\pi\varepsilon_0 r^2$ (3) $4\pi\varepsilon_0 R$ (4) $4\pi\varepsilon_0 R^2$

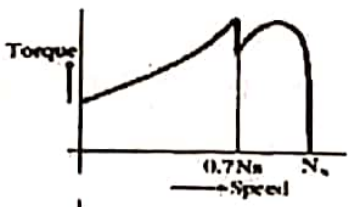
58. The driving point impedance Z(s) for the circuit shown below is :

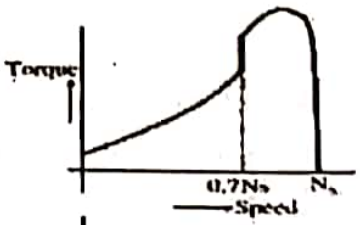


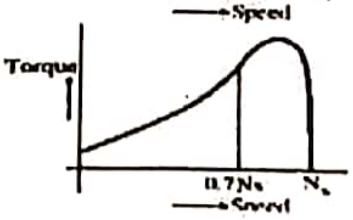
(1) $\frac{s^4+3s^2+1}{s^3+2s}$ (2) $\frac{s^4+2s^2+1}{s^2+2}$

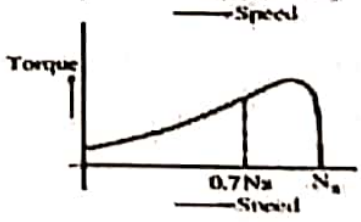
(3) $\frac{s^2+1}{s^4+s^2+1}$ (4) $\frac{s^3+1}{s^4+s^2+1}$

59. A single phase induction motor is provided with capacitor and centrifugal switch in series with auxiliary winding. The switch is expected to operate at a speed of 0.7 Ns, but due tomalfunctioning the switch fails to operate. The torque-speed characteristic of the motor is represented by :

(1) 

(2) 

(3) 

(4) 

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60. The no-load speed of a 230 V separately excited dc motor is 1400 rpm. The armature resistance drop and the brush drop are neglected. The field current is kept constant at ratedvalue. The torque of the motor in Nm for an armature current of 8 A is :

(1) 10 (2) 12.5 (3) 15 (4) 17.5

61. A 3×3 matrix P is such that, $p^3 = P$. Then the eigen values of P are :

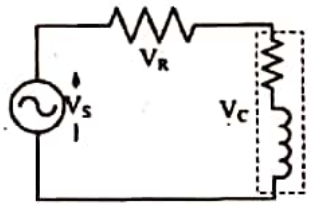
(1) 1, 1, –1

(2) 1, 0.5 + j0.866, 0.5 – j0.866

(3) 1, -0.5 + j0.866, –0.5 – j0.866

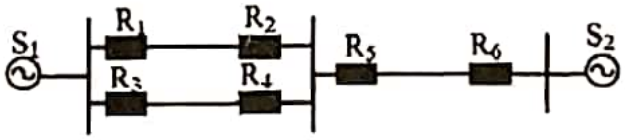
(4) 0, 1,–1

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



(1) 65,35 (2) 50,50 (3) 60,90 (4) 60, 80

63. A power system with two generators is shown in the figure below. The system (generators, buses and transmission lines) is protected by six overcurrent relays R_1 to R_6. Assuming a mix of directional and non-directional relays at appropriate locations, the remote backup relays for R_4 are :



(1) R_1, R_2 (2) R_2, R_6 (3) R_2, R_5 (4) R_1, R_6

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

(1) 189×189 (2) 100×100

(3) 90×90 (4) 180×180

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

(1) 1 (2) 2 (3) 4 (4) 16

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

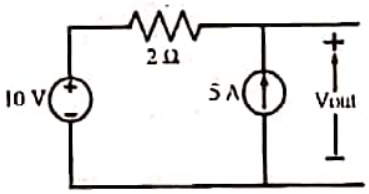
(1) Interchanging the terminals of the AC supply.

(2) Interchanging the terminals of the capacitor.

(3) Interchanging the terminals of the auxiliary winding.

(4) Interchanging the terminals of both the windings.

67. In the circuit shown below, the voltage and current sources are ideal. The voltage (V_{out}) across the current source, in volts, is :



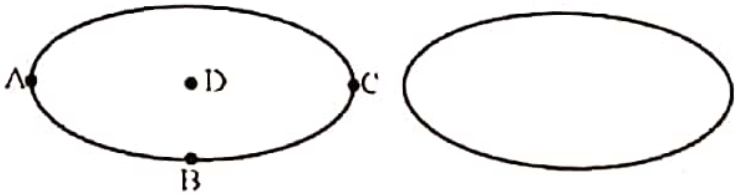
(1) 0 (2) 5

(3) 10 (4) 20

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

(1) 2 and 5 (2) 5 and 2 (3) 3 and 4 (4) 4 and 3

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



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

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70. A single-phase 100 kVA, 1000 V / 100 V, 50 Hz transformer has a voltage drop of 5% across its series impedance at full load. Of this, 3% is due to resistance. The percentage regulation of the transformer at full load with 0.8 lagging power factor is :

(1) 4.8 (2) 6.8

(3) 8.8 (4) 10.8

71. A single-phase, full-bridge rectifier fed from a 230 V, 50 Hz sinusoidal source supplies a series combination of finite resistance, R, and a very large inductance L. The two most dominant frequency components in the source current are :

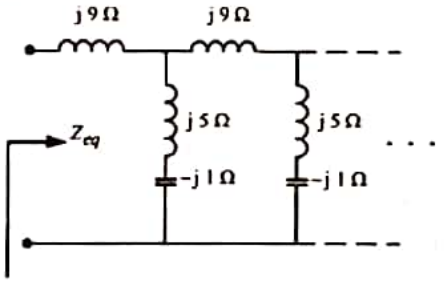
(1) 50 Hz, 0 Hz (2) 50 Hz, 100 Hz

(3) 50 Hz, 150 Hz (4) 150 Hz, 250 Hz

72. A 0-1 Ampere moving iron ammeter has an internal resistance of 50 mΩ and inductance of 0.1 mH. A shunt coil is connected to extend its range to 0-10 Ampere for all operating frequencies. The time constant in milliseconds and resistance in mΩ of the shunt coil respectively are :

(1) 2,5.55 (2) 2,1 (3) 2.18,0.55 (4) 11.1,2

73. The equivalent impedance Z_{eq} for the infinite ladder circuit shown in the figure is :



(1) J12Ω (2) – J12Ω (3) J13Ω (4) 13Ω

74. Consider two npn BJT devices, first device has base doping N_{B1} and second device has base doping N_{B2}. If N_{B2} is two times that of N_{B1} then (Here β_1 and β_2 are the common emitter current gain of device 1 and device 2 respectively) :

(1) $\beta_1 > \beta_2$ (2) $\beta_1 < \beta_2$

(3) $\beta_1 = \beta_2$ (4) None of the above

75. When the temperature decreases then the width of the depletion region in a PN junction diode ?

(1) Increases (2) Decreases

(3) Do not change (4) Increases and then decreases

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76. A clamper circuit :

(i) adds or subtract a dc voltage to or from input waveform

(ii) does not change shape of the input waveform

(iii) amplifies the input waveform

Which of the above statements are correct ?

(1) (i) and (ii)
(2) (i) and (iii)
(3) (ii) and (iii)
(4) (i), (ii) and (iii)

77. A CRO is operated with X and Y settings of 0.5 ms/cm and 100 mV/cm respectively. The screen of the CRO is 10 cm × 8 cm (X and Y). A sine wave of frequency 200 Hz and rms amplitude of 300 mV is applied to the Y input. The screen will show :

(1) one cycle of the undistorted sine wave
(2) two cycle of the undistorted sine wave
(3) one cycle sine wave with clipped amplitude
(4) two cycle of the sine wave with clipped amplitude

78. The voltmeter choice for measuring the emf of a 100 V dc source would be :

(1) 100 V, 1 mA
(2) 100 V, 2 mA
(3) 100 V, 10 kΩ/V
(4) 100 V, 100Ω/kV

79. A three phase transformer is supplied at 6000 V on the delta connected side. The terminal voltage on the star connected side when loaded at power factor 0.8 lagging is 415 V. The equivalent resistance and reactance drops are 1% and 5% respectively. The turn ratio is approximately equal to :

(1) 22 (2) 24 (3) 26 (4) 30

80. The number of samples is one period of signal $\sin(3.15\ \pi n)$ is :

(1) 80 (2) 40 (3) 315 (4) 63

81. The slip of the induction motor does not depends on :

(1) Rotor Speed
(2) Synchronous Speed
(3) Shaft Torque
(4) Core-loss Component

82. A system with transfer function $G(s) = \dfrac{(s^2+9)(s+2)}{(s+1)(s+3)(s+4)}$ is excited by $\sin(\omega t)$. The steady-state output of the system is zero at :

(1) $\omega = 1$ rad/s
(2) $\omega = 2$ rad/s
(3) $\omega = 3$ rad/s
(4) $\omega = 4$ rad/s

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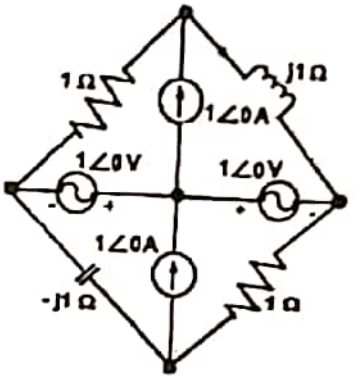
83. In the circuit shown below, the current through the inductor is :

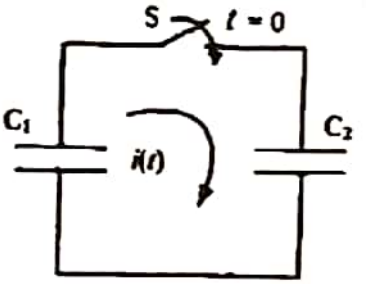


(1) $\frac{2}{1+j}A$ (2) $\frac{-1}{1+j}A$ (3) $\frac{1}{1+j}A$ (4) $0A$

84. The sequence components of the fault current are as follows :
$I_{positive} = j1.5\ pu$, $I_{negative} = j0.5\ pu$, $I_{zero} = -j1\ pu$. The type of fault in the system is :

(1) LG (2) LL (3) LLG (4) LLLG

85. In the following figure, C_1 and C_2 are ideal capacitors. C_1 has been charge to 12 V before the ideal switch S is closed at t = s. The current i(t) for all t is :



(1) Zero (2) A step function
(3) An exponentially decaying function (4) An impulse function

86. A 220 V, 15 kW, 1000 rpm shunt motor with armature resistance of 0.25Ω, has a rated line current of 68 A and a rated field current of 2.2 A. The change in field flux required to obtain a speed of 100 rpm while drawing a line current of 52.8 A and a field current of 1.8 A is :

(1) 18.18% increase (2) 18.18% decrease
(3) 36.36% increase (4) 36.36% decrease

87. If $V_A - V_B = 6V$, then $V_C - V_D$ is :

(1) $-5V$ (2) 2V (3) 3V (4) 6V

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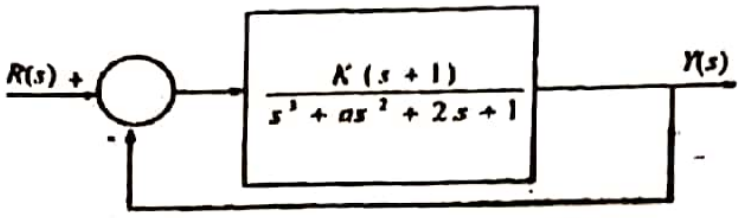
88. The feedback system shown below oscillates at 2 rad/s when :



(1) K = 2 and a = 0.75 (2) K = 3 and a = 0.75

(3) K = 4 and a = 0.5 (4) K = 2 and a = 0.5

89. The bus admittance matrix of a three-phase three-line system is $Y = j\begin{bmatrix} -13 & 10 & 5 \\ 10 & -18 & 10 \\ 5 & 10 & -13 \end{bmatrix}$. If each transmission line between the two buses is represented by an equivalent π-network, the magnitude of the shunt susceptance of the line connecting bus 1 and 2 is :

(1) 4 (2) 2 (3) 1 (4) 0

90. The locked rotor current in a 3-phase, star connected 15 kW, 4-pole, 230 V, 50 Hz induction motor at rated conditions is 50 A. Neglecting losses and magnetizing current, the approximate locked rotor line current drawn when the motor is connected to a 236 V, 57 Hz supply is :

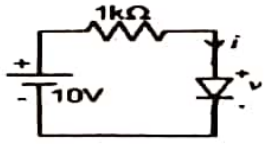
(1) 58.5 A (2) 45.0 A (3) 45.7 A (4) 55.6 A

91. The output Y of a 2-bit comparator is logic 1 whenever the 2-bit input a is greater than the 2-bit input 8. The number of combinations for which the output is logic 1, is :

(1) 4 (2) 6 (3) 8 (4) 10

92. The i-v characteristics of the diode in the circuit given below are :

$$i = \begin{cases} (v - 0.7)/500A & , \quad v \geq 0 \\ 0A & , \quad v < 0 \end{cases}$$



The current in the circuit is

(1) 10 mA (2) 9.3 mA (3) 6.67 mA (4) 6.2 mA

93. Two independent random variables X and Yare uniformly distributed in the interval [−1, 1]. The probability that max [X,Y) is less than 1/2 is :

(1) 3/4 (2) 9/16 (3) 1/4 (4) 2/3

94. If $x = \sqrt{-1}$, then the value of X^X is :

(1) $e^{-\pi/2}$ (2) $e^{\pi/2}$ (3) x (4) 1

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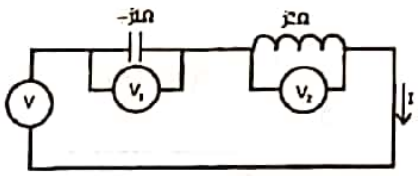
95. With initial condition x(1) = 0.5, the solution of the differential equation $t\frac{dx}{dt} + x = t$ is :

(1) $x = t - \frac{1}{2}$ (2) $x = t^2 - \frac{1}{2}$

(3) $x = t^2/2$ (4) $x = t/2$

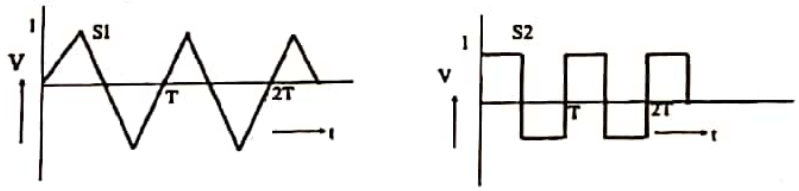
96. Three moving iron type voltmeter are connected as shown below. Voltmeter readings are V, V_1, V_2 are indicated. The correct relation among the voltmeter readings is :



(1) $V = V_1/\sqrt{2} + V_2/\sqrt{2}$ (2) $V = V_1 + V_2$

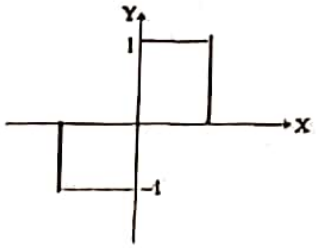
(3) $V = V_1, V_2$ (4) $V = V_1 - V_2$

97. The two signals S1 and S2, shown in figure, are applied to Y and X deflection plates of an oscilloscope :

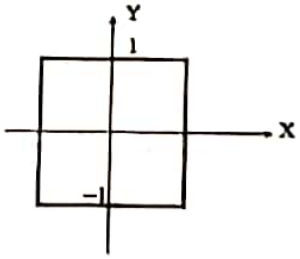


The waveform displayed on the screen is :

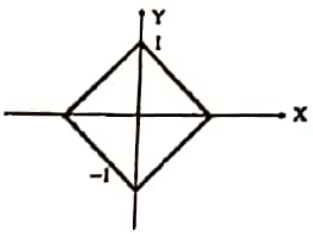
(1)



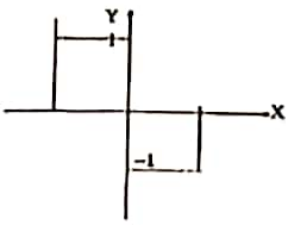
(2)



(3)



(4)



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98. A periodic waveform observed across a load is represented by :

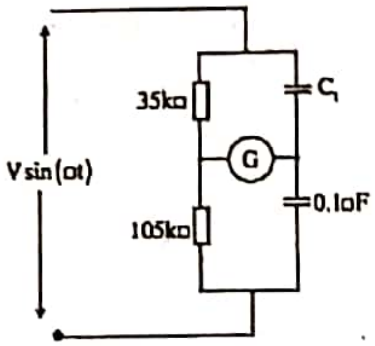
$$V(t)=\begin{cases}1+\sin wt & , \quad 0 \le wt < 6\pi \\ -1+\sin wt & , \quad 6\pi \le wt < 12\pi\end{cases}$$

The measured value, using moving iron voltmeter connected across the load, is :

(1) $\sqrt{3}/2$ (2) $\sqrt{2}/3$

(3) 3/2 (4) 2/3

99. In the bridge circuit shown, the capacitors are loss free. At balance, the value of capacitance C_1 in microfarad is :



(1) 0.3 μF (2) 0.5 μF

(3) 0.8 μF (4) 1 μF

100. Let $\Delta(fv) = x^2y + y^2z + z^2x$; where f and v are scalar and vector fields respectively. If $v = yi + zj + xk$, then $v = \Delta f$ is :

(1) $x^2y + y^2z + z^2x$ (2) $2xy + 2yz + 2zx$

(3) $x + y + z$ (4) 0

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Answer Key of Electrical Engineering
Ph.D Entrance Examination (31/12/2020)

Question No.	Code A	Code B	Code C	Code D
1	D	D	D	D
2	C	B	C	A
3	C	C	D	D
4	C	A	A	D
5	D	A	C	B
6	D	D	C	A
7	A	B	D	C
8	A	D	D	D
9	B	C	A	C
10	B	A	A	B
11	D	B	A	C
12	A	C	B	C
13	D	B	D	C
14	D	B	D	C
15	B	D	B	B
16	A	B	C	A
17	C	C	A	A
18	D	D	A	C
19	C	D	C	B
20	B	A	B	C
21	A	A	D	D
22	B	C	C	B
23	D	A	C	C
24	D	C	C	A
25	B	C	D	A
26	C	A	D	D
27	A	C	A	B
28	A	C	A	D
29	C	A	B	C
30	B	D	B	A
31	A	D	B	B
32	C	A	D	C
33	A	D	B	B
34	C	D	A	B
35	C	B	D	D
36	A	A	B	B
37	C	C	A	C
38	C	D	A	D
39	A	C	A	D
40	D	B	A	A
41	D	C	C	A
42	C	C	A	C
43	D	C	A	A
44	A	C	A	C
45	C	B	B	C

46	C	A	A	A
47	D	A	C	C
48	D	C	C	C
49	A	B	B	A
50	A	C	B	D
51	B	C	A	A
52	C	A	C	B
53	B	A	A	D
54	B	A	C	D
55	D	B	C	B
56	B	A	A	C
57	C	C	C	A
58	D	C	C	A
59	D	B	A	C
60	A	B	D	B
61	C	B	D	D
62	A	D	B	C
63	A	B	C	D
64	A	A	A	A
65	B	D	A	C
66	A	B	D	C
67	C	A	B	D
68	C	A	D	D
69	B	A	C	A
70	B	A	A	A
71	D	D	C	C
72	B	C	C	A
73	C	D	C	A
74	A	A	C	A
75	A	C	B	B
76	D	C	A	A
77	B	D	A	C
78	D	D	C	C
79	C	A	B	B
80	A	A	C	B
81	B	A	D	D
82	D	B	A	C
83	B	D	D	C
84	A	D	D	C
85	D	B	B	D
86	B	C	A	D
87	A	A	C	A
88	A	A	D	A
89	A	C	C	B
90	A	B	B	B
91	C	D	B	B
92	C	C	C	D
93	C	C	B	B
94	C	C	B	A
95	B	D	D	D

96	A	D	B	B
97	A	A	C	A
98	C	A	D	A
99	B	B	D	A
100	C	B	A	A