

# APTRANSCO 2019 EE

Adda247

PART - A

1. A high-Q quartz crystal exhibits series resonance at the frequency  $\omega_s$  and parallel resonance at the frequency  $\omega_p$ , then
  - (A)  $\omega_s \ll \omega_p$
  - (B)  $\omega_s \gg \omega_p$
  - (C)  $\omega_s$  is very close to, but greater than  $\omega_p$
  - (D)  $\omega_s$  is very close to, but less than  $\omega_p$
2. The present output  $Q_n$  of an edge triggered JK Flip-Flop is logic 0. If  $J = 1$ , then  $Q_{n+1}$  will be
  - (A) logic 0
  - (B) Race around
  - (C) Indeterminate
  - (D) logic 1
3. The minimum number of 2 to 1 multiplexers required to realize an 8 to 1 Multiplexer is
  - (A) 4
  - (B) 3
  - (C) 7
  - (D) 10
4. The contents of Register (B) and Accumulator (A) of 8085 microprocessor are  $49_H$  and  $3A_H$  respectively. The contents of A and the status of Carry flag (CY) and Sign flag (S) after executing SUB B instruction are
  - (A)  $A = F1, CY = 1, S = 1$
  - (B)  $A = 0F, CY = 1, S = 1$
  - (C)  $A = F0, CY = 0, S = 0$
  - (D)  $A = 1F, CY = 1, S = 0$
5. Type of relay most suited for
 

|  |                                    |
|--|------------------------------------|
| 1. Buchholz relay                          | P. Feeder                          |
| 2. Translay relay                          | Q. Transformer                     |
| 3. Carrier current, phase comparison relay | R. Radial distribution             |
| 4. Directional over current relay          | S. Generator                       |
| 5. Negative sequence relay                 | T. Ring main distributor           |
|  | U. Long overhead transmission line |

  - (A) 1-P, 2-Q, 3-T, 4-R, 5-S
  - (B) 1-Q, 2-R, 3-T, 4-U, 5-P
  - (C) 1-S, 2-Q, 3-S, 4-T, 5-U
  - (D) 1-Q, 2-P, 3-U, 4-T, 5-S
6. A transmission line has self and mutual impedances of 0.8 p.u and 0.2 p.u. Find the positive, negative and zero sequence impedances respectively.
  - (A) 1.2, 0.6 and 0.08 p.u
  - (B) 0.8, 0.6 and 1.2 p.u
  - (C) 0.8, 0.8 and 1.2 p.u
  - (D) 0.6, 0.6 and 1.2 p.u
7. Grading of the cables is performed in order to achieve
  - (i) Uniform stress
  - (ii) Reduction in quantity of insulation
  - (iii) Reduction in quality of insulation
  - (A) (i), (ii)
  - (B) (ii)
  - (C) (i), (iii)
  - (D) (ii), (iii)
8. A three phase transformer having a line voltage ratio of 400/33000 V is connected in the star-delta. The CTs on the 400V side have a CT ratio of 1000/5. What must be the ratio of CTs on the 33000 side?
  - (A) 7/5
  - (B) 5/7
  - (C) 3/5
  - (D) 5/2
9. The input impedance ( $Z_i$ ) and the output impedance ( $Z_o$ ) of an ideal trans-conduc (voltage controlled current source) amplifier are
  - (A)  $Z_i = \text{Infinity}$   $Z_o = \text{Infinity}$
  - (B)  $Z_i = 0$   $Z_o = \text{Infinity}$
  - (C)  $Z_i = 0$   $Z_o = 0$
  - (D)  $Z_i = \text{Infinity}$   $Z_o = 0$



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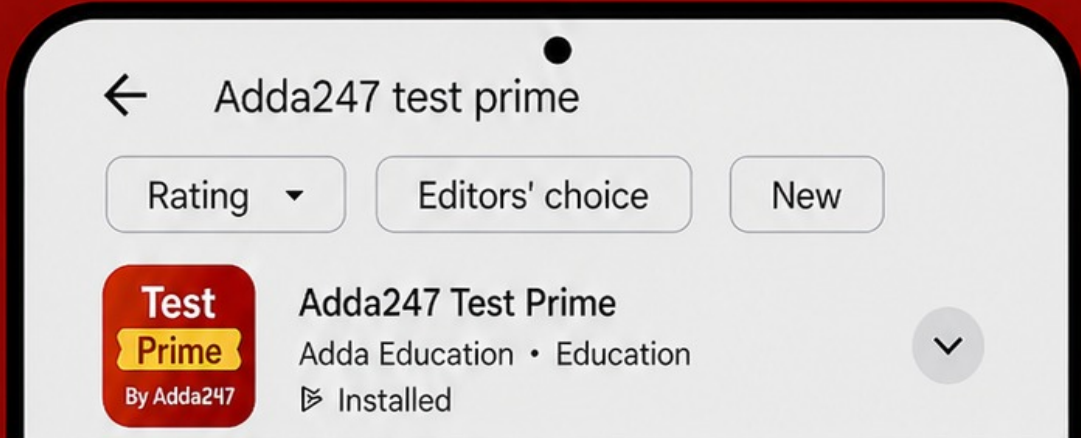
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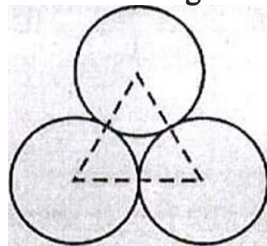
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10. At a particular unbalanced node, the real powers specified are  
 Leaving the node 20 MW, 25 MW  
 Entering the node 60 MW, 30 MW  
 The balancing power will be  
 (A) 30 MW leaving the node  
 (B) 45 MW leaving the node  
 (C) 45 MW entering the node  
 (D) 22.5 MW entering the node and 22.5 MW leaving the node.
11. A 3 phase transmission line operating at  $V_s = 400$  kV and has  $ABCD$  parameters  
 $A = D = 0.8 \angle 0^\circ$ ,  $B = 100 \angle 90^\circ$  ohms  $C = 0.5 \times 10^{-6} \angle 90^\circ$  mhos. What is the value of  
 inductive shunt reactor required for compensating Ferranti effect ?  
 (A) 1500 ohms (B) 750 ohms (C) 500 ohms (D) 300 ohms
12. The incremental fuel cost for two generating units are given by  
 $IC_1 = 25 + 0.2 PG_1$   
 $IC_2 = 32 + 0.2 PG_2$ , where  $PG_1$  and  $PG_2$  are real power generated by the units.  
 The economic allocation for a total load of 250 MW, neglecting transmission loss is given by  
 (A)  $PG_1 = 140.25$  MW,  $PG_2 = 109.75$  MW  
 (B)  $PG_1 = 109.75$  MW,  $PG_2 = 140.25$  MW  
 (C)  $PG_1 = PG_2 = 125$  MW  
 (D)  $PG_1 = 100$  MW,  $PG_2 = 150$  MW
13. The conductors of 1.6 km long, 3-phase, 3.3 kV overhead lines are in horizontal  
 formation with 762 mm between centres. The effective diameter of the conductors is 3.5  
 mm. The equivalent spacing (in mm) is  
 (A) 560 (B) 762 (C) 960 (D) 862
14. A large power system is represented by Thevenin's equivalent. The  $E_{th}$  and  $Z_{th}$  are  
 $0.9 \angle 0^\circ$  p.u and  $0.25 \angle 90^\circ$  p.u respectively. If a shunt capacitor bank is connected to  
 raise the bus voltage to 1.0 p.u. The MVAR rating of the capacitor bank is  
 (assume base MVA 100 and base kV 138)  
 (A) 10 (B) 20 (C) 30 (D) 40
15. A transmission line has equal voltages at the two ends, maintained constant by two  
 sources. A third source is to be provided to maintain constant voltage equal to the end  
 voltages at either the mid-point of the lines (case 1) or at 75% of the distance from  
 sending end (case 2). The maximum power transfer capabilities of the line in the  
 original case, case 1 and case 2 respectively, will be in the ratio of  
 (A) 1 : 1 : 1 (B)  $1 : 2 : \frac{1}{0.75}$  (C) 1 : 2 : 4 (D) 1 : 4 : 16
16. The geometric mean radius of a conductor in terms of the radius 'r' of an individual  
 strand for three equal strands as shown in Figure



- (A)  $\sqrt[3]{e^{-0.25r} * 2r * 2r}$  (B)  $\sqrt[3]{e^{0.25r} * 2r * 3r}$   
 (C)  $\sqrt[3]{e^{-0.5r} * r * 2r}$  (D)  $\sqrt[3]{e^{0.52r} * 2r * 2r}$

17. A consumer consumes 600 kWh per day at a load factor of 0.40. If the consumer increases the load factor to 0.70 without increasing maximum demand, what is the consumption of energy in kWh ?  
 (A) 950 kWh (B) 1000 kWh (C) 1050 kWh (D) 1100 kWh
18. For an SCR, during turn-on and turn-off, the quantities responsible, respectively, are  
 (A) gate voltage and gate current  
 (B) holding current and latching current  
 (C) latching current and holding current  
 (D) forward break over voltage and reverse break over voltage
19. A particular power electronic controller develops a symmetrical output voltage from  $\pi/6$  rad. to  $\pi$  rad.,  $7\pi/6$  rad. to  $2\pi$  rad. across a resistive load over a cycle. The circuit contains  
 (A) a diode (B) two diodes connected in anti-parallel  
 (C) a TRIAC (D) a SCR
20. A single-phase mid-point full-wave SCR converter with maximum mid-point voltage of  $V_{max}$  volts, develops an average output voltage across a resistive load at firing delay angles of 0 and  $\pi/2$  rad., respectively, as  
 (A)  $\frac{2V_{max}}{\pi}, \frac{V_{max}}{\pi}$  (B)  $\frac{V_{max}}{\pi}, \frac{V_{max}}{2\pi}$  (C)  $\frac{V_{max}}{2\pi}, \frac{V_{max}}{\pi}$  (D)  $\frac{V_{max}}{\pi}, -\frac{V_{max}}{2\pi}$
21. A 240 V, 50 Hz single-phase half-wave SCR converter supplies a resistance load at a firing delay angle of  $\pi/3$  rad. The rms load voltage is  
 (A)  $\frac{240}{\sqrt{2}} \left\{ \frac{5}{6} - \frac{\sqrt{3}}{4\pi} \right\}^{1/2}$  (B)  $\frac{240}{\sqrt{2}} \left\{ \frac{5}{6} + \frac{\sqrt{3}}{4\pi} \right\}^{1/2}$   
 (C)  $\frac{240}{\sqrt{2}} \left\{ \frac{5}{12} - \frac{\sqrt{3}}{4\pi} \right\}^{1/2}$  (D)  $\frac{240}{\sqrt{2}} \left\{ \frac{5}{12} - \frac{\sqrt{3}}{2\pi} \right\}^{1/2}$
22. A single-phase half-wave controlled SCR converter with a commutating diode supply an R-L load at an average load voltage of 150 V at a firing delay angle of  $60^\circ$ . The supply voltage to the converter is  
 (A)  $50\sqrt{2}\pi$  (B)  $100\pi$  (C)  $200\pi$  (D)  $150\sqrt{2}\pi$
23. 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  
 (A) 100 A (B) 200 A (C) 300 A (D) 400 A
24. In the inductance and capacitance of a power system are respectively 1 H and  $0.01 \mu\text{F}$  and the instantaneous value of interrupted current is 10 A, then the voltage across breaker contact will be  
 (A) 50 kV (B) 57 kV (C) 60 kV (D) 100 kV

25. The conducting pairs of SCRs in a bridge-type 3-phase ac-dc converter with SCRs S1, S3, S5 connected in top-half and S4, S6, S2 in bottom-half of the converter, and supplying a resistance load are  
 (A) (S6, S1), (S1, S2), (S2, S3), (S3, S4), (S4, S5), (S5, S6)  
 (B) (S1, S4), (S4, S3), (S3, S6), (S6, S5), (S5, S2), (S2, S1)  
 (C) (S1, S2), (S2, S3), (S3, S4), (S4, S5), (S5, S6), (S6, S1)  
 (D) (S1, S5), (S5, S2), (S2, S6), (S6, S3), (S3, S4), (S4, S1)
26. For a dc-dc boost converter circuit, the order of connection of components L, C, D, MOSFET-Switch in between supply and load from left to right is  
 (A) L-series, Switch-series, C-parallel, D-parallel  
 (B) Switch-series, L-series, C-parallel, D-parallel  
 (C) L-series, Switch-parallel, D-series, C-parallel  
 (D) Switch-series, L-parallel, C-parallel, D-series
27. In a dc-dc buck converter when the MOSFET switch is triggered, the rate of change of current in the 400  $\mu$ H inductor, L is  $7.5 \times 10^4$  A/sec. If the converter is operated with a 50 V input voltage, the output voltage of the converter is  
 (A) 15 V (B) 20 V (C) 25 V (D) 30 V
28. A single-phase full-bridge inverter with switches S1 & S2 in one leg and S3 & S4 in the other leg connected along with feed-back diodes D1 & D2 and D3 & D4, respectively, develops a square wave voltage across an R-L load. The conducting devices carrying currents during the time intervals  $t_0$  to  $t_1$ ,  $t_1$  to  $t_2$ ,  $t_2$  to  $t_3$ , and  $t_3$  to  $t_4$ , are  
 (A) S1, S4 D2, D3 S2, S3 D1, D4  
 (B) D1, D4 S1, S4 D2, D3 S2, S3  
 (C) D2, D3 S2, S3 D1, D4 S1, S4  
 (D) S2, S3 D1, D4 S1, S4 D2, D3
29. A separately excited dc motor controlled by a single-phase SCR full-converter <sup>supp.</sup> at 200 V ac voltage draws 40 A at a firing delay angle of  $45^\circ$ . If the armature res<sup>is</sup> of the motor is 0.25 ohm, the back emf is  
 (A)  $\left(\frac{200}{\pi} - 10\right)$  V (B)  $\left(\frac{200}{\pi} + 10\right)$  V  
 (C)  $\left(\frac{400}{\pi} - 10\right)$  V (D)  $\left(\frac{400}{\pi} + 10\right)$  V
30. In an adjustable speed dc drive operated by an ac-dc converter with armature voltage control upto base speed,  
 (A) The torque increased linearly with increase in speed  
 (B) The torque decreased linearly with increase in speed  
 (C) The torque remains constant with increase in speed  
 (D) The power remains constant with increase in speed
31. The sequence of triggering of SCRs in a 3-phase bridge type converter with SCRs S1, S2, S3 connected in top-half and S4, S5, S6 in bottom-half of the converter, and supplying a resistance load  
 (A) S1, S2, S3, S4, S5, S6 (B) S1, S6, S2, S4, S3, S5  
 (C) S1, S4, S3, S6, S5, S2 (D) S1, S3, S4, S6, S2, S5

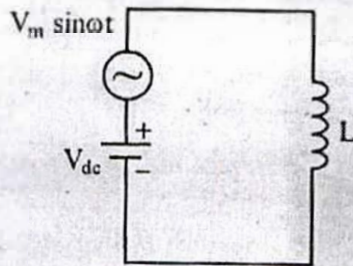
Handwritten notes for question 29:  

$$V_c = \frac{2V_m}{\pi} \cos \alpha$$

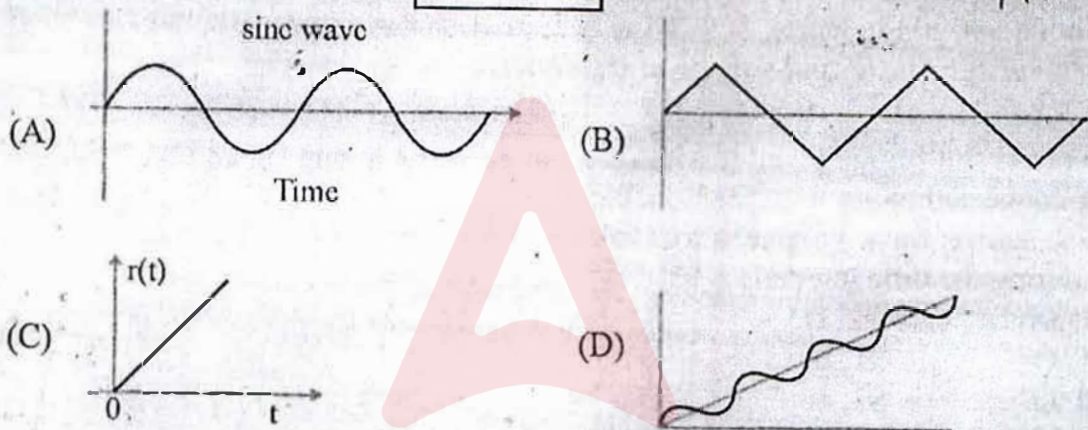
$$V_c = \frac{400}{\pi}$$

32. In a linear two-port network, when 10 V is applied to Port 1, a current of 4 A flows through Port 2 when it is short-circuited. When 5 V is applied to Port 1, a current of 1.25 A flows through a  $1 \Omega$  resistance connected across Port 2. When 3 V is applied to Port 1, the current through a  $2 \Omega$  resistance connected across Port 2 is  
 (A) 0.34 A (B) 0.44 A (C) 0.54 A (D) 0.64 A

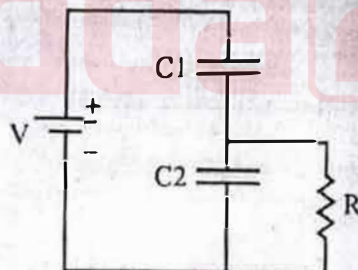
33. What will be the shape of current in the circuit ?



$Z_1 = Y_{11} V_1 + Y_{12} V_2$   
 $Z_2 = Y_{21} V_1 + Y_{22} V_2$   
 $Z_1 = Y_{11} 0 + 0$   
 $Y_{11} = \frac{Z_1}{10}$



34. In steady state, what will be the capacitor ( $C_2$ ) voltage (if  $C_1 = C_2$ ) in the circuit given below ?

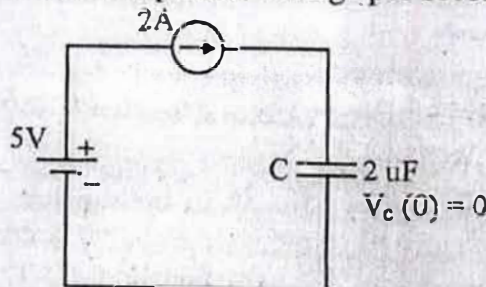


$i = C \frac{dv}{dt}$   
 $= \frac{V}{RC}$   
 $= \frac{V}{RC} \times C_1$

- (A)  $V/2$  (B)  $V$  (C)  $0$

(D)  $V/RC$

35. What will be the raise in the capacitor voltage per second ?

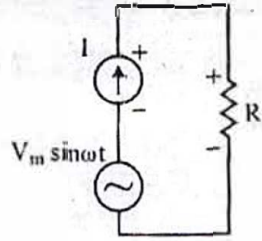


$i = C \frac{dv}{dt}$   
 $\frac{dv}{dt} = \frac{i}{C}$

- (A) 1 V/s (B) 0 V/s (C) 2 V/s (D) 5 V/s

**B**

36. What will be the average power drawn from voltage source ?



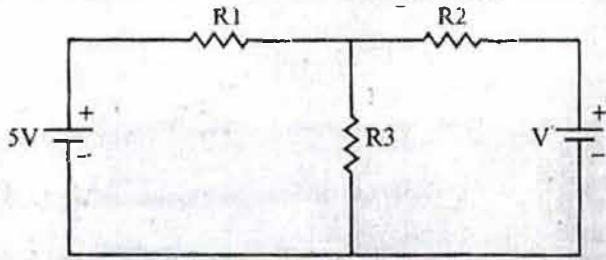
Handwritten notes for question 36:  

$$+ I^2 R t = \frac{V_m^2}{\pi} \times$$
  

$$= I^2 R$$

- (A)  $IR$  (B)  $0$  (C)  $V_m^2/R$  (D)  $V_m^2 I/\pi$

37. If  $R_1 = R_2$ , what should be the voltage magnitude to have zero current through  $R_3$  ?



Handwritten notes for question 37:  

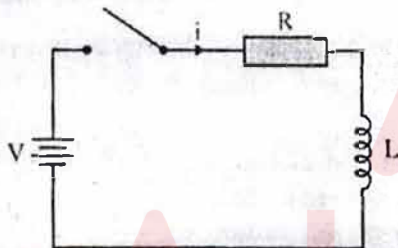
$$\frac{V_1 - 5}{R_1} - \frac{V - 5}{R_2} = 0$$
  

$$V - 5 = 0$$

- (A)  $2.5 V$  (B)  $5 V$  (C)  $-2.5 V$  (D)  $-5 V$

38. A series RL circuit is excited at  $t = 0$  by closing a switch as shown in the figure.

Assuming zero initial conditions, the value of  $\frac{d^2 i}{dt^2}$  at  $t = 0^+$  is



Handwritten notes for question 38:  

$$V = R i + L \frac{di}{dt}$$
  

$$0 = R \frac{d^2 i}{dt^2} + L \frac{d^3 i}{dt^3}$$
  

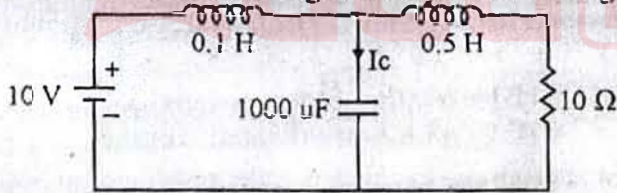
$$\frac{d^3 i}{dt^3} = -\frac{R}{L} \frac{d^2 i}{dt^2}$$
  

$$i(t) = \frac{V}{R} + C e^{-\frac{R}{L} t}$$
  

$$= \frac{V}{R} \left[ 1 - e^{-\frac{R}{L} t} \right]$$

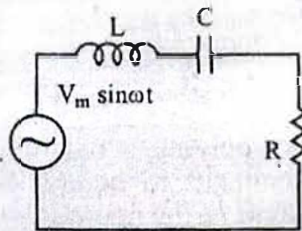
- (A)  $V/L$  (B)  $-V/R$  (C)  $0$  (D)  $-RV/L^2$

39. Determine the current through the capacitor during steady state.



- (A)  $1 A$  (B)  $0 A$  (C)  $10000 A$  (D)  $0.25 A$

40. If the voltage across the resistor is equal to supply voltage, what will be the ratio of voltages (absolute) between L and C ?



Handwritten notes for question 40:  

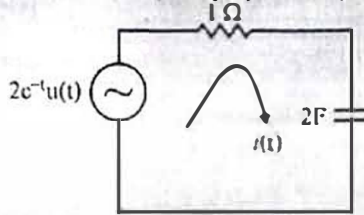
$$= \frac{V}{R} \left[ 0 + \frac{R}{L} e^{-\frac{Rt}{L}} \right]$$
  

$$= \frac{V}{L} \times \frac{R}{L} e^{-\frac{Rt}{L}}$$
  

$$= \frac{V}{L}$$
  
 MRR1

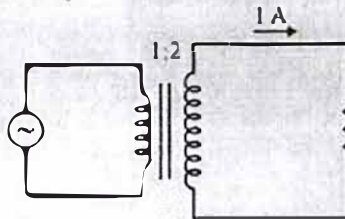
- (A)  $1$  (B)  $0.5$  (C)  $0.25$  (D)  $2.5$

41. In the circuit shown below, the values of  $I(0^+)$  and  $I(\infty)$  will be



- (A) Zero and 1 A (B) 2 A and 4 A (C) Zero and 2 A (D) 2 A and zero

42. A single-phase transformer has a turns ratio of 1:2 and is connected to a purely resistive load as shown in the figure. The magnetizing current as well as the load current drawn is 1 A. If the core losses and leakage reactances are neglected, the primary current should be



$$\frac{N_1}{N_2} = \frac{I_2}{I_1} = \frac{1}{2} \Rightarrow I_1 = 2 \text{ A}$$

- (A) 1.41 A (B) 2 A (C) 2.24 A (D) 3 A

43. 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 the resistance. The percentage regulation of the transformer at full load with 0.8 lagging power factor is

- (A) 4.8 (B) 6.8 (C) 8.8 (D) 10.8

44. Which of the following statements is valid for transformers?

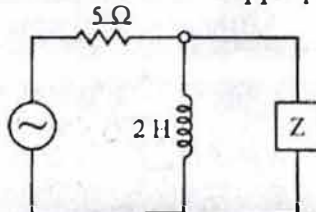
- (A) In an open circuit test, copper losses are obtained while in short circuit test, core losses are obtained.  
 (B) In an open circuit test, current is drawn at high power factor.  
 (C) In a short circuit test, current is drawn at zero power factor.  
 (D) In an open circuit test, current is drawn at low power factor.

$$\cos \phi = \frac{24}{24.5} \approx 0.98$$

45. A single-phase transformer has a no-load loss of 64 W as obtained from the open circuit test. When a short circuit test is performed with 90% of the rated current flowing in its both LV and HV windings, the measured loss is 81 W. The transformer should exhibit maximum efficiency at

- (A) 50.0% of the rated current (B) 64.0% of the rated current  
 (C) 80.0% of the rated current (D) 88.8% of the rated current

46. The value of Z in figure which is most appropriate to cause parallel resonance at 500 Hz is



- (A) 125.00  $\mu\text{F}$  (B) 304.20  $\mu\text{F}$  (C) 2.0  $\mu\text{F}$  (D) 0.05  $\mu\text{F}$

$$5\omega = \frac{1}{\omega C} \Rightarrow C = \frac{1}{5\omega^2} = \frac{1}{5 \times 1000^2} = 0.05 \mu\text{F}$$

$$Z = \sqrt{\frac{64}{100}} = \frac{8}{10} = 0.8 \Omega$$

47. A three-phase, four-wire, 400 V system is supplying a balanced star-connected load with impedance of  $10 \angle -300^\circ \Omega$ . The voltages to neutral being  $230.9 \angle -900^\circ$ ,  $230.9 \angle -300^\circ$  and  $230.9 \angle -1500^\circ$ . The current in the neutral wire is

- (A) 10 A (B) zero (C) 17.3 A (D) 5 A

$$I_n = \frac{1}{\sqrt{3}} \times 10 = 5.77 \text{ A}$$

$$\frac{900}{1000} = 0.9$$

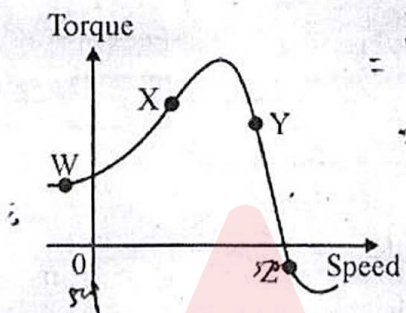
48. An 8-pole, DC generator has a simplex wave-wound armature containing 32 coils of 6 turns each. Its flux per pole is 0.06 Wb. The machine is running at 250 rpm. The induced armature voltage is  
 (A) 96 V (B) 192 V (C) 384 V (D) 768 V

49. 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  
 (A) 3.94 kW and 1.06 kW (B) 2.50 kW and 2.50 kW  
 (C) 5.00 kW and 0.00 kW (D) 2.96 kW and 2.04 kW

$0.5 < \cos \phi < 1$

50. The torque/speed curve of an induction motor is as shown in the figure. Four points of operation are marked as W, X, Y and Z. Which one of them represents the operation at a slip greater than 1?

eg 2  $\frac{0.06 \times 384 \times 250}{8} \times \frac{32 \times 6}{2}$



$$= V_L I_L \cos(\phi - \theta)$$
  

$$= P = \sqrt{3} V_L I_L \cos \phi$$
  

$$V_L I_L = \frac{5 \times 1000}{0.707 \times \sqrt{3}}$$
  

$$Z = \frac{32 \times 6}{192 \times 2}$$
  

$$\frac{384}{384}$$

- (A) W (B) X (C) Y (D) Z

51. No-load test on a 3-phase induction motor was conducted at different supply voltage and a plot of input power versus voltage was drawn. This curve was extrapolated to intersect the y-axis. The intersection point yields the  
 (A) core loss (B) stator copper loss  
 (C) stray load loss (D) friction and windage loss



52. A field excitation of 20 A in a certain alternator results in an armature current of 400 A in short circuit and a terminal voltage of 2000 V on open circuit. The magnitude of the internal voltage drop within the machine at a load current of 200 A is  
 (A) 1 V (B) 10 V (C) 100 V (D) 1000 V

$$Z_s = \frac{2000}{400}$$

53. If a synchronous motor is running at a leading power factor, its excitation induced voltage ( $E_f$ ) is  
 (A) equal to terminal voltage  $V_t$  (B) higher than the terminal voltage  $V_t$   
 (C) less than terminal voltage  $V_t$  (D) dependent upon supply voltage  $V_t$

54. In a salient pole synchronous motor, the developed reluctance torque attains the maximum value when the load angle in electrical degrees is  
 (A) 0 (B) 45 (C) 60 (D) 90



55. A 220V, 10kW, 900 rpm separately excited DC motor has an armature resistance of 0.02 ohm. When the motor operates at rated speed and with rated terminal voltage, the electromagnetic torque developed by the motor is 70 Nm. Neglecting the rotational losses of the machine, the current drawn by the motor from the 220V supply is  
 (A) 34.2 A (B) 30 A (C) 22 A (D) 4.84 A

$I_a = \frac{V - E_b}{R_a}$

B

$I_a = \frac{V - E_b}{R_a}$

56. A unity feedback system has the following unit impulse response :

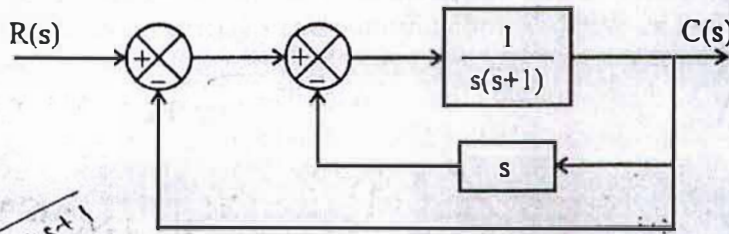
$$c(t) = -te^{-t} + 2e^{-t}, (t \geq 0)$$

The open loop transfer function of the system is

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

Handwritten notes for Q56:  
 $C(s) = \frac{-1}{(s+1)} + \frac{2}{s+1}$   
 $= \frac{-1+2s+2}{(s+1)^2} = \frac{2s+1}{(s+1)^2}$

57. For the system shown in the block diagram, the transfer function  $\frac{C(s)}{R(s)}$  is equal to



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

Handwritten notes for Q57:  
 $\frac{1}{s(s+1)}$   
 $1 + \frac{1}{s+1} + \frac{1}{s(s+1)}$   
 $\frac{1}{s^2+s+1}$

Handwritten notes for Q57:  
 $\frac{2s+1}{(s+1)^2} = \frac{2s+1}{s^2+2s+1}$

58. A unity feedback system has  $G(s) = \frac{k}{s(s+1)}$ . The steady state error in the output response for unit step input is .

- (A)  $\infty$  (B) zero (C) k (D)  $\frac{1}{k}$

Handwritten notes for Q58:  
 $v_p = \frac{1}{s_0}$   
 $= \frac{1}{1+k}$

59. The open loop transfer function of a unity feedback system is  $G(s) = \frac{k(s+1)}{s(s-1)(s+6)}$ .

The system is unstable for

- (A)  $k > 7.5$  (B)  $k = 7.5$  (C)  $0 < k < 7.5$  (D) Any value of  $k > 0$ .

60. A system has damping ratio of 0.4. The frequency response of the system exhibits a peak resonance of

- (A) 2.25 (B) 1.36 (C) 1.8 (D) 2

Handwritten notes for Q60:  
 $\frac{2.25}{\sqrt{1-0.4^2}}$

61. An open loop system is converted into a closed loop system using negative feedback. The feedback path has unity gain. As compared to the open loop system, the closed loop system has the following property :

- (A) Overall gain is increased.  
 (B) Bandwidth is reduced  
 (C) Effect of parameter variations is reduced.  
 (D) Disturbance rejection capability is reduced.

Handwritten notes for Q61:  
 Original system:  $\frac{sk-30-k}{s}$   
 Closed loop system:  $\frac{sk-30-k}{s^2+5s-k}$   
 Characteristic equation:  $s^2+5s-k=0$   
 For stability,  $k > 7.5$

$\phi = \sin^{-1} \left( \frac{1.04}{1.04} \right) \left( \frac{2}{x} \right)$

$T \leq 0.1$   
 $\alpha \tau = 0.04$   
 $\alpha \leq \frac{0.04}{0.1}$   
 $= 0.4$   
 $\frac{4}{100} = 4\%$

62. A Lead compensator  $G_c(s) = \frac{(1 + 0.12 s)}{(1 + 0.04 s)}$  can provide a maximum phase shift of  
 (A)  $90^\circ$  (B)  $60^\circ$  (C)  $45^\circ$  (D)  $30^\circ$
63. It is required to melt 3 tonnes of steel using an electric arc furnace. The heat energy required to melt one kg of steel is approximately 170 k Cal. The electric power utilised by the furnace is 510 kW. The time taken by the furnace is  
 (A) 1 hour 10 minutes (B) 2 hours 20 minutes  
 (C) 45 minutes (D) 4 hours
64. The scheduled speed of a train over a level track is 30 kmph. The distance between stations is 1 km, and the station stopping time is 20 sec. The average speed of the train is  
 (A) 42 kmph (B) 40 kmph (C) 36 kmph (D) 34 kmph
65. The relation among specific energy consumption (S), total energy consumption in watt-hours (T), train weight in tonnes (W), and distance travelled (D) in km is  
 (A)  $T = \frac{S}{WD}$  (B)  $D = \frac{TW}{S}$  (C)  $W = \frac{TD}{S}$  (D)  $S = \frac{T}{WD}$
66. Which bridge is best suited for use in Harmonic Distortion Analyzers ?  
 (A) Heaviside (B) Kelvin's double Bridge  
 (C) Wein (D) Schering
67. Which of the following statements is INCORRECT with regard to potentiometers ?  
 (A) They can be used for a.c. magnetic testing.  
 (B) They are basically null-type instruments.  
 (C) Standardization of d.c. potentiometers is done using d.c. standard sources.  
 (D) Standardization of a.c. potentiometers is done using a.c. standard sources.
68. A moving coil galvanometer is made into a d.c. ammeter by connecting  
 (A) a low resistance across the meter.  
 (B) a high resistance across the meter.  
 (C) a high resistance in series with the meter.  
 (D) a low resistance in series with the meter.
69. A 1-phase, 240 V induction type energy meter has a meter constant of 600 revolutions per kwh. For a load current of 10A at a power factor of 0.8 lagging, speed of the disc in rpm is  
 (A) 57.6 (B) 38.4 (C) 19.2 (D) 9.6
70. The open loop transfer function of a system is  $G(s) H(s) = \frac{16(s+1)}{s(s+2)(s+4)}$ . The centroid and angles of asymptotes are  
 (A)  $-2.5, 45^\circ, -45^\circ$  (B)  $-3, 60^\circ, -60^\circ$   
 (C)  $-2.5, 90^\circ, 270^\circ$  (D)  $-2.5, 30^\circ, -30^\circ$

$\frac{1000}{600} = 1.666 \times 60$   
 $x = 100 \times 1.666 \times 10$   
 $x = \frac{16660}{100}$   
 $x = 166.6$   
 $\frac{166.6}{10} = 16.66$   
 $\frac{16.66}{1.8} = 9.25$

$\Sigma G_{poles} = 1000$   
 $x = 8 \times 1240$   
 $x = G \times 1240$

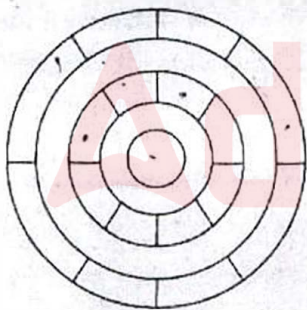
**B**

$\frac{-2-4-1}{3}$

$E_L = V - 2iR_e$   
 $E_b = 220 - 0.02 \times 10^4$   
 $E_b$

PART – B

71. A successful democracy depends upon widespread interest and participation in politics, in which voting is an essential part. To deliberately refrain from taking such an interest, and from voting, is a kind of implied anarchy; it is to refuse one's political responsibility while enjoying the benefits of a free political society. This passage relates to  
 (A) Duty to vote (B) Right to vote  
 (C) Freedom to vote (D) Right to participate in politics
72. Four political parties W, X, Y and Z decided to set up a joint candidate for the coming parliamentary elections. The formula agreed by them was the acceptance of a candidate of the most of the parties. For aspiring candidates A, B, C and D approached the parties for their ticket.  
 A was acceptable to W but not Z B was acceptable to Y but not X  
 C was acceptable to W and Y D was acceptable to W and X  
 When candidate B was preferred by W and Z, candidate C was preferred by X and Z and candidate A was acceptable to X but not Y. Who got the ticket ?  
 (A) A (B) B (C) C (D) D
73. Consider the following statements :  
 1. All artists are whimsical. 2. Some artists are drug addicts.  
 3. Frustrated people are prone to become drug addicts.  
 From the above three statements it may be concluded that :  
 (A) Artists are frustrated.  
 (B) Some drug addicts are whimsical.  
 (C) All frustrated people are drug addicts.  
 (D) Whimsical people are generally frustrated.
74. Consider the following figure and answer the item that follows :



What is the minimum number of different colours required to paint the figure given above such that no two adjacent regions have the same colour ?

- (A) 3 (B) 4 (C) 5 (D) 6

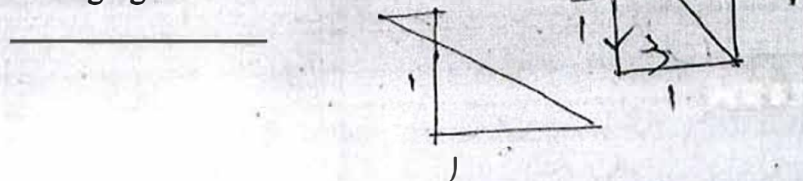
75. You go to a movie theater with your family to watch a movie for which you had been waiting for weeks. A person selling the tickets asks for double the printed price of tickets as only a few tickets are left. You would  
 (A) threatened to report the matter to the theatre administration unless he gives ticket to you at the regular price.  
 (B) go back without watching the movie.  
 (C) take the tickets at the double the price and enjoy the movie.  
 (D) not purchase the ticket and report the matter to the theatre manager/administration.

76. Gita is prettier than Sita but not as pretty as Rita. Then,  
 (A) Sita is not as pretty as Gita. (B) Sita is prettier than Rita.  
 (C) Rita is not as pretty as Gita. (D) Gita is prettier than Rita. *A C D R R X H I M*
77. How many letters of the English alphabet (capitals) appear same when looked at in a mirror?  
 (A) 9 (B) 10 (C) 11 (D) 12 *A E* *V W X* *Z*
78. Two glasses of equal volume are respectively half and three-fourth filled with milk. They are then filled to the brim by adding water. Their contents are then poured into another vessel. What will be the ratio of milk to water in the vessel?  
 (A) 1:3 (B) 2:3 (C) 3:2 (D) 5:3 *A* *D* *1/2 to* *3/4 to*
79. In a college, the ratio of number of arts graduate to science is 3:2. If 20% arts graduate and 25% science graduate qualify for IAS, the percentage of non-qualifiers is  
 (A) 22 (B) 72 (C) 78 (D) 60 *= 115/75 = 1.53*
80. In a rare coin collection, there is one gold coin for every three non-gold coins. 10 more gold coins are added to the collection and the ratio of gold coins to non-gold coins would be 1 : 2. Based on the information, the total number of coins in the collection now becomes?  
 (A) 90 (B) 80 (C) 60 (D) 50 *(100)* *= (x+10)/x = 1/2*
81. Two persons A and B are running on circular track. At the start, B is ahead of A and their positions make an angle of  $45^\circ$  at the centre of the circle. When A reaches the point diametrically opposite point, he meets B. What is the ratio of speeds of B and A?  
 (A) 4 : 3 (B) 3 : 7 (C) 7 : 4 (D) 3 : 4 *90x + 20 = 180*
82. If X and Y are two natural numbers such that X is between -3 and -1, Y is between -2 and 1 then  $X^2 - Y^3$  is in between which of the following?  
 (A) -3 and 1 (B) 0 and 17 (C) -8 and 9 (D) -5 and 0 *2x + 10 = 17*
83. The letters L, M, N, O, P, Q, R, S and T in their order are substituted by nine integers 1 to 9 but not in that order. 4 is assigned to P. The difference between P and T is 5. The difference between N and T is 3. What is the integer assigned to N?  
 (A) 7 (B) 5 (C) 4 (D) 6
84. Three persons A, B & C wear shirts of Black, Blue and Orange colours (not necessarily in the order) and pants of green, yellow and orange (not necessarily in that order). No person wore shirt and pant of the same colour. Further, it is given that,  
 1. A did not wear shirt of black colour. 2. B did not wear shirt of blue colour.  
 3. C did not wear shirt of orange colour. 4. A did not wear the pants of green colour.  
 5. B wore pants of orange colour.  
 What were the colours of the pants and shirts worn by C respectively?  
 (A) Orange and black. (B) Green and blue.  
 (C) Yellow and blue. (D) Yellow and black.

85. P is the brother of N. O is the daughter of N. R is the sister of P, Q is the brother of O and S is the husband of N. Who is the uncle of Q ?  
 (A) P (B) N (C) S (D) R
86. BDEH : FLOX :: ACFG : ?  
 (A) EYOA (B) CIRU (C) CRUT (D) EJST
87. Which one set of letters when sequentially placed at the gaps in the given letter series shall complete it ?  
 bms\_tvb\_sut\_bm\_u\_vbmsutv  
 (A) sumtv (B) musvt (C) umstv (D) umvst
88. Three bus tickets from city X to Y and two tickets from city X to Z cost ₹ 61 but two tickets from city X to Y and five tickets from city X to Z cost ₹ 81. What are the fares for cities Y and Z from X ?  
 (A) 13, 17 (B) 11, 13 (C) 15, 17 (D) 13, 11
89. What will come in the place of the (?) in the following number series ?  
 5 14 45 130 ? 1182  
 (A) 397 (B) 224 (C) 329 (D) 379
90. If certain amount of money becomes ₹ 2,500 in a span of 5 years and ₹ 3,000 in a span of 7 years at simple interest, then the principal amount is  
 (A) ₹ 1,500 (B) ₹ 1,750 (C) ₹ 1,250 (D) ₹ 2,200
91. If  $ABC \times DEED = ABCABC$ , where A, B, C, D and E are different digits; what are the values of D and E ?  
 (A) 0 and 2 (B) 1 and 0 (C) 0 and 2 (D) 1 and 2
92. There are four hobby clubs in a college viz., painting, photography, chess and dancing. The painting group meets every second day, the photography group meets every third day, the chess group meets every fourth day and the dancing group meets every fifth day. How many times do all the five groups meet on the same day with in 240 days ?  
 (A) 120 (B) 12 (C) 5 (D) 4
93. In the following question two statements 1 and 2 are given. There may be cause and effect relationship between the two statements. These two statements may be the effect of the same cause or independent causes. These statements may be independent causes without having any relationship. Read both the statements and mark your answer.  
**Statement 1** : The life today is fast too fast, demanding and full of variety in all aspects which at times leads to stressful situation.  
**Statement 2** : Number of suicide cases among teenagers is on increase.  
 (A) If statement 1 is the cause and statement 2 is its effect.  
 (B) If statement 2 is the cause and statement 1 is its effect.  
 (C) If both statements 1 and 2 are independent causes.  
 (D) If both the statements 1 and 2 are effects of some common cause.

**Directions for the following 3 questions :** Seven cricket players A, B, C, D, E, F & G are to be honoured with Arjuna award at a sports function. The players will be seated on the dais in a row. A and G have to leave the function early and so must be seated at the extreme right. B will receive the best player's trophy and so must be in the center to facilitate presentation. C and D are rivals and therefore must be seated as far apart as possible.

94. Which of the following pairs cannot be seated together ?  
 (A) B and D      (B) C and F      (C) D and G      (D) E and A
95. Which of the following pairs cannot occupy the seats on either side of B ?  
 (A) F and D      (B) D and E      (C) E and G      (D) C and F
96. Which of the following cannot be seated at either end ?  
 (A) C      (B) D      (C) F      (D) G
97. A train travels at a certain average speed for distance of 63 km and then travels a distance of 73 km at an average speed of 6 km/hr more than its original speed. If it takes 3 hrs to complete the total journey, what is the original speed of the train in km/hr ?  
 (A) 24      (B) 33      (C) 42      (D) 66
98. A question paper must have a question on one of the 8 poets; A, B, C, D, E, F, G or H. First 4 belong to medieval period while the rest are considered modern poets. Generally modern poets figure in the question papers in alternate years. Generally those who like H like G also; and those who like F like E also. The paper setters do not like to ask about F as he has written book on F, but he likes F. Last year, the paper contained a question on A. On the basis of information given, this year paper is most likely to contain a question on  
 (A) C      (B) E      (C) F      (D) H
99. In a group of 6 women there are 4 dancers, 4 vocal musicians, 1 actor and 3 violinists. Girija and Vanaja are among the violinists while Jalaja and Shailaja do not know how to play on the violin. Shailaja and Tanuja are among the dancers. Jalaja, Vanaja, Shailaja and Tanuja are all vocal musicians and 2 of them are also violinists. If Puja is an actor, who among the following is certainly a dancer and a violinist ?  
 (A) Jalaja      (B) Puja      (C) Shailaja      (D) Tanuja
100. Ram and Shyam start from the same point in opposite directions. After each 1 km, Ram always turns left and Shyam always turns right. Which of the following statements is correct ?  
 (A) After both have travelled 2 km, the distance between them is 4 km.  
 (B) They meet after each has travelled 3 km.  
 (C) They meet for the first time after each has travelled 4 km.  
 (D) They go on without ever meeting again.



Test

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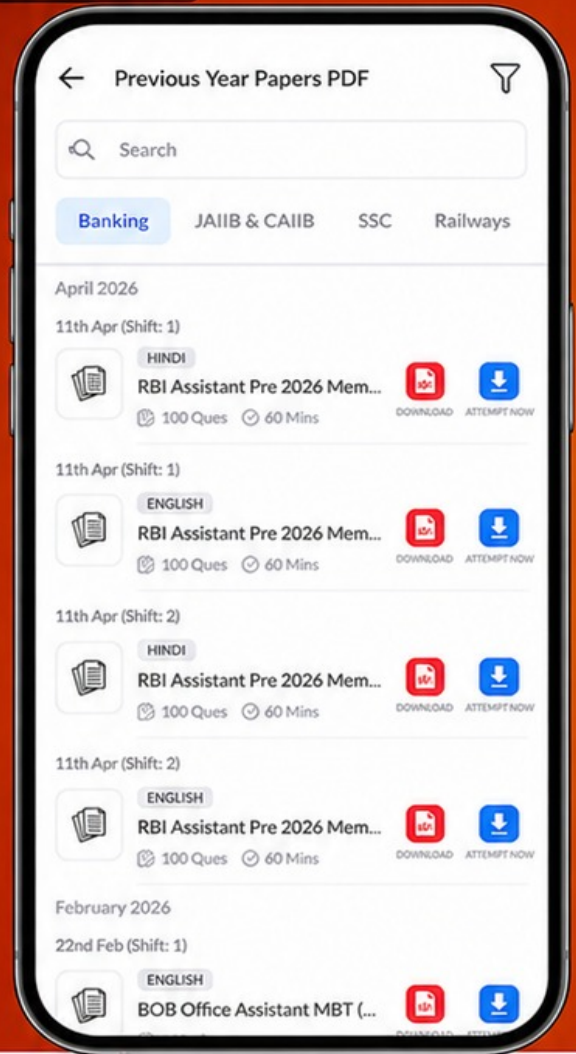
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| SET-A Q.No | Answer  | SET-B Q.No | Answer  | SET-C Q.No | Answer  | SET-D Q.No | Answer  |
|------------|---------|------------|---------|------------|---------|------------|---------|
| 1          | C       | 1          | D       | 1          | C       | 1          | A       |
| 2          | A       | 2          | D       | 2          | B       | 2          | D       |
| 3          | D       | 3          | C       | 3          | B       | 3          | D       |
| 4          | B       | 4          | A       | 4          | C       | 4          | B       |
| 5          | C       | 5          | D       | 5          | C       | 5          | B       |
| 6          | B       | 6          | D       | 6          | B       | 6          | B       |
| 7          | C       | 7          | A       | 7          | A,C     | 7          | C       |
| 8          | D       | 8          | A       | 8          | D       | 8          | A       |
| 9          | A       | 9          | A       | 9          | A       | 9          | B       |
| 10         | C       | 10         | B       | 10         | A,B,C,D | 10         | C       |
| 11         | D       | 11         | C       | 11         | C       | 11         | B       |
| 12         | C       | 12         | A       | 12         | D       | 12         | C       |
| 13         | D       | 13         | C       | 13         | D       | 13         | A       |
| 14         | A       | 14         | D       | 14         | B       | 14         | D       |
| 15         | C       | 15         | B       | 15         | A       | 15         | C       |
| 16         | A       | 16         | A       | 16         | B       | 16         | D       |
| 17         | D       | 17         | C       | 17         | C       | 17         | C       |
| 18         | D       | 18         | C       | 18         | A       | 18         | D       |
| 19         | C       | 19         | C       | 19         | D       | 19         | A       |
| 20         | A       | 20         | A       | 20         | C       | 20         | C       |
| 21         | D       | 21         | A,B,C,D | 21         | D       | 21         | C       |
| 22         | D       | 22         | A,B,C,D | 22         | B       | 22         | D       |
| 23         | A       | 23         | D       | 23         | D       | 23         | A       |
| 24         | A       | 24         | D       | 24         | A       | 24         | C       |
| 25         | A       | 25         | A,C     | 25         | A       | 25         | A       |
| 26         | B       | 26         | C       | 26         | D       | 26         | D       |
| 27         | C       | 27         | B       | 27         | D       | 27         | D       |
| 28         | A       | 28         | B       | 28         | B       | 28         | A       |
| 29         | C       | 29         | C       | 29         | B       | 29         | A       |
| 30         | D       | 30         | C       | 30         | B       | 30         | A       |
| 31         | B       | 31         | B       | 31         | C       | 31         | D       |
| 32         | D       | 32         | C       | 32         | D       | 32         | D       |
| 33         | C       | 33         | D       | 33         | B       | 33         | A       |
| 34         | C       | 34         | A       | 34         | C       | 34         | C       |
| 35         | C       | 35         | A,B,C,D | 35         | B       | 35         | D       |
| 36         | A       | 36         | B       | 36         | C       | 36         | B       |
| 37         | A,B,C,D | 37         | D       | 37         | A       | 37         | A       |
| 38         | A,B,C,D | 38         | D       | 38         | A       | 38         | B       |
| 39         | D       | 39         | B       | 39         | C       | 39         | C       |
| 40         | B       | 40         | A       | 40         | D       | 40         | C       |
| 41         | A,C     | 41         | D       | 41         | C       | 41         | A       |
| 42         | C       | 42         | C       | 42         | D       | 42         | A,B,C,D |
| 43         | B       | 43         | A       | 43         | A       | 43         | A,B,C,D |
| 44         | B       | 44         | D       | 44         | C       | 44         | D       |
| 45         | C       | 45         | C       | 45         | C       | 45         | D       |
| 46         | C       | 46         | D       | 46         | D       | 46         | C       |
| 47         | A,B,C,D | 47         | B       | 47         | D       | 47         | C       |
| 48         | C       | 48         | C       | 48         | C       | 48         | B       |
| 49         | D       | 49         | A       | 49         | A       | 49         | B       |
| 50         | A       | 50         | A       | 50         | D       | 50         | C       |

| SET-A Q.No | Answer | SET-B Q.No | Answer | SET-C Q.No | Answer  | SET-D Q.No | Answer  |
|------------|--------|------------|--------|------------|---------|------------|---------|
| 51         | A      | 51         | D      | 51         | D       | 51         | C       |
| 52         | B      | 52         | D      | 52         | A       | 52         | B       |
| 53         | D      | 53         | B      | 53         | A       | 53         | A,C     |
| 54         | D      | 54         | B      | 54         | A       | 54         | C       |
| 55         | B      | 55         | B      | 55         | D       | 55         | A       |
| 56         | B      | 56         | A      | 56         | C       | 56         | A,B,C,D |
| 57         | D      | 57         | D      | 57         | A       | 57         | C       |
| 58         | C      | 58         | B      | 58         | C       | 58         | D       |
| 59         | A      | 59         | C      | 59         | D       | 59         | D       |
| 60         | D      | 60         | B      | 60         | B       | 60         | B       |
| 61         | C      | 61         | C      | 61         | A       | 61         | A       |
| 62         | D      | 62         | D      | 62         | B       | 62         | B       |
| 63         | B      | 63         | A      | 63         | C       | 63         | D       |
| 64         | C      | 64         | C      | 64         | C       | 64         | A       |
| 65         | A      | 65         | D      | 65         | A       | 65         | D       |
| 66         | A      | 66         | C      | 66         | A,B,C,D | 66         | C       |
| 67         | D      | 67         | D      | 67         | A,B,C,D | 67         | D       |
| 68         | D      | 68         | A      | 68         | D       | 68         | B       |
| 69         | B      | 69         | C      | 69         | D       | 69         | D       |
| 70         | B      | 70         | C      | 70         | C       | 70         | C       |
| 71         | C      | 71         | A      | 71         | C       | 71         | D       |
| 72         | D      | 72         | C      | 72         | D       | 72         | A       |
| 73         | C      | 73         | B      | 73         | C       | 73         | C       |
| 74         | B      | 74         | A      | 74         | A       | 74         | B       |
| 75         | C      | 75         | D      | 75         | D       | 75         | D       |
| 76         | B      | 76         | A      | 76         | B       | 76         | A       |
| 77         | D      | 77         | C      | 77         | D       | 77         | A       |
| 78         | D      | 78         | D      | 78         | B       | 78         | B       |
| 79         | A      | 79         | C      | 79         | A       | 79         | D       |
| 80         | C      | 80         | A      | 80         | D       | 80         | C       |
| 81         | B      | 81         | D      | 81         | D       | 81         | D       |
| 82         | A      | 82         | B      | 82         | A       | 82         | C       |
| 83         | B      | 83         | D      | 83         | C       | 83         | D       |
| 84         | A      | 84         | B      | 84         | B       | 84         | B       |
| 85         | C      | 85         | A      | 85         | D       | 85         | C       |
| 86         | D      | 86         | B      | 86         | A       | 86         | B       |
| 87         | C      | 87         | D      | 87         | A       | 87         | B       |
| 88         | A      | 88         | D      | 88         | B       | 88         | A       |
| 89         | D      | 89         | A      | 89         | C       | 89         | D       |
| 90         | B      | 90         | C      | 90         | C       | 90         | A       |
| 91         | D      | 91         | B      | 91         | D       | 91         | C       |
| 92         | A      | 92         | D      | 92         | B       | 92         | D       |
| 93         | A      | 93         | A      | 93         | D       | 93         | C       |
| 94         | B      | 94         | D      | 94         | B       | 94         | A       |
| 95         | D      | 95         | C      | 95         | C       | 95         | D       |
| 96         | D      | 96         | C      | 96         | C       | 96         | B       |
| 97         | A      | 97         | C      | 97         | B       | 97         | D       |
| 98         | C      | 98         | B      | 98         | A       | 98         | B       |
| 99         | B      | 99         | D      | 99         | D       | 99         | A       |
| 100        | D      | 100        | B      | 100        | A       | 100        | C       |