DRDO SET EXAM 2008
ELECTRICAL ENGINEEERING

DRDO SET 2008 - Electrical Engineering Question Paper

EE : Electrical Engineering

Code

Time : 10.00 to 13.00 hrs   Name of the Candidate: ____________________

Registration No.: ____________________

Signature of Candidate   Signature of Invigilator

Please read the following instructions carefully

1. Verify that this question paper booklet contains **32 pages** (including **4 blank pages** for rough work) and **150 questions**.
2. There are **two sections** in this question paper - **Section A** with **100 questions** and **Section B** with **50 questions**.
3. This question paper booklet has a paper code either X or Y. **If your question paper code is X, then you must have an Objective Response Sheet (ORS) with code X. If your question paper code is Y, then you must have an Objective Response Sheet (ORS) with code Y. If there is a mismatch exchange the booklet.**
4. All answers are to be marked only on the Objective Response Sheet (ORS).
5. Every question has 4 choices (A), (B), (C) and (D) for the answer and only **ONE** of them is the most appropriate answer. Darken only one bubble, which you consider to be the correct answer, from among the four choices.
6. The question booklet along with the ORS must be handed over to the Invigilator before leaving the examination hall.
7. Blank papers, clip boards, log tables, slide rules, calculators, cellular phones, pagers and electronic gadget in any form are **NOT** allowed.
8. Write your **Name** and **Registration Number** and put **your signature** in the space provided above.
9. **Using a good quality Blue/Black pen, write your Registration Number, Subject Code and Question Booklet Code in the boxes provided on the ORS answer sheet and** ***darken the appropriate bubble under each digit with HB Pencil.***
10. Write your Name and put your signature in the appropriate boxes of ORS. Do **NOT** write these anywhere else.

Marking Scheme

(a) In Section A, you will be awarded (+4) marks for each correct answer and (–1) mark for each wrong answer. In Section B, you will be awarded (+2) marks for every correct answer and (–½) mark for each wrong answer.

(b) In case you have not darkened any bubble for a question you will be awarded Zero (0) marks for that question.

08-EE-Y-1/32

Section - A

1. The primary winding of a single phase iron core transformer is connected to a 74 V, 50 Hz source. The primary and secondary windings have 100 and 400 turns respectively. If 25% of the flux in the primary winding leaks into air, the mutual flux in the core will have a peak value of

(A) 0.25 mWb (B) 0.5 mWb (C) 2.5 mWb (D) 5 mWb

2. A 4000 V/2000 V, 60 Hz single phase transformer has a total impedance of 60 Ω referred to the primary side. The primary and secondary windings have negligible resistances. If the transformer supplies a resistive load of 20 Ω, the full load voltage at the secondary side will be

(A) 1143 V (B) 1600V (C) 2000 V (D) 3200 V

3. A 600 kVA, 11 kV/400 V single phase transformer having 0.15 pu leakage impedance is connected in parallel with a 300 kVA, 11 kV/400 V single phase transformer having 0.05 pu leakage impedance. The maximum permissible kVA loading of the two in parallel without overloading any one is

(A) 300 kVA (B) 400 kVA (C) 800 kVA (D) 1200 kVA

4. A separately excited dc generator rotating at 3000 rpm produces an emf of 157 V and delivers a current of 20 A. The braking torque exerted by the armature is

(A) 0.17 N-m (B) 10 N-m (C) 12 N-m (D) 12.5 N-m

5. A separately excited dc generator having armature resistance of 0.1 Ω supplies 4 kW at a terminal voltage of 200 V. If the machine is now operated as a motor at the same terminal voltage and the same armature current with the flux/pole being increased by 10%, the ratio of the generator speed to the motor speed will approximately be

(A) 0.09 (B) 0.11 (C) 1.04 (D) 1.12

6. A 300 V dc shunt motor draws a line current of 51 A. The armature and the field resistances are 32 mΩ and 300 Ω respectively. Assuming 1 HP = 746 W, the mechanical power developed by the motor is

(A) 20 HP (B) 20.1 HP (C) 20.4 HP (D) 20.5 HP

7. In a 3 phase induction motor, the speed of the revolving magnetic field is

(A) directly proportional to the frequency of the source
(B) inversely proportional to the frequency of the source
(C) independent of the frequency of the source
(D) equal to the frequency of the source

8. The rotor of a 6 pole, 3 phase, 60 Hz induction motor has per phase resistance and reactance of 0.1 Ω and 0.5 Ω respectively. The voltage induced per phase in the rotor at standstill condition is 150 V. When the motor develops maximum torque, the rotor current per phase will be

(A) 150 A (B) $150\sqrt{2}$ A (C) 750 A (D) $750\sqrt{2}$ A

9. When a 3 phase alternator supplies a resistive load, the armature reaction flux will be

(A) zero
(B) in quadrature with the main field flux
(C) in the same direction with the main field flux
(D) in the reverse direction with the main field flux

10. A 3 phase, 8 pole, 50 Hz star connected alternator has 72 coils in 72 slots. The coils are short pitched by 3 slots. The value of the pitch factor is

(A) $\frac{\sqrt{2}}{3}$ (B) $\frac{1}{2}$ (C) $\frac{\sqrt{3}}{2}$ (D) 1

11. If a particular application needs high speed and high starting torque, which one of the following motors will be preferred?

(A) Universal motor
(B) Capacitor start and run induction motor
(C) Shaded pole induction motor
(D) Capacitor start induction motor

12. For a shaded pole induction motor, the direction of rotation of the motor is

(A) from the main pole to the shaded pole
(B) from the shaded pole to the main pole
(C) either (A) or (B) depending on the voltage
(D) either (A) or (B) depending on the power factor

13. A reluctance motor is usually preferred in

(A) electric shavers
(B) refrigerators
(C) lifts and hoists
(D) recording instruments

14. A balanced 3 phase star connected voltage source having positive sequence RYB with $\bar{E}_{RY} = 10\angle 0°$ V is applied to a balanced delta connected load having $5\angle 30°\ \Omega$ impedance per phase. The line current $\bar{I}_a$ drawn by the load is

(A) $\frac{2}{\sqrt{3}}\angle 60°$ A (B) $\frac{2}{\sqrt{3}}\angle -30°$ A

(C) $\frac{2}{\sqrt{3}}\angle -60°$ A (D) $\frac{2}{\sqrt{3}}\angle -150°$ A

15. A single phase overhead transmission line delivers a power of 5500 kW to a load at 11 kV. The receiving end voltage leads the current by 45°. The resistance and the inductive reactance of the transmission line are 10 Ω and 10 Ω respectively. The sending end voltage is

(A) 12 kV (B) 15 kV (C) 21 kV (D) 22 kV

16. In a string of 2 suspension insulators, each unit has a self capacitance X and a pin to earth capacitance 0.1X. If the maximum voltage across any unit is not to exceed 12.1 kV, the insulator string can withstand a maximum voltage of

(A) 11 kV (B) 13.2 kV (C) 23.1 kV (D) 33 kV

17. A 300 km long overhead transmission line having inductance of 1.25 mH/km and capacitance of 5 nF/km terminates at a load impedance of 2 kΩ. When a surge voltage of 100 kV is applied to the transmission line, the voltage reflected back from the load is

(A) 10 kV (B) 30 kV (C) 60 kV (D) 100 kV

18. An earth fault relay has a setting of 150% and a current rating of 5 A. It is connected to a current transformer of ratio 200:5. The current in the primary for which the relay picks up is

(A) 7.5 A (B) 20 A (C) 300 A (D) 1500 A

19. Which one of the following terms is associated with relay?

(A) Breaking capacity
(B) Making capacity
(C) Short time capacity
(D) Drop out ratio

20. An equilaterally spaced 3 phase transmission line has a total corona loss of 30 kW at 112 kV, 50 Hz. If the frequency is changed to 60 Hz, the total corona loss will be

(A) 32 kW (B) 34 kW (C) 36 kW (D) 38 kW

21. When a line fault occurs in the power system shown in Fig. Q.21, the fault MVA will be

(A) 1 MVA (B) 10 MVA (C) 100 MVA (D) 500 MVA

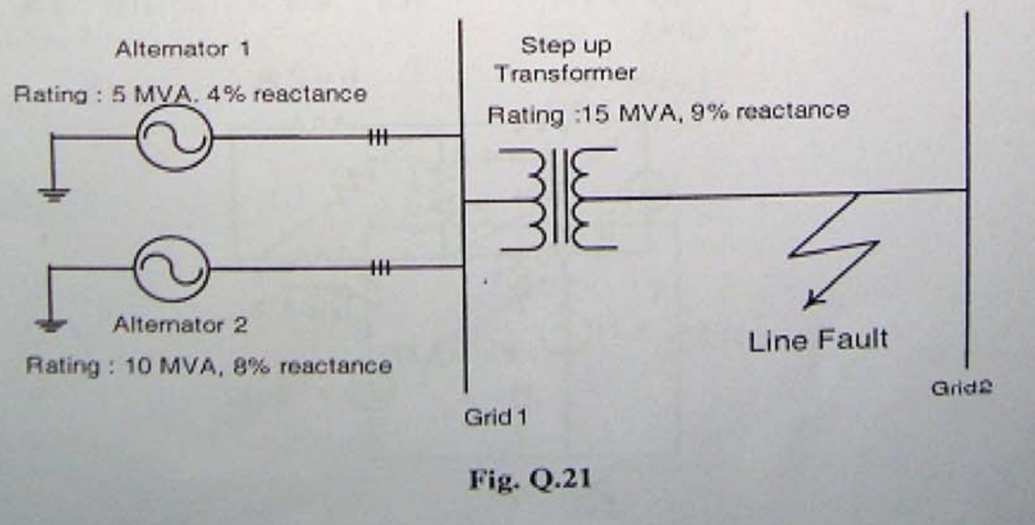

Fig. Q.21

22. Which one of the following types of static relay uses a polarity detector as a component?

(A) Static overcurrent relay
(B) Static directional relay
(C) Static differential relay
(D) Static distance relay

23. A 115 kV transmission line having per unit impedance of $j0.4$ is in parallel with a 230 kV transmission line having per unit impedance of $j0.6$. When 400 MW total power is transferred from one grid to another, the power transferred by the 115 kV line is

(A) 133 MW (B) 160 MW (C) 200 MW (D) 240 MW

24. Which one of the following is **NOT** a method used for improving the steady state stability of a power system as well as enhancing the power transfer?

(A) Multiple transmission circuits
(B) Damping for generators
(C) Shunt reactors
(D) Shunt capacitors

25. The Tirril voltage regulator used for a generator is of

(A) vibrating contact type
(B) rheostatic type
(C) magnetic amplifier type
(D) electronic type

26. The number of twigs and links in a connected network graph with 'n' nodes and 'b' branches are, respectively,

(A) n–2, b–n–2 (B) n–1, b–n+1 (C) n, 2^n–b (D) 2^n, 2^n–b

27. The current i_5 as shown in Fig. Q.27 is equal to

(A) –12 A (B) – 4 A (C) 4 A (D) 8 A

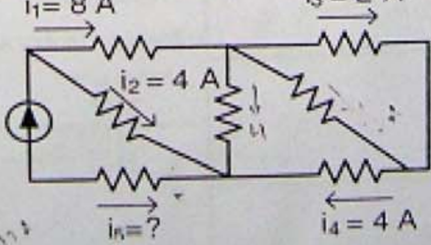

Fig. Q.27

28. The voltage v as shown in Fig. Q.28 is equal to

(A) −10 V (B) 0 V (C) 10 V (D) 20 V

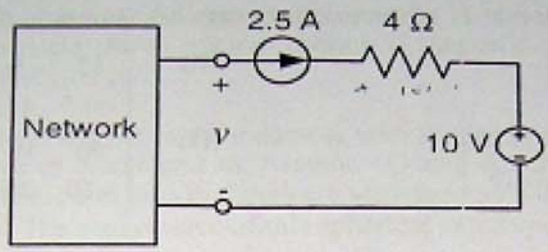

Fig. Q.28

29. The diode shown in Fig. Q.29 has zero cut-in voltage and zero forward resistance. The diode current i_D is

(A) − 4 A (B) 0 A (C) 1 A (D) 4 A

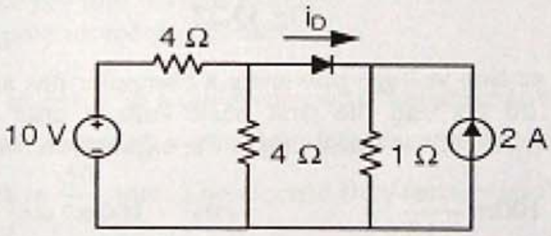

Fig. Q.29

30. The Thevenin equivalent impedance Z_{th} between the terminals M and N, as shown in Fig. Q.30, is

(A) 1

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

(C) $\frac{2s+1}{2+\frac{1}{s}}$

(D) $\frac{2s+1}{s+1}$

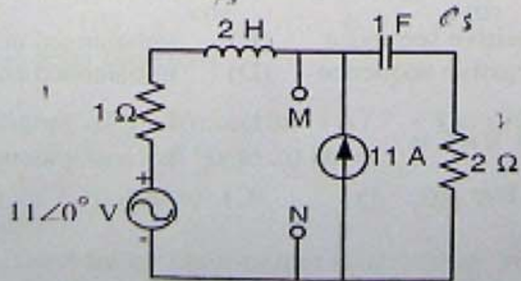

Fig. Q.30

31. Consider a current source i(t) connected across a 0.5 mH inductor, where $i(t) = 0$ A for $t < 0$ and $i(t) = (8e^{-250t} - 4e^{-1000t})$ A for $t \geq 0$. The voltage across the inductor at $t = 0$ s is

(A) 0.5 V (B) 1 V (C) 2 V (D) 4 V

32. The h-parameter matrix of the two-port network shown in Fig. Q.32 is

(A) $\begin{bmatrix} 20 & 10 \\ 10 & 20 \end{bmatrix}$ (B) $\begin{bmatrix} 15 & 0.5 \\ -0.5 & 1/20 \end{bmatrix}$

(C) $\begin{bmatrix} 1/15 & -1/30 \\ -1/30 & 1/15 \end{bmatrix}$ (D) $\begin{bmatrix} 20 & 10 \\ -10 & 20 \end{bmatrix}$

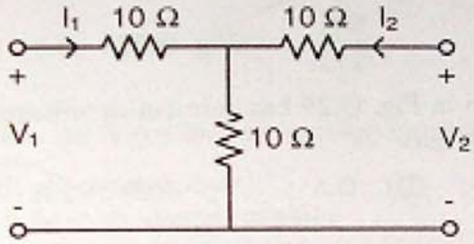

Fig. Q.32

33. Suppose that the ac line voltage powering a computer has an RMS value of 100 V, a frequency of 100 Hz and the first peak voltage after $t = 0$ s is attained at $t_{max} = 1$ ms. Which one of the following is the expression for this ac voltage?

(A) $100\sqrt{2}\cos\left(100\pi t - \frac{\pi}{10}\right)$ (B) $100\sqrt{2}\sin\left(100\pi t - \frac{\pi}{10}\right)$

(C) $100\sqrt{2}\cos\left(200\pi t - \frac{\pi}{5}\right)$ (D) $100\sqrt{2}\sin\left(200\pi t - \frac{\pi}{5}\right)$

34. In a series RLC resonant circuit with the resonant frequency f_0, the quality factor is

(A) $\frac{1}{2\pi f_0 RC}$ (B) $\frac{L}{2\pi f_0 R}$ (C) $\frac{1}{2\pi f_0 LC}$ (D) $\frac{L}{2\pi f_0 C}$

35. The phase voltages of a 3 phase source are: $v_{an}(t) = 100\cos(\omega t - 60°)$, $v_{bn}(t) = 100\cos(\omega t + 60°)$, $v_{cn}(t) = -100\cos(\omega t)$. This source is

(A) balanced and positive sequence (B) unbalanced and positive sequence
(C) balanced and negative sequence (D) unbalanced and negative sequence

36. If $\vec{E} = y\vec{a}_x - x\vec{a}_y$, then $\nabla \times \vec{E}$ is

(A) 0 (B) $y\vec{a}_x$ (C) $-x\vec{a}_y$ (D) $-2\vec{a}_z$

37. Which one of the following statements is TRUE?

(A) Current in a wire is the electric charge per unit distance
(B) Stationary charges produce constant magnetic fields
(C) A perfect conductor cannot contain electrostatic field within it
(D) A charged particle shows cycloid motion if magnetic and electric fields are applied parallelly on it

38. Consider two concentric spherical conductors with the inner sphere of diameter 1 m and the outer sphere of diameter 2 m. Assume +Q and –Q Coulomb charges on the inner and outer spheres and also that they are separated by a dielectric medium with permittivity ε F/m. The capacitance of this spherical capacitor in Farad is

(A) $4\pi\varepsilon$ (B) $8\pi\varepsilon$ (C) $\frac{2\pi\varepsilon}{\ln 2}$ (D) Q/2

39. The equation $\nabla.\vec{B}=0$ ($\vec{B}$ is the magnetic flux density) implies

(A) magnetostatic fields are conservative
(B) magnetostatic fields have no sources or sinks
(C) $\vec{B}$ is the force per unit current element
(D) magnetic dipole moment is conservative

40. The electric field intensity in a dielectric (with dielectric constant $\varepsilon_r = 6$) filling the space between the plates of a parallel-plate capacitor is 6π kV/m. The distance between the plates is $\frac{50}{3\pi}$ mm. The electric flux density and the potential difference between the plates are, respectively,

(A) 10^{-12} C/m^2, 100 kV (B) 10^{-11} C/m^2, 100 kV
(C) 10^{-9} C/m^2, 100 V (D) 10^{-6} C/m^2, 100 V

41. Which one of the following signals is **NOT** periodic?

(A) $\sin 10\pi t$ (B) $\sin 31t$
(C) $\sin 10\pi t + \sin 31t$ (D) $\sin(10\pi + 31)t$

42. The value of the integral $\int_0^{\infty} e^{-\alpha t^2}\delta(t+10)dt$ is

(A) 0 (B) $e^{-100\alpha}$ (C) $e^{-10\alpha}$ (D) $e^{100\alpha}$
[δ(.) is the Dirac delta function]

43. Consider the signal $x(t)=10\cos(10\pi t+\pi/7)+4\sin(30\pi t+\pi/8)$. Its power lying within the frequency band 10 Hz to 20 Hz is

(A) 4 W (B) 8 W (C) 50 W (D) 58 W

44. A system is defined by its input output relationship $y(t)=2x(t+2)+2$ where $y(t)$ and $x(t)$ are the output and the input of the system, respectively. The system is

(A) linear and causal (B) linear and non-causal
(C) non-linear and causal (D) non-linear and non-causal

Dont take the marked answer, which may be right or wrong. Plz refer the books.

45. Consider the trigonometric series, which holds true for all t, given by

$$x(t) = \sin \omega_0 t + \frac{1}{3}\sin 3\omega_0 t + \frac{1}{5}\sin 5\omega_0 t + \frac{1}{7}\sin 7\omega_0 t + \dots .$$

At $\omega_0 t = \pi/2$, the series converges to

(A) 0.5 (B) $\pi/4$ (C) $\pi/2$ (D) 2

46. Consider a distortionless system $H(\omega)$ with magnitude and phase responses as shown in Fig. Q.46. If an input signal $x(t) = 2\cos 10\pi t + \sin 26\pi t$ is given to this system, the output will be

(A) $4\cos 10\pi t + \sin 26\pi t$

(B) $8\cos 10\pi t + \sin 26\pi t$

(C) $4\cos\left(10\pi t - \frac{\pi}{6}\right) + \sin\left(26\pi t - \frac{13\pi}{30}\right)$

(D) $8\cos\left(10\pi t - \frac{\pi}{2}\right) + \sin\left(26\pi t - \frac{\pi}{2}\right)$

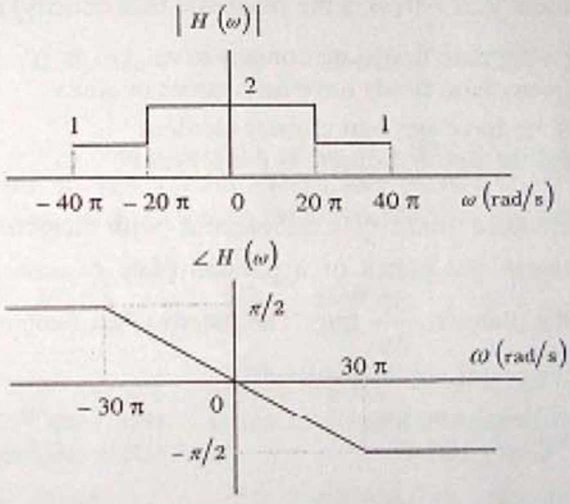

Fig. Q.46

47. If $x(t) \leftrightarrow X(f)$ denotes a Fourier transform (FT) pair, $\Pi\left(\frac{t}{T}\right)$ denotes a rectangular pulse of width T and '$*$' denotes the convolution operation, then the FT of the signal $x(t) = \Pi\left(\frac{t}{T}\right) * \Pi\left(\frac{t}{T}\right)$ is

(A) $T^2\text{sinc}^2(fT)$ (B) $-j\,\text{sgn}(fT)$ (C) $T^2 e^{-(f/T)^2}$ (D) $T\text{sinc}(2fT)$

48. Consider a function $X(s) = \dfrac{s+8}{s^2+6s+13}$. Its inverse Laplace transform $x(t)$ is

(A) $e^{-3t}(\cos 3t + \sin 5t)$

(B) $e^{-3t}(\cos 2t + \sin 2t)$

(C) $5e^{-3t}(\cos 2t + \sin 2t)$

(D) $e^{-3t}(\cos 2t + \frac{5}{2}\sin 2t)$

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49. If the z-transform of a discrete time signal $x[n]$ is denoted as $X(z)$, then the z-transform of $x[n-2]$ and $x[n/2]$ will be, respectively,

(A) $z^{-2}X(z)$, $2X(2z)$
(B) $z^{2}X(z)$, $X(2z)$
(C) $X(z-2)$, $X(z/2)$
(D) $z^{-2}X(z)$, $X(z^{2})$

50. The region of convergence (ROC) of the z-transform of discrete time Dirac delta function $\delta[n]$ is

(A) the entire z plane
(B) only $|z| < 1$
(C) only $|z| = 1$
(D) only $|z| > 1$

51. For an npn BJT, the base current is 15 μA, common emitter current gain β is 100 and the base emitter voltage is 0.75 V. If reverse saturation current is negligible, its emitter current will be

(A) 0 mA (B) 0.99 mA (C) 1.5 mA (D) 1.515 mA

52. While measuring the $I_C - V_{CE}$ characteristics of an npn BJT, V_{BE} is adjusted to get a collector current of 1 mA at $V_{CE} = 0.5$ V. The Early voltage V_A of this transistor is 99.5 V. Keeping V_{BE} the same, if V_{CE} is raised to 10.5 V, the new value of the collector current will be

(A) 1.1 mA (B) 10 mA (C) 11 mA (D) 20 mA

53. For an n-channel JFET, the pinch off voltage Vp is – 4 V, V_{DD} is 10 V and the drain saturation current at zero gate bias I_{D0} is 2 mA. The value of the saturated drain current for a gate voltage of – 2 V is

(A) 0.5 mA (B) 2 mA (C) 4.5 mA (D) 18 mA

54. A sinusoidal voltage of 1 V peak is applied at the input of an amplifier which operates at ± 12 V power supplies. A sinusoidal voltage of 10 V peak is available across a 1 kΩ load at the output of the amplifier. The input current to the amplifier from the sinusoidal source is negligible. If the amplifier draws a current of 10 mA from each of the two power supplies, the power dissipated in the amplifier is

(A) 50 mW (B) 140 mW (C) 190 mW (D) 240 mW

55. Which one of the following statements is **NOT** true when a resistance is included between the emitter and ground of a common emitter amplifier?

(A) The input resistance is increased
(B) The voltage gain is decreased
(C) The amplifier is able to handle larger input signals without distortion
(D) The overall voltage gain becomes very sensitive to the β of the transistor

56. For the transistor shown in Fig. Q.56, β is 100, I_B is 25 μA and the thermal voltage (V_T) at room temperature is 25 mV. If R_S is negligible, the voltage gain of the amplifier is

(A) – 8 (B) – 50 (C) – 100 (D) – 200

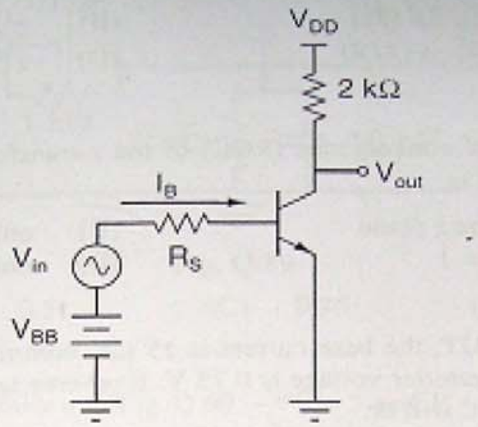


Fig. Q.56

57. The transistors used in the differential amplifier shown in Fig. Q.57 are identical and $V_{DD} = -V_{EE} = 10$ V. The thermal voltage at room temperature is 25 mV, β is 100 and the base emitter voltage is 0.7 V. The output voltage V_{out} is

(A) 0 V (B) 4 sin50t V (C) 8 sin50t V (D) 16 V

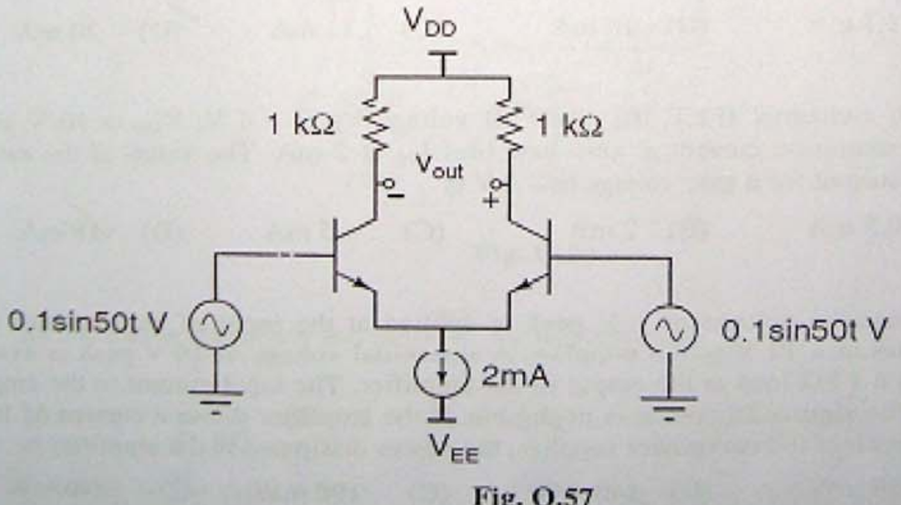


Fig. Q.57

58. In order to realize a current amplifier, the desired feedback topology will be

(A) series-series (B) series-shunt
(C) shunt-series (D) shunt-shunt

59. The high frequency gain of the circuit shown in Fig. Q.59 is

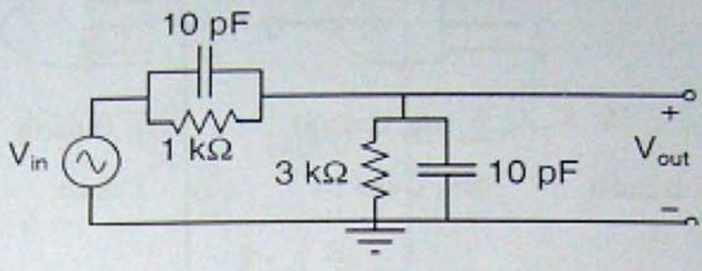


Fig. Q.59

(A) zero (B) 0.5 (C) 0.75 (D) infinite

60. For the oscillator circuit shown in Fig. Q.60, $\frac{V_{out}}{V_f} = 3 + sCR + \frac{1}{sCR}$.

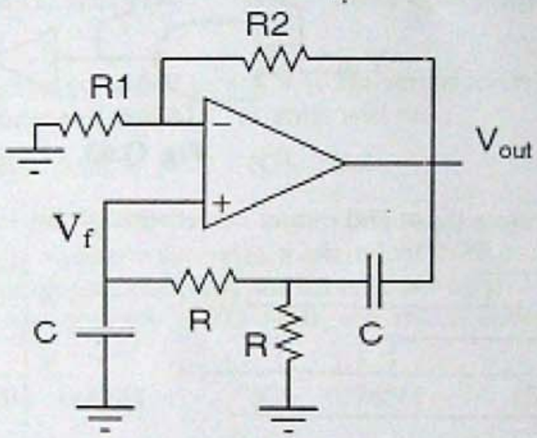


Fig. Q.60

Its oscillating frequency and ratio $\frac{R2}{R1}$ are respectively,

(A) $\omega_0 = \frac{1}{\sqrt{3}\,RC}$ rad/s, 2

(B) $\omega_0 = \frac{1}{\sqrt{3}\,RC}$ rad/s, 3

(C) $\omega_0 = \frac{1}{RC}$ rad/s, 3

(D) $\omega_0 = \frac{1}{RC}$ rad/s, 2

61. Which one of the following statements is **NOT** true for a general purpose OPAMP like 741 consisting of multistage amplifiers?

(A) The first stage is a differential amplifier

(B) The final stage amplifier has low output impedance

(C) In order to provide a gain roll-off of – 20 dB/decade till unity gain frequency, a compensation capacitor is used

(D) The main purpose of the compensation capacitor is to increase the upper cut-off frequency

62. For the gates shown in Fig. Q.62(a) and Fig. Q.62(b), the x and y inputs are, respectively,

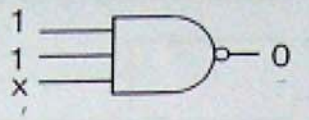


Fig. Q.62(a)

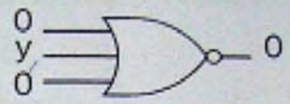


Fig. Q.62(b)

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

63. A latch is designed as shown in Fig. Q.63.

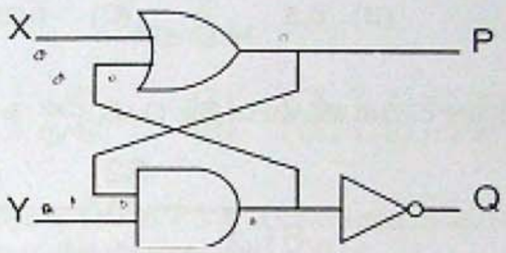
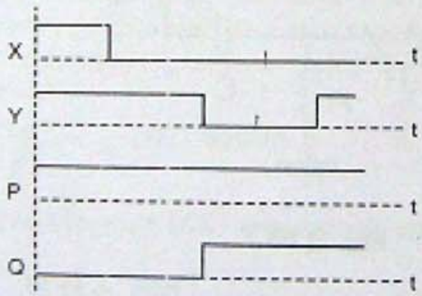


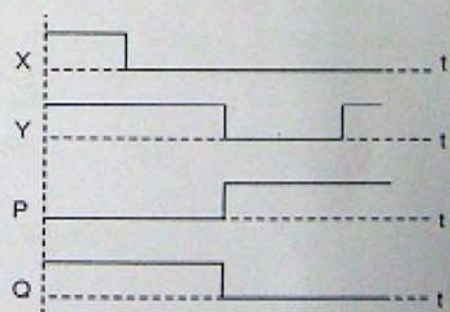
Fig. Q.63

The appropriate input and output waveforms of this latch are

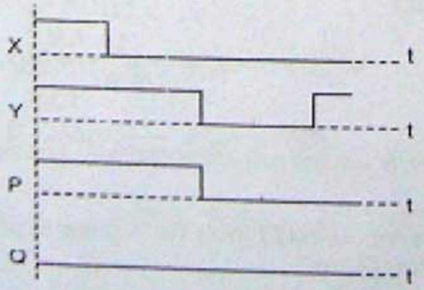
(A)



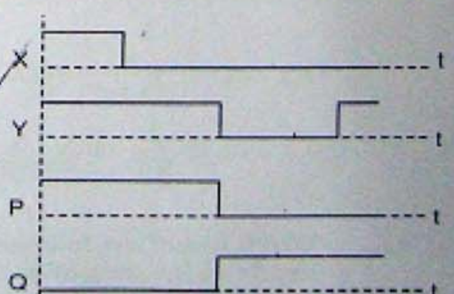
(B)



(C)



(D)



69. A triac operating at a voltage of 120 V rms and a frequency of 60 Hz delivers power to a resistive load. The maximum rate of change of current $\left(\frac{di}{dt}\right)$ expected is 50 A/μs. The required snubber inductor value is

(A) 2.4 μH (B) $4.4\sqrt{2}$ μH (C) $4.4\sqrt{\pi}$ μH (D) 4.4π μH

70. A single-phase half wave controlled rectifier, operating at 120 V rms and 60 Hz ac supply, has a firing angle of 60°. The average value of its output voltage is

(A) $\frac{45\sqrt{2}}{\pi}$ V (B) $\frac{45\sqrt{3}}{\pi}$ V (C) $\frac{90\sqrt{2}}{\pi}$ V (D) $\frac{90\sqrt{3}}{\pi}$ V

71. Which one of the following statements about a Gate Turn-Off (GTO) thyristor is **NOT** true?

(A) The GTO retains the basic 4 layer structure (PNPN) of a conventional thyristor
(B) The I-V characteristics of the GTO in the forward direction is different as compared to a conventional thyristor
(C) Due to its special structure, the GTO has limited reverse blocking capability as compared to a conventional thyristor
(D) The GTO has gate controlled turn-off capability unlike a conventional thyristor

72. Which of the following statements about an Insulated Gate Bipolar Transistor (IGBT) is **NOT** true?

(A) The IGBT is developed by combining the characteristics of a BJT and a MOSFET
(B) The on-state losses of an IGBT are lesser than a MOSFET
(C) The IGBT is slower than a BJT
(D) The IGBT contains a parasitic thyristor

73. A boost converter with an input voltage of 5 V dc and an output voltage of 10 V dc will have a duty cycle of

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

74. A Darlington pair consisting of two power transistors has an effective β of 125. If the driver BJT has a β of 20, the β of the main transistor is

(A) 5 (B) 25 (C) 65 (D) 100

75. A cycloconverter is controlling a reversible ac drive in the speed range corresponding to firing angles 45° to 150°. If the highest value of the input power factor is 0.5, the load power factor will be

(A) $\frac{\sqrt{2}}{\sqrt{3}}$ (B) 1 (C) $\frac{\sqrt{3}}{\sqrt{2}}$ (D) $\sqrt{3}$

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(A) $\frac{\sqrt{2}}{\sqrt{3}}$ (B) 1 (C) $\frac{\sqrt{3}}{\sqrt{2}}$ (D) $\sqrt{3}$

76. A unity feedback system has the open loop transfer function $G(s) = \frac{2s}{(s+1)(s+2)}$.

The steady state response of the closed loop system to a unit step reference input is

(A) unit step (B) unit ramp

(C) unit impulse (D) zero

77. A unity feedback system has the open loop transfer function $G(s) = \frac{10^4}{s(s+10)^2}$. The closed loop system is

(A) stable

(B) marginally stable

(C) unstable

(D) stable at an angular frequency of 10 rad/s

78. The maximum value of K along the real axis of the root locus plot of the open loop transfer function $G(s) = \frac{K}{s(s+4)}$ is

(A) 2 (B) 4 (C) 8 (D) ∞

79. When a zero at $s = -4.5$ is added to the $G(s)$ in Q.78, the value of K at which the breakaway point of the root locus occurs is

(A) 0.5 (B) 1 (C) 2 (D) 4

80. The frequency at which the Nyquist plot of a unity feedback system with the open loop transfer function $G(s) = \frac{25s}{\sqrt{(s+1)(s+1)^4}}$ crosses the negative real axis is

(A) 1 rad/s (B) $\sqrt{2}$ rad/s (C) $\sqrt{3}$ rad/s (D) 5 rad/s

81. The Bode plots of a low pass system with the unity steady state gain show an absolute magnitude of 0.5 and a phase angle of $-90°$ at the frequency of $\omega = 1$ rad/s. The transfer function of the system can be

(A) $G(s) = \frac{0.5}{s(s+1)}$ (B) $G(s) = \frac{1}{s(s+1)}$

(C) $G(s) = \frac{0.5}{(s+1)^2}$ (D) $G(s) = \frac{1}{(s+1)^2}$

82. The phase margin of the low pass system with the unity steady state gain and the Bode plots parameters as given in Q.81 is

(A) 0° (B) 90° (C) 180° (D) 360°

83. A feedforward proportional-derivative (PD) compensator in a closed loop system

(A) reduces steady state accuracy (B) improves steady state accuracy

(C) reduces stability (D) improves stability

84. A compensator with the transfer function $G(s) = \frac{1+0.1\tau s}{1+\tau s}$ can give a maximum gain of

(A) -20 dB (B) -10 dB (C) 0 dB (D) 20 dB

85. If $\tau = 1$ in the $G(s)$ of Q.84, then the compensator can give the minimum phase at a frequency of

(A) $\sqrt{0.1}$ rad/s (B) 0.777 rad/s (C) 1 rad/s (D) $\sqrt{10}$ rad/s

86. A dc motor model $G(s) = \frac{1}{s(s+1)}$ is to obtain a steady state error of less than 0.1 for a unit ramp input. The above design specification can be achieved by a feed forward lead compensator whose steady state gain must be greater than

(A) 100 (B) 10 (C) 1 (D) 0.1

87. The dynamic model of a pendulum is given by $\frac{d^2\theta}{dt^2} + 400\theta = 100T$, where θ is the displacement in rad/s and T is the applied torque in N-m. Its representation in time scale state variable form $\dot{X} = \alpha X + \beta u$ can have the constants

(A) $\alpha = \begin{bmatrix} 0 & 1 \\ -4 & 0 \end{bmatrix}; \beta = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ (B) $\alpha = \begin{bmatrix} 0 & 1 \\ -4 & 0 \end{bmatrix}; \beta = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$

(C) $\alpha = \begin{bmatrix} 0 & 0 \\ 4 & 1 \end{bmatrix}; \beta = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ (D) $\alpha = \begin{bmatrix} 0 & 0 \\ -4 & 1 \end{bmatrix}; \beta = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$

88. The state transition matrix of the system with the transfer function $G(s) = \frac{1}{s^2}$ is

(A) $\begin{bmatrix} 1 & t \\ 0 & 1 \end{bmatrix}$ (B) $\begin{bmatrix} e^{-1} & e^{-t} \\ 1 & e \end{bmatrix}$ (C) $\begin{bmatrix} e & e^{t} \\ 1 & e \end{bmatrix}$ (D) $\begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix}$

89. A system has the state variable representation $\dot{X} = \begin{bmatrix} 0 & 1 \\ 0 & -1 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u; y = \begin{bmatrix} 1 & 1 \end{bmatrix} X$. Its transfer function is

(A) 1 (B) $\frac{1}{s}$ (C) $\frac{1}{s+1}$ (D) $\frac{1}{s^2}$

90. Which one of the following statements related to modeling of system dynamics is **NOT** true?

(A) The transfer function is not changed by a linear transformation of state
(B) A given state description can be transformed to a controllable canonical form if the controllability matrix is nonsingular
(C) A change of state by a nonsingular linear transformation does not change the controllability
(D) Zeros cannot be computed from its state description matrices

91. The Wheatstone bridge network shown in Fig. Q.91 is balanced when $\delta = 0$. For $\delta \neq 0$, the unbalanced voltage V_u is

(A) $E\delta/2$ (B) $E\delta$ (C) $2E\delta$ (D) 0

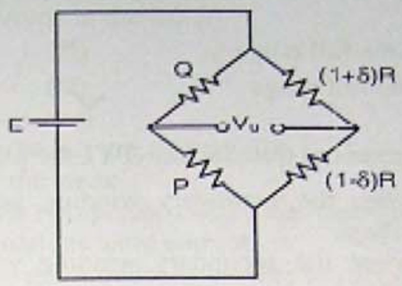

Fig. Q.91

92. Which one of the following measuring instruments consumes the least power?

(A) Induction type (B) Moving iron type
(C) Dynamometer type (D) Permanent magnet moving coil type

93. Which one of the following statements regarding the permanent magnet moving coil instruments is **NOT** true?

(A) The relationship between coil current and deflection is not governed by the pole shape of the magnet
(B) The instruments can measure the sum of two currents using two co planar coils
(C) The instruments can measure the ratio of two currents using two crossed coils
(D) The instruments cannot measure the rms values of ac currents

94. If the measurement of a quantity involves the product of readings of two instruments which have systematic errors x_1 % and x_2 %, then the systematic error in the measurement of the quantity is approximately

(A) $(x_1 + x_2)$% (B) $(x_1 x_2)$% (C) (x_1 / x_2)% (D) (x_2 / x_1)%

95. A pointer is connected to the spindle of a dynamometer type phase angle meter. The two light coils of the phase angle meter mounted on the spindle

(A) carry equal amount of currents in phase with each other and develop torques opposing each other
(B) carry unequal amount of currents in phase with each other and develop torques opposing each other
(C) carry equal amount of currents at quadrature to each other and develop torques opposing each other
(D) carry the load current and develop the magnetic field required for the meter

96. Two signals of frequency 1 Hz each are applied to the X and Y plates of an oscilloscope. If the time interval between the zero crossings of the two signals is 100 ms, then the phase difference between the signals is

(A) 18° (B) 36° (C) 72° (D) 144°

97. A $3\frac{1}{2}$ digit voltmeter has the resolution of

(A) 0.01% of the full range (B) 0.05% of the full range
(C) 0.1% of the full range (D) 0.5% of the full range

98. In the case of a potential transformer (PT), the phase angle error is

(A) positive when the secondary winding voltage reversed leads the primary winding voltage
(B) negative when the secondary winding voltage reversed leads the primary winding voltage
(C) always positive
(D) always negative

99. A current transformer (CT) of turns ratio 1:248 is rated as 1000/4 A, 20 VA. The core loss and magnetizing components of the primary current are 4 A and 8 A under rated conditions. The ratio error for the rated burden and the rated secondary current at 0.8 power factor lagging is

(A) 0 (B) −0.64 (C) −0.66 (D) 0.66

100. For the CT specifications given in Q.99, the phase angle error for the rated burden and the rated secondary current at 0.8 power factor lagging is

(A) $\frac{1}{496}$ rad (B) $\frac{1}{248}$ rad (C) $\frac{1}{124}$ rad (D) $\frac{1}{62}$ rad