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GATE - INSTRUMENTATION ENGINEERING
MOCK TEST PAPER

- *There are a total of 65 questions carrying 100 marks.*

- *Questions (1-25) will carry 1-mark each and questions (26-55) will carry 2-marks each.*

- *Questions (56-65) belongs to general aptitude (GA). Questions (56-60) will carry 1-mark each, and question (61-65) will carry 2-marks each*

- *For Q.1-25 and Q.56-60 1/3 mark will be deducted for each wrong answer. For Q.26-51 and Q. 61-65 2/3 mark will be deducted for each wrong answer. The question pairs (Q.52, Q.53) and (Q.54, Q.55) are linked questions. For Q.52 &54 2/3 mark will be deducted. There is no negative marking for Q.53 &Q.55.*

- *Q.48-51 are common data questions. If first question is attempted wrongly then answer of second question will not be evaluated.*

- *Pattern of questions : MCQs*

- *Total marks   : 100*

- *Duration of test   : 3 Hours*

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For IIT-JAM, JNU, GATE, NET, NIMCET and Other Entrance Exams

1-C-8, Sheela Chowdhary Road, Talwandi, Kota (Raj.) Tel No. 0744-2429714

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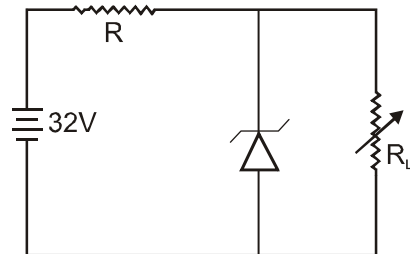UGC NET, GATE, CSIR NET, IIT-JAM, IBPS, CSAT/IAS, SLET, CTET, TIFR, NIMCET, JEST, JNU, ISM etc.

1. Eigen values for the Matrix A = $\begin{bmatrix} 3 & 1 & 0 \\ 0 & 1 & 0 \\ 4 & 2 & 1 \end{bmatrix}$
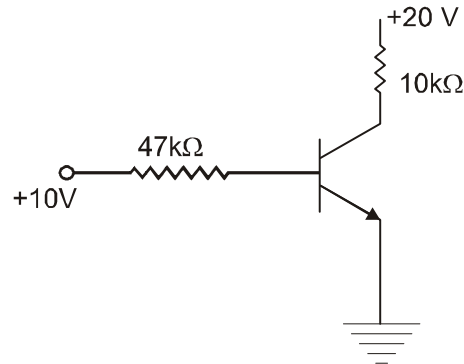
(A) 1, 3

(B) 3, 0, 2

(C) 3, 0, 1

(D) 3, 2

2. Apply the method of variation of parameters to solve $x^2 y_2 + x y_1 - y = x^2 e^x$ then

(A) $y = c_1 x + c_2 \dfrac{1}{x} + e^x - x^{-1} e^x$

(B) $y = c_1 x + c_2 \dfrac{1}{x} - e^x - x^{-1} e^x$

(C) $y = c_1 x + c_2 \dfrac{1}{x} + e^x + x^{-1} e^x$

(D) $y = c_1 x + c_2 \dfrac{1}{x} - e^x + x^{-1} e^x$

3. A 24 V, 600 mW, Zener diode is used for providing a 24 V stabilized supply to a variable load. Assume that for proper zener action, a minimum of 10 mA must flow through the Zener. If the input voltage is 32 V, what would be the value of R and the maximum load current ?
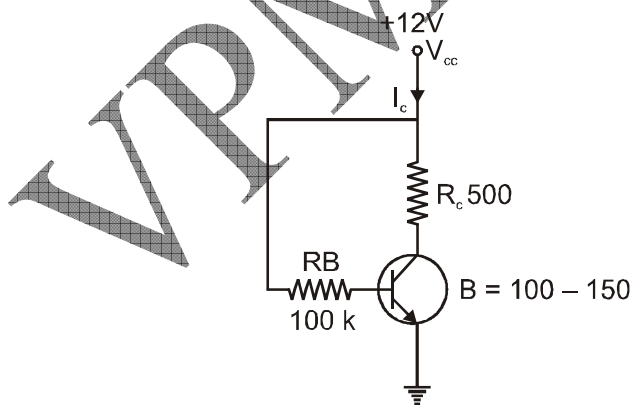
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(A) 320 Ω, 15 mA

(B) 400 Ω, 15 mA

(C) 400 Ω, 10 mA

(D) 320 Ω, 10 mA

4. For an op-amp having a slew rate of 3V/μsec, what is the maximum closed loop voltage gain that can be used when the input signal varies by 0.4 V in 12 μ sec?

(A) 9

(B) 90

(C) 900

(D) None of these

5. In the transistor circuit shown in the figure below, collector to - ground voltage is + 20 V. Which of the following is the probable error ?

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+20 V

10kΩ

47kΩ

+10V

(A) Collector - emitter terminals shorted

(B) Emitter to ground connection open

(C) 10 kΩ resistor open

(D) Collector - base terminal shorted

6. The base-biased transistor circuit of figure is subjected to increase in junction temperature from 25°C to 75° C. If β increases from 100 to 150 with rising temperature, calculate the percentage change in a-point value (I_C, V_{CE}) over the temperature range. Assume that V_{BE} reacts at 0.7 V.

+12V
V_{cc}

I_c

R_c 500

RB
100 k

B = 100 – 150

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(A) – 48 %

(B) – 46. 57 %

(C) – 40 %

(D) – 44.57 %

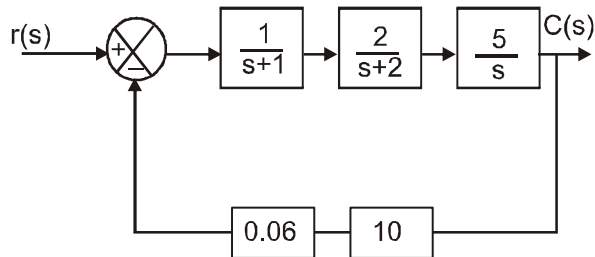**7.**   Laplace Transform of the given function

$$x|t| = \delta(t^2 - 3t + 2) \text{ is } -$$

(A) $e^{-s} \cdot e^{-2s}$

(B) $e^{-s} + e^{-2s}$

(C) $e^{s} \cdot e^{2s}$

(D) $e^{s} + e^{2s}$

8.   FET Tuned amplifier with g_m = 15 mA/V, r_d = 10 K has a resonant impedance of 10

KΩ. The gain resonance is given by

(A) 75

(B) 300

(C) 7.5

(D) None of these

9.   The transfer function of the control system shown in the given figure is

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(A) $\dfrac{10}{s(s+1)(s+2)}$

(B) $\dfrac{6}{s^3 + 3s^2 + 2s + 6}$

(C) $\dfrac{6}{s(s+1)(s+2)}$

(D) $\dfrac{10}{s^3 + 3s^2 + 2s + 6}$

10. The impulse response of a system is given by $c(t) = \dfrac{1}{2}e^{-t/2}$

Which one of the following is it's unit step response?

(A) $1 - e^{-t/2}$

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

(C) $2 - e^{-t}$

(D) $1 - e^{-2t}$

11. If $u = \phi\left(\dfrac{y}{x}\right) + x\psi\left(\dfrac{y}{x}\right),$ then the value of

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$$x^2 \frac{\partial^2 u}{dx^2} + 2xy \frac{\partial^2 u}{dx\,dy} + y^2 \frac{\partial^2 u}{\partial y^2}, \qquad \text{is}$$

(A) 0

(B) u

(C) 2u

(D) –u

12. A unity feedback system is characterized by the open-loop transfer function

$$G(s) = \frac{1}{s(0.5s+1)(0.2s+1)}$$

Determine the steady-sate errors for unit-step, unit-ramp and unit-acceleration input.

(A) ∞, 1, 0

(B) 0, 1, ∞

(C) 1, 0, 1

(D) 1, 0, ∞

13. Calculate the maximum velocity of the beam of electron in a CRT having a cathode anode voltage of 1000V. Assume the electrons to leave the cathode with zero velocity. Charge of electron = 1.6×10^{-19} C and mass of electron = 9.1×10^{-31} kg.

(A) 0.1875×10^6 m/s

(B) 0.1875×10^7 m/s

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(C) 0.1875×10^8 m/s

(D) 0.1875×10^9 m/s

14. When testing a coil having a resistance of 10Ω, resonance occurred when the oscillator frequency was 10 MHz and the rotating capacitor was set at $500/2\pi$ PF. The effective value of the Q of the coil is
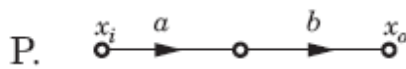
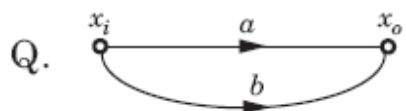(A) 20

(B) 254

(C) 314

(D) 542

15. Consider the List I and List II
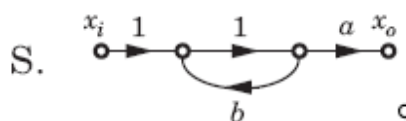
List I (Signal Flow Graph)   List II (Transfer Function)

1. $a + b$

2. ab

3. $\dfrac{a}{(1 - ab)}$
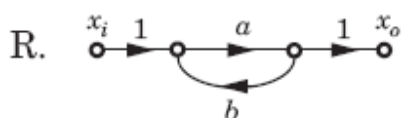
4. $\dfrac{a}{1 - b}$

The correct match is

	P	Q	R	S
(A)	2	1	3	4
(B)	2	1	4	3
(C)	1	2	4	3
(D)	1	2	3	4

16. A rectifier instrument is used to measure a square wave a.c. of amplitude 100 V. This meter would read.
(A) 111 V
(B) 100 V
(C) 90 V
(D) 70.7 V

17. Two transformers of identical voltages but of different capacities are operating in parallel. For satisfactory load sharing
(A) impedances must be equal
(B) per - unit impedances must be equal
(C) per - unit impedances and X / R ratios must be equal
(D) None of these

18. What is current though the LED in the circuit shown in **Fig.**? Assume that voltage drop across the LED is 2 V.
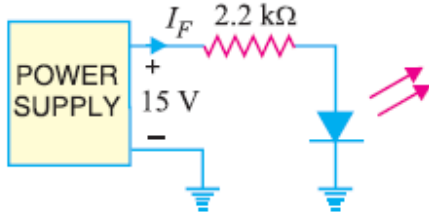
(A) 7.89 mA

(B) 4.15 mA

(C) 5.91 mA

(D) 11.15 mA

19. In the circuit of Fig. find (V_2/V_1) using mesh method.
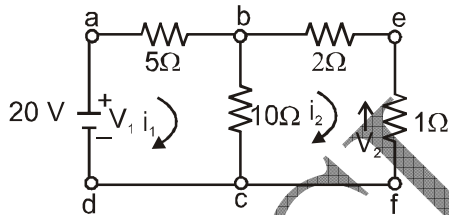
(A) $\dfrac{2}{19}$

(B) $\dfrac{19}{2}$

(C) $\dfrac{1}{16}$

(D) None of these

20. Find r in the circuit of Fig

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(A) 2.03 Ω

(B) 3.78 Ω

(C) 1.38 Ω
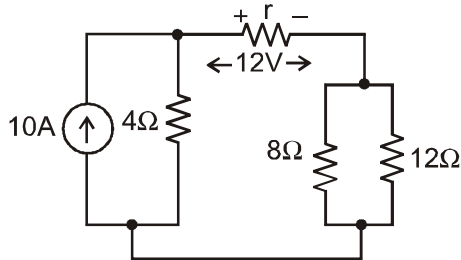
(D) None of these

21. Three impedances Z_R, Z_Y and Z_B are connected in star across a 100V, 50Hz 3ϕ supply.

Let, $Z_R = 50\underline{|0°}$ Ω

$Z_Y = j\ 10$ Ω

$Z_B = j\ 10$ Ω

Find the power factor of the system?

(A) 10

(B) 0.1

(C) 1

(D) None of these

22. The z parameters z_{11} and z_{21} for the 2-port network shown in the given figure respectively are
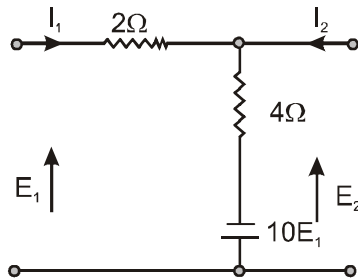
(A) $Z_{11} = -\dfrac{6}{11}\Omega; z_{21} = \dfrac{16}{11}\Omega$

(B) $Z_{11} = \dfrac{6}{11}\Omega; z_{21} = \dfrac{4}{11}\Omega$

(C) $Z_{11} = \dfrac{6}{11}\Omega; z_{21} = -\dfrac{16}{11}\Omega$

(D) $Z_{11} = \dfrac{4}{11}\Omega; z_{21} = \dfrac{4}{11}\Omega$

23. The discrete-time system shown in figure, is known as the unit delay element, Determine whether the system is

(A) causal

(B) linear

(C) time-invariant & stable

(D) all of these

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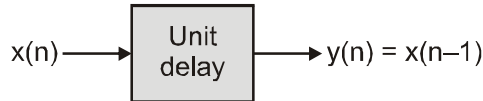
Unit delay element

24. A continuous time signal is given below

    x|t| = 8 cos 200 πt.

    if the sampling frequency f_S = 150 Hz. The discrete time signal x(n) or x(nTs) obtained after sampling is

    (A) $8 \cos\left(\dfrac{8\pi n}{3}\right)$

    (B) $8 \cos\left(\dfrac{2\pi n}{3}\right)$

    (C) $8 \cos\left(\dfrac{\pi n}{3}\right)$

    (D) None of these

25. What is the probability that all 3 children in a family have different birthdays? (Assume 1 year = 365 days).

    (A) 0.892

    (B) 0.992

    (C) 0.753

    (D) None of these

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26. A waveform [30 + 40 sin (250t + 30°)] is to be sampled periodically and reproduced from these samples. How many sample values are required to be stored in order to produce 1 sec. of this waveform

(A) 79.62 samples

(B) 125.6 sample

(C) 159.16 samples

(D) None of these

27. The hexadecimal number B6C7 is equivalent to decimal number

(A) 49761

(B) 46791

(C) 47691

(D) 49716

28. If $(x567)_8 + (27x5)_8 = (75yx)_8$, values of x and y are

(A) 4, 4

(B) 3, 4

(C) 3, 3

(D) 4, 3

29. The main disadvantage of PCM is

(A) its inability to handle analog signals

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(B) its incompatibility with TDM

(C) the large bandwidths that are required for it

(D) the high error rate which its quantizing noise introduces.

30. What value of series resistor is required to limit the current through a LED to 20 mA with a forward voltage drolp of 1.6 V when connected to a 10V supply?

(A) $360\,\Omega$

(B) $584\,\Omega$

(C) $469\,\Omega$

(D) $420\,\Omega$

31. Serial input data of 8085 can be loaded into 7 bit of the accumulator by.

(A) Executing a RIM instruction

(B) Execution RST 1

(C) Using TRAP

(D) None of these

32. A control system with impulse response $0.5(1 + e^{-2t})$ is cascaded to another control block whose impulse response is e^{-t}. The transfer function of the cascaded combination is

(A) $\dfrac{1}{(s+1)(s+2)}$

(B) $\dfrac{1}{s(s+1)}$

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

(D) $\dfrac{0.5}{s(s+1)(s+2)}$

33. For $\phi(s) = \dfrac{0.5}{s(s+1)(s+2)}$ the coefficient matrix A is

(A) $\begin{bmatrix} 6 & -5 \\ -6 & 0 \end{bmatrix}$

(B) $\begin{bmatrix} 5 & -5 \\ 0 & -6 \end{bmatrix}$

(C) $\begin{bmatrix} 6 & 0 \\ -5 & -6 \end{bmatrix}$

(D) $\begin{bmatrix} 0 & 1 \\ -5 & -6 \end{bmatrix}$

34. What is the separation on photographic plate in the velocity selector of Bain bridge mass spectro-cope with E = 200 V/cm and H = 0.2 Tesla, H in main chamber as 0.3 Tesla? Mixture of signgly charged ions of carbon isotopes C^{12} and C^{13} is analysed.

(A) 0.69 cm

(B) 0.59 cm

(C) 0.49 cm

(D) 0.39 cm

35. The 8051 can handle ……………… Interrupt source.

(A) 3

(B) 4

(C) 5

(D) 6

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36. A photo-diode is exposed to light with an illumination of 2.5 mW/cm^2. If the sensitivity of the photo-diode for the given conditions is 37.4 μA/mW/cm^2, find the reverse current through the device.

(A) 79.5 μA

(B) 93.5 μA

(C) 49.5 μA

(D) 98.5 μA

37. What is the cardiac output when heart rate is 75 beats/min and stroke volume is 50 mL/beat ?

(A) 2.75 Lit/min

(B) 3.75 Lit/min

(C) 4.75 Lit/min

(D) 5.75 Lit/min

38. What is the mean corpuscular volume (MCV) in blood with PCV = 45% and RBC count = 5.0 millions/mm^3 ?

(A) 40 cubic microns

(B) 60 cubic microns

(C) 80 cubic microns

(D) 90 cubic microns

39. What is the mean corpuscular haemoglobin concentration (MCHC) in blood with Hb as 15 g percent and PCV as 45 percent ?

(A) 11.1%

(B) 22.2%

(C) 33.3%

(D) 55.5%

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40. Which of the following statements about the use of mass spectrometry in protein investigation is not correct?

(A) Mass spectrometry involves ionized molecules in the gas phase.

(B) Mass spectrometry is used for analyzing the sequence of peptides.

(C) Ionic fragments are separated according to their mass-to-charge ratio in Mass spectrometry.

(D) Mass spectrometry involves the separation of ionic fragments on a gel.

41. Which of the following wavelength ranges is associated with UV spectroscopy?

(A) 0.8 - 500µm

(B) 400 - 100nm

(C) 380 - 750nm

(D) 0.01 - 10nm

42. Which of the following compounds does not absorb light in the UV/visible spectrum?

(A) Aspirin

(B) Paracetamol

(C) Chloral hydrate

(D) Phenobarbitone

43. When one leg of a Michelson interferometer is lengthened slightly, 150 dark fringes sweep through the field of view. If the light used has l = 480 nm, how far was the mirror in that leg moved?

(A) 0.016 mm

(B) 0.026 mm

(C) 0.036 mm

(D) 0.046 mm

44. What is the thickness of a thin glass plate (μ = 1.5) introduced in one of the arms of a Michelson interferometer using 5890 Å with a shift of 10 fringes?

(A) 4.89 μm

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(B) 5.89 µm

(C) 6.89 µm

(D) 7.89 µm

45. The optical fibre is 2 m long and has a diameter of 20 µm. If a ray of light is incident one end of the fibre at an angle $\theta_1 = 40°$, how many reflections does it make before emerging from the other end? (index of refraction of the fibre is 1.30).

(A) 27000

(B) 37000

(C) 47000

(D) 57000

46. In practice, optical fibres have a coating of glass ($n_3 = 1.512$) to protect the optical surface of the fibre. If the fibre itself has an index of refraction $n_2 = 1.700$, what is the critical angle for total reflection of a ray inside the fibre?

(A) 42.7°

(B) 52.7°

(C) 62.7°

(D) 72.7°

47. What is minimum speed of striking the target in a X-ray tube when it passes 5 mA at a potential difference of 100 kV?

(A) 1.38×10^3 m/sec

(B) 1.38×10^4 m/sec

(C) 1.38×10^5 m/sec

(D) 1.38×10^6 m/sec

Common Data Q– 48 & 49.

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For the system represented by the block diagram shown in Figure

Fig.

48. Closed loop transfer function when the input R is at station A–

(A) $\dfrac{G_1G_2G_3}{1+G_3H_1+G_2H_3+G_1G_2G_3H_2}$

(B) $\dfrac{G_1+G_2+G_3}{1+G_3H_1+G_2H_3+G_1G_2G_3H_2}$

(C) $\dfrac{G_1G_2G_3}{1+G_3H_1+G_2H_3-G_1G_2G_3H_2}$

(D) None of these

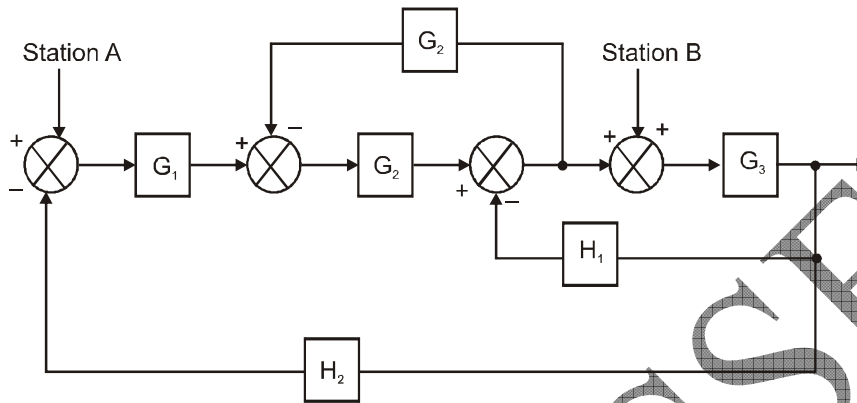**49.** The close loop transfer function when the input R is at station B–

(A) $\dfrac{G_1G_2G_3}{1+G_2H_3+G_3H_1+G_1G_2G_3H_2}$

(B) $\dfrac{G_3(1+G_2H_3)}{1+G_2H_3+G_3H_1+G_1G_2G_3H_2}$

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(C) $\dfrac{1 + G_3 + G_2H_3}{1 + G_2H_3 + G_3H_1 + G_1G_2G_2H_3}$

(D) None of these

Linked Answer Q. 50- 51

Two 11 kV, 20 mVA, three phase star connected generator operated in parallel as shown in the figure. The positive, negative and zero sequence reactance of each having respectively j0.36, j0.30, j0.20 p.u. The star point of the generator is isolated and that of the other is earthed to 2Ω resistor. The single line to ground fault occurs at the terminals of the one generator.

50. The fault current will be

(A) 2.5 p.u

(B) 2.66 p.u.

(C) 1.24 p.u.

(D) 2.95 p.u.

51. The current in the grounding resistor is

(A) 2.79 kA

(B) 2.90 kA

(C) 266. Ka

(D) 250. kA

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Linked Que. 52 & 53

A 25 - KVA transformer has 500 turns on the primary and 40 turns on the secondary winding.The primary winding is connected to a 3 - KV, 50 Hz. ac source.

52. The secondary emf -

(A) 60 V

(B) 120 V

(C) 240 V

(D) 400V

53. The maximum flux in the core -

(A) 0.027 Wb

(B) 0.054 Wb

(C) 0.059 Wb

(D) None of these

Linked Ans Que 54 - 55

A single - phase, 50 - KVA , 2400 V / 240 - V , 50 Hz transformer is used to step down the voltage of a distribution system . The low tension voltage is required to be kept constant at 240 V.

54. What load impedance connected to the LV side will be loading the transformer fully at 0.8 power factor lagging?

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(A) 230.40. Ω

(B) 1.152 Ω

(C) 50 Ω

(D) 2.304 Ω

55. What is the value of this impedance referred to the high voltage side?

(A) 230.40 Ω

(B) 57.6 Ω

(C) 115.2 Ω

(D) None of these

56. No doubt, it was our own government but it was being run on borrowed ideas, using _____solutions.

(A) Worn out

(B) Second hand

(C) Impractical

(D) Appropriate

The question below consists of pair of related words followed by four pairs of words. Select the pair best expresses the relation in the original pair:

57. Ratify: Approval::

(A) Mutate: change

(B) Pacify: conquest

(C) Duel: combat

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(D) Appeal: authority

58. A car goes 35 km in 1 hour, next 270 km in 3 hrs. and next 80 km in $2\frac{1}{2}$ hrs. Find the average speed of the car.

(A) 59.23 km/h.

(B) 61.5 km/h

(C) 80 km/h

(D) None of these

59. Some critics believe that Satyajit Ray never quite came back to the great beginning he made in this path breaking film Pather Panchali. _____ have endured decades of well-traveled bad prints to become a signpost in cinematic history.

(A) The bizarre history of its misty origins

(B) Its haunting images

(C) Its compelling munificence

(D) The breathtaking awe it inspires

Choose the most appropriate word from the options given below that is most nearly opposite in meaning to the given word:
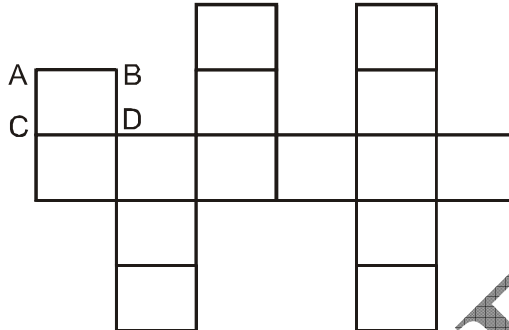
60. Valedictory

(A) Sad

(B) Collegiate

(C) Derivative

(D) Generosity

Each of the 11 letters A, H, I M, O,T, U V, W, X and Z appears same when looked at in mirror. They are called symmetric letters. Other letters in the alphabet are asymmetric letters.

61. If the area of a given square ABCD is 3 find the total area of the entire figure?

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(A) 45^2

(B) 45

(C) 48

(D) 31

62. The portion of the immunoglobulin molecule which binds the Specific antigen is formed by the amino terminal portions of both the H and L chains.

(A) H chain

(B) L chain

(C) Both (A) and (B)

(D) None of these

63. In a certain code Language

134 means good and tasty

478 means see good picture

729 means picture are faint

Which number has been used here for faint?

(A) 9

(B) 2

(C) Data are inadequate

(D) 253

64. A bag contains an equal number of one rupee, 50 paisa and 25 paisa coins. If the value of money in the bag is Rs. 35, find the total number of coins of each type?

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(A) 7

(B) 40

(C) 30

(D) 20

Profit to sale-Table for three companies A, B and C for 1996-97

	Companies	1996	1997
Total units		300000	400000
Shares	A	5%	25%
	B	60%	40%
	C	35%	35%
Price	A	10%	8%
(per unit)	B	7%	14%
(in rupees)	C	9%	10%
Profit	A	3%	1%
(per unit)	B	0.5	5%
(in rupees)	C	2%	2.5

65. What is the increase in the total profits of company B in 1997?

(A) 800%

(B) 900%

(C) 750%

(D) 789%

![VPM logo] **VPM CLASSES**

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ANSWER KEY

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Answer	A	A	A	B	B	D	B	A	D	A	A	B	C	A	B
Question	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Answer	A	C	C	A	B	B	C	D	B	B	A	B	D	C	D
Question	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Answer	A	C	D	A	C	B	B	D	C	D	B	C	C	B	C
Question	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Answer	C	D	A	B	B	A	C	A	B	C	B	B	A	B	D
Question	61	62	63	64	65										
Answer	B	C	C	D	D										

HINTS AND SOLUTION

1.(A) We compute

$$A - \lambda I = \begin{bmatrix} 3 & 1 & 0 \\ 0 & 1 & 0 \\ 4 & 2 & 1 \end{bmatrix} - \lambda \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 3-\lambda & 1 & 0 \\ 0 & 1-\lambda & 0 \\ 4 & 2 & 1-\lambda \end{bmatrix}$$

Then

$$\det (A - \lambda I) = 0$$

$$\begin{vmatrix} 3-\lambda & 1 & 0 \\ 0 & 1-\lambda & 0 \\ 4 & 2 & 1-\lambda \end{vmatrix} = \lambda^3 - 5\lambda^2 + 7\lambda - 3 = (\lambda-1)^2(\lambda-3) = 0$$

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The roots are $\lambda = 1$ and $\lambda = 3$. These are the eigenvalues.

2. (A) Given eq. can be written as

$$y_2 + \frac{1}{x}y_1 - \frac{1}{x^2}y = e^x \qquad \text{...(1)}$$

$\Rightarrow \quad (x^2D^2 + xD - 1)y = 0 \qquad \text{...(2)}$

where

$$D = \frac{d}{dx}$$

which is a homogeneous eq.

Put $x = e^z$

then $D_1 = D = \dfrac{d}{dx}$ then eq (2) become

$$[D_1(D_1 - 1) + D_1 - 1]y = 0$$

$$[D_1^2 - 1]y = 0 \qquad \text{...(3)}$$

it's A. E. is $m^2 - 1 = 0$

$$m = \pm 1$$

then solution of eq (3) is

$$y = ae^z + be^{-z}$$

$$y = ae^z + b(e^z)^{-1}$$

$$y = Ax + Bx^{-1} \qquad \text{...(4)}$$

be the complete solution of eq (1) then A and B are function of x which are so chosen that (1) will be satisfied. Differentiating (4) w.r.t x we have

$$y_1 = A_1x + A + B_1x^{-1} - Bx^{-2} \qquad \text{...(5)}$$

Choose A and B s.t.

$$A_1x + B_1x^{-1} = 0 \qquad \text{...(6)}$$

then by eq (4) we get

$$y_1 = A - Bx^{-2} \qquad \text{...(7)}$$

Differentiating (7)

$$y_2 = A_1 - (B_1 x^{-2} - 2Bx^{-3}) \qquad \text{...(8)}$$

using (4), (7) and (8), (1) reduces to

$$A_1 - B_1 x^{-2} = e^x \qquad \text{...(9)}$$

Solving (6) and (9)

$$A_1 = \frac{dA}{dx} = \frac{1}{2} e^x$$

$$B_1 = \frac{dB}{dx} = -\frac{1}{2}x^2 e^x$$

Integrating

$$A = \frac{1}{2}\int e^x dx + c_1$$

$$= \frac{1}{2}e^x + c_1$$

$$B = -\frac{1}{2}\int x^2 e^x + dx + c_2$$

$$= c_2 - \frac{1}{2}x^2 e^x + xe^x - e^x.$$

Substitute the value of A and B in eq. (4) we have the required solution is

$$y = \left[\frac{1}{2}e^x + c_1\right]x + \left[c_2 - \frac{1}{2}x^2 e^x + xe^x - e^x\right]x^{-1}$$

$$\Rightarrow \quad y = c_1 x + c_2 x^{-1} + e^x - x^{-1}e^x$$

3.(A) Here, $V_2 = 24$ V; $\qquad P_z = 600$ mW,

$\qquad I_{z,min} = 10$mA

then, $\dfrac{32-24}{R} = \dfrac{600\times10^{-3}}{24}$

or $\qquad R = \dfrac{8\times24}{600\times10^{-3}} = 320\Omega$

Current through R,

$$I = \frac{32 - 24}{320} = 25 mA$$

∴   maximum load current,

$$I_{L,max} = I - I_{z,min}$$

$$= 25 - 10 = 15 \ mA$$

4.(B) Let A be the closed loop gain.

∴ $V_0 = AV_i$

∴ $\dfrac{dV_0}{dt} = A \dfrac{dV_i}{dt}$

but $\dfrac{dV_0}{dt} = slew \ rate = S$

∴ $S = A \dfrac{dV_i}{dt}$

∴ $A = \dfrac{S}{\left(\dfrac{dV_i}{dt}\right)} = \dfrac{\left(\dfrac{3}{10^{-6}}\right)}{\left(\dfrac{0.4}{12 \times 10^{-6}}\right)} = 90$

Any closed loop gain of magnitude greater than 90 would drive the output at a rate greater than the slew rate allows, so the maximum closed loop gain is 90.

5.(B) For collector to ground which is the same as emitter terminal to read the full supply voltage at 20 V, no current should be drawn and this can happen if emitter to ground connection is open as there will be either I_H or I_C.

6. (D) $I_B = \dfrac{V_{CC} - V_{BE}}{R_B}$

$$= \frac{12 - 0.7}{100 \times 10^3} = 0.113 \ mA$$

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$$I_C = \beta\, I_B = 100 \times 0.113 = 11.3 \text{ mA}$$

$$V_{CE} = V_{CC} - I_C R_C$$

$$= 12 - (11.3 \times 10^{-3} \times 500)$$

$$= 5.35 \text{ V}$$

At 75° C $I_B = 0.113$ mA

$$I_C = \beta\, I_B = 150 \times 0.113 = 16.95 \text{ mA}$$

$$V_{CE} = 12 - (16.95 \times 10^{-3} \times 500)$$

$$= 3.32 \text{ V}$$

$\therefore$ $\Delta I_C = \dfrac{16.75 - 11.3}{11.3} \times 100$

$$= 50 \text{ \% (increased)}$$

and Δ $V_{CE} = \dfrac{3.52 - 6.35}{6.35} \times 100$

$$= -44.57\% \text{ (decreased)}$$

7.(B)   The given impulse function is

$$x(t) = \delta(t^2 - 3t + 2) = \delta[\,(t-1)(t-2)]$$

or $x(t) = \delta(t - 1)\, u(t - 1) + \delta(t - 2)u(t - 2)$

or $x(t) = \delta(t - 1) + \delta(t - 2)$

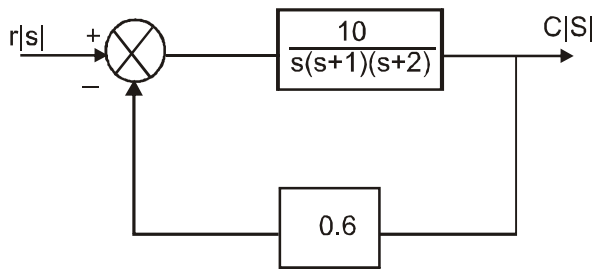Therefore, $X(s) = L\,[\delta(t-1)] + L\,[\delta(t - 2)] = e^{-s} + e^{-2s}$

8. (A) $A_V = g_m\, R$

$R = r_d \,||\, R_{max} = \dfrac{10 \times 10}{10 + 10}$

$R = 5\ K\Omega$

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$\therefore \quad A_V = 15 \times 10^{-3} \times 5 \times 10^3$

$A_V = 75$

9.(D)

$$\frac{c(s)}{r(s)} = \frac{\dfrac{10}{s(s+1)(s+2)}}{1 + \dfrac{(0.6)(10)}{s(s+1)(s+2)}}$$

$$\frac{c(s)}{r(s)} = \frac{10}{s^3 + 3s^2 + 2s + 6}$$

10.(A) $C|t| = \dfrac{1}{2} e^{-t/2}$

$$C|s| = \frac{1}{2} \times \frac{1}{\left(s + \dfrac{1}{2}\right)}$$

$$\frac{C(s)}{R(s)} = \frac{1}{2\left(S + \dfrac{1}{2}\right)}$$

$$\Rightarrow C(s) = \frac{1}{2s\left(s + \dfrac{1}{2}\right)} = \frac{A}{s} + \frac{B}{\left(s + \dfrac{1}{2}\right)}$$

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$A = 1$, $B = \dfrac{1}{2\left(-\dfrac{1}{2}\right)} = -1.$

$\therefore$ $C|s| = \dfrac{1}{s} - \dfrac{1}{\left(s + \dfrac{1}{2}\right)}$

$C|t| = (1 - e^{-t/2})\, u|t|.$

11.(A) Let $\upsilon = \phi\left(\dfrac{y}{x}\right)$ and $w = x\psi\left(\dfrac{y}{x}\right)$

Then $u = \upsilon + w$

Now υ is homogenous of degree zero and w is homogenous of degree one

$\Rightarrow$ $\qquad x^2\dfrac{\partial^2\upsilon}{\partial x^2} + 2xy\dfrac{\partial^2\upsilon}{\partial x\,\partial y} + y^2\dfrac{\partial^2\upsilon}{\partial y^2} = 0$ $\qquad$ ...(1)

and $\qquad x^2\dfrac{\partial^2 w}{\partial x^2} + 2xu\dfrac{\partial^2 w}{\partial x\,\partial y} + y^2\dfrac{\partial^2 w}{\partial y^2} = 0$ $\qquad$ ...(2)

Adding (1) and (2), we get

$\qquad x^2\dfrac{\partial^2 u}{\partial x^2}(\upsilon + w) + 2xy\dfrac{\partial^2}{\partial x\,\partial y}(\upsilon + w) + y^2\dfrac{\partial^2}{\partial y^2}(\upsilon + w) = 0$

$\Rightarrow$ $\qquad x^2\dfrac{\partial^2 u}{\partial x^2} + 2xy\dfrac{\partial^2 u}{\partial x\,\partial y} + y^2\dfrac{\partial^2 u}{\partial y^2} = 0$

12.(B) For a unity feedback system, H(s) =1.

The position error constant

$\qquad K_p = \underset{s\to 0}{\mathrm{Lt}}\, G(s)$

$\qquad\quad = \underset{s\to 0}{\mathrm{Lt}}\, \dfrac{1}{(0.5s + 1)(0.2s + 1)} = \infty$

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Therefore, the steady-state error for a unit-step input is

$$e_{ss}(t) = \frac{1}{1+K_p} = \frac{1}{1+\infty} = 0$$

The velocity error constant

$$K_v = \underset{s\to 0}{Lt}\, sG(s)$$

$$= \underset{s\to 0}{Lt}\, s \times \frac{1}{s(0.5s+1)(0.2s+1)} = 1$$

Therefore, the steady-state error for a unit-ramp input is

$$e_{ss}(t) = \frac{1}{K_v} = \frac{1}{1} = 1$$

The acceleration error constant

$$K_a = \underset{s\to 0}{Lt}\, s^2 G(s)$$

$$= \underset{s\to 0}{Lt}\, s^2 \times \frac{1}{s(0.5s+1)(0.2s+1)} = 0$$

Therefore, the steady-state error for unit-acceleration input is

$$e_{ss}(t) = \frac{1}{K_a} = \frac{1}{0} = \infty$$

13.(C) Work done by the electric field = eV

Kinetic energy = $1/2\, mv^2$

$$\frac{1}{2}mv^2 = eV$$

or $v = \sqrt{\frac{2eV}{m}} = \sqrt{\frac{2\times 1.6\times 10^{-19}\times 1000}{9.1\times 10^{-31}}}$

$$= 0.1875 \times 10^8 \text{ m/s}$$

14.(A) $Q = \frac{L\omega_0}{R} = \frac{1}{C\omega_0 R}$

$$= \frac{1}{(500/2)\times 10^{-12} \times 2\pi \times 10^7 \times 10}$$

$$= \frac{10^4}{500} = \frac{10000}{500} = 20$$

15.(B) P. $P_1 = ab$, $\Delta = 1$, $L = 0$, $T = ab$

Q. $P_1 = a$, $P_2 = b$, $\Delta = 1$, $L = \Delta_k = 0$, $T = a + b$

R. $P_1 = a$, $L_1 = b$, $\Delta = 1 - b$ $\Delta_1 = 1$, $T = \dfrac{a}{1-b}$

S. $P_1 = a$, $L_1 = ab$, $\Delta = 1 - ab$, $\Delta_1 = 1$ $T = \dfrac{a}{1-ab}$

16.(A) $V_{rms(ns)} = \dfrac{F_{ns}}{1.11} \times V_{indicated}$ .F of square wave = 1

$V_{indicated} = 100 \times 1.11 = 111$ V.

17.(C) Satisfactory parallel operation of transformer means it should not be overheated or operated at low power factor. With different percentage impedance and X / R ratios, the impedance triangles are not identical in shape and size . Though parallel operation is possible at this conditions the power factor at which the transformers will operate is different (i.e.) one transformer will operate at different pf (i.e.) & one transformer will operate with low power factor.

18.(C) Current through LED $I_F = \dfrac{V_S - V_D}{R_S}$

Here $V_S = 15$ V ; $V_D = 2$ V ; $R_S = 2.2$ k$\Omega = 2.2 \times 10^3$ Ω

$I_F = \dfrac{15 - 2}{2.2 \times 10^3} = 5.91 \times 10^{-3} A = 5.91 \, mA$

19.(A) In the loop abcd, let the loop current be i_1 and in loop befc it is i_2.

∴ In loop abcd,

$5 i_1 + (i_1 - i_2) 10 = V_1$

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$$15 i_1 - 10 i_2 = V_1 \qquad\qquad (1)$$

i.e.,

While, in loop befc,

$$2 i_2 + i_2 \times 1 + (i_2 - i_1) 10 = 0$$

or, $\qquad\qquad -10 i_1 + 13 i_2 = 0 \qquad\qquad (2)$

Solving (1) and (2),

$$i_2 = \frac{10}{95} V_1 \qquad\qquad (3)$$

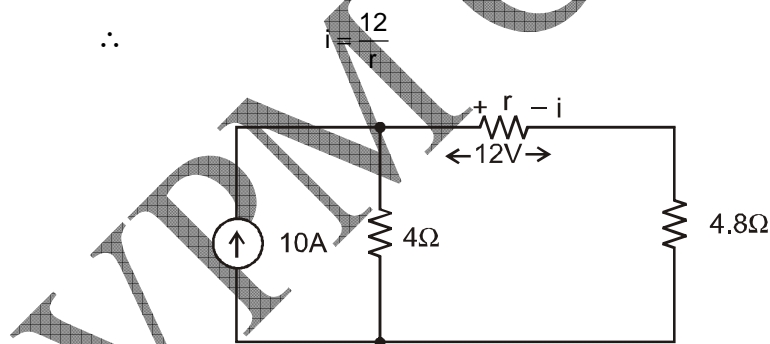But, $\qquad V_2 = i_2 \times 1 = i_2 = \frac{10}{95} V_1 \qquad\qquad$ [using (3)]

$\therefore \qquad \cdot \dfrac{V_2}{V_1} = \dfrac{10}{95} = \dfrac{2}{19}$

20.(B) Parallel combination of 8 Ω and 12 Ω resistances gives

$$\frac{8 \times 12}{12 + 8} = 4.8 \Omega$$

Let i be the current through r.

$\therefore \qquad i = \dfrac{12}{r}$

and also from Fig.

$$i = 10 \frac{4}{4 + r + 4.8}$$

[from the current division formulae]

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or, $\dfrac{12}{r} = \dfrac{40}{4 + r + 4.8}$

or, $r + 8.8 = 3.33\ r$

∴ $r = 3.78\ \Omega$.

21.(B) Let $V_{RY} = 100\underline{|0°}\ V$

$V_{YB} = 100\underline{|-120°}\ V$

$V_{BR} = 100\underline{|120°}\ V$

In star connection, phase voltage leads corresponding line voltage by 30°

$$V_{RN} = \dfrac{100}{\sqrt{3}}\underline{|-30°}V = 57.74\underline{|-30°}V$$

$$V_{YN} = \dfrac{100}{\sqrt{3}}\underline{|-120° - 30°} = 57.74\underline{|-150°}V$$

$$V_{BN} = \dfrac{100}{\sqrt{3}}\underline{|120° - 30°} = 57.74\underline{|90°}V$$

$$I_A = \dfrac{V_{RN}}{Z_R}\dfrac{57.74\underline{|-30°}}{50\underline{|0°}} = 1.1548\underline{|-30°}$$

$$I_B = \dfrac{V_{YN}}{Z_Y}\dfrac{57.74\underline{|-150°}}{10\underline{|90°}} = 5.774\underline{|-240°}$$

$$I_c = \dfrac{V_{BN}}{Z_B}\dfrac{57.74\underline{|90°}}{10\underline{|90°}} = 5.774\underline{|0°}$$

Power of Phase R   = 57.74 × 1.1548 cos 0°

= 66.67 W

Active power of phase Y= 57.74 × 5.774 cos 90°

= 0 W

∴ ΣVI cos φ = 66.67 + 0+ 0 =66.67 W

Reactive power of phase R   = 57.74 × 1.1548 sin 0°

= 0 VAR

Reactive power of phase Y   = 57.74 × 5.774 sin 90°

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$\qquad\qquad\qquad\qquad\qquad\qquad$ = 333.4 VAR

Reactive power of phase B $\qquad$ = 57.74 × 5.774 × sin 90°

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad$ = 333.4 VAR

∴ ΣVI sin ϕ = = 0 + 333.4 + 333.4 = 666.8 VAR

∴ Power factor = $\dfrac{\Sigma VI\cos\phi}{\Sigma VI} = \dfrac{\Sigma VI\cos\phi}{\sqrt{\left(\Sigma VI\cos\phi\right)^2 + \left(\Sigma VI\sin\phi\right)^2}}$

∴ Power factor = $\dfrac{66.67}{\sqrt{\left(66.67\right)^2 + \left(666.8\right)^2}} = 0.1$.

22.(C) Apply Loop law's to both loops, we get
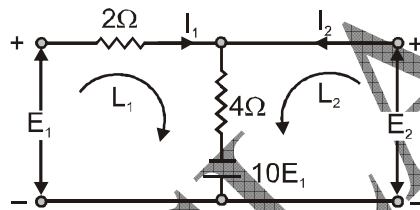
$\qquad$ $11E_1 = 6 I_1 + 4I_2$ $\qquad\qquad$ ...(i)

$\qquad$ $E_2 = (I_1 + I_2) 4 - 10 E_1$ $\qquad$ ....(ii)

Putting the expression for E_1 form equation (i) in equation (ii), we get

$$E_2 = (I_1 + I_2) 4 - \dfrac{10\left[2I_1 + 4\left(I_1 + I_2\right)\right]}{11}$$

$$= I_1\left[4 - \dfrac{20}{11} - \dfrac{40}{11}\right]$$

Putting $I_2 = 0$ and as $Z_{21} = \left.\dfrac{E_2}{I_1}\right|_{I_2=0}$, thus

$$E_2 = I_1\left[\dfrac{44-60}{11}\right] = -\dfrac{16}{11}I_1$$

From equation (i) , we get

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$$z_{11} = \frac{E_1}{I_1}\bigg|_{I_2=0} = \frac{6}{11}\Omega.$$

23.(D) When output does not depend on the future input values, therefore, the system is **causal.**

Let $\qquad x(n) = \alpha_1 x_1(n) + \alpha_2 x_2(n).$

Then, we have $\quad y(n) = T\{\alpha_1 x_1(n) + \alpha_2 x_2(n)\}$

$$y(n) = \alpha_1 x_1(n-1) + \alpha_2 x_2(n-1)$$

or $\qquad y(n) = \alpha_1 y_1(n) + \alpha_2 y_2(n)$

Thus, the superposition property is satisfied and the system is **linear.**

Let $y_1(n)$ be the response to $x_1(n) = x(n - n_0)$.

Then, we have $\quad y_1(n) = T\{x_1(n)\} = x_1(n-1) = x(n-1-n_0)$

and $\qquad y(n - n_0) = x(n - n_0 - 1) = x(n - 1 - n_0) = y_1(n)$

Hence, the system is **time-invariant.**

Since, $\quad |y(n)| = |x(n-1)| \le k$ if $|x(n)| \le k$ for all n

Therefore, the system is **BIBO stable.**

24.(B) The highest frequency component of continuous time signal is

$$f = 100\ Hz.$$

The continuous-time signal x(t) is sampled at f_s = 150 Hz. The frequency of discrete-time signal will be

$$F = \frac{f}{f_s} = \frac{100}{150} = \frac{2}{3}$$

Then, the discrete-time signal will be given as

$$x(n) = 8\cos 2\pi f n = 5\cos 2\pi\left(\frac{2}{3}\right)n = 8\cos\frac{4\pi}{3}n$$

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or $\quad x(n) = 8\cos\left(2\pi - \dfrac{2\pi}{3}\right)n = 8\cos\dfrac{2\pi n}{3} = 8\cos\dfrac{2\pi n}{3}$.

25.(B) The 1st child may be born on any of 365 days of the year; the 2nd also on any of the 365 days, and similarly the 3rd child. Hence, the total number of possible ways in which the 3 children have birthday is 365 × 365 × 365. These cases are mutually exclusive, exhaustive and equally likely. As regards the number of favorable cases out of these, we note that the 1st child may have born of the 365 days of the year as its birthday. In order that the 2nd child has a birthday different form that of the 1st, it should have been born on any of the 364 days. So, the number of cases favorable to the event "different birthdays" is 365 × 364 × 363.

$$P = \frac{365 \times 364 \times 363}{365 \times 365 \times 365} = 0.992$$

26.(A) The input waveform is

x|t| = 30 + 40 sin(250t + 30°)

The first term represents a d.c with shift whereas the second term is a sinewave of frequency

$$f_m = \frac{250}{2\pi} = 39.79 \text{ Hz}$$

∴ Minimum sample rate

$$f_s \text{ (min.)} = 2f_m = 2 \times 39.79$$

$$= 79.58 \text{ Hz}$$

The maximum allowable time interval between the sample values is

$$T_s\,(max) = \frac{1}{f_s\,(min)} = \frac{1}{79.58}$$

T_S (max) = 12.56 ms

Now, the number of samples required to be stored to produce 1 sec. is given by

No of samples = $\dfrac{1 \sec}{12.56 ms}$

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= 79.62 samples.

27.(B) $(B6C7)_{16} = (?)_{10}$ $= 7 \times 16^0 + 12 \times 16^1 + 6 \times 16^2 + 11 \times 16^3$

= 7 + 192 + 1536 + 45056

= 46791

28.(D)

```
  x  5  6  7
  2  7  x  5
  ─────────────
  7  5  3  4
```

```
8|12
  1 – 4
8|11
  1 – 3
8|13
  1 – 5
```

x = 4

y = 3

29.(C) The main disadvantage of PCM is that the large bandwidths that are required for it. The encoding, decoding and quantizing circuitry of PCM is also complex, but PCM provides high immunity.

30.(D) Series resistor, $R_S = \dfrac{V_S - V_D}{I_F}$

Here $V_S = 10 \text{ V} ; V_D = 1.6 \text{ V} ; I_F = 20 \text{ mA} = 20 \times 10^{-3} \text{ A}$

∴ $R_S = \dfrac{10 - 16}{20 \times 10^{-3}} = 420\,\Omega$

31.(A) Serial input data of 8085 can be loaded into 7 - bit of the accumulator by executing a RIM instruction . RIM instruction is a multipurpose instruction used to read status of interrupts 7.5, 6.5, 5.5 and to read serial data input bit. No Flags are affected by this instruction.

32.(C) Transfer Function of system 1 $= \dfrac{1}{2}\left(\dfrac{1}{s} + \dfrac{1}{s+2}\right)$, Transfer Function of system 2 $= \dfrac{1}{(s+1)}$

∴ Transfer Function of cascaded system $= \dfrac{1}{2} \dfrac{(2s+2)}{s(s+2)} \times \dfrac{1}{(s+1)} = \dfrac{1}{s(s+2)}$

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33.(D) Since, $[s - A]^{-1} = \phi(s)$

or $\begin{bmatrix} s & 0 \\ 0 & s \end{bmatrix} - [A] = [\phi(s)]^{-1}$

or $\begin{bmatrix} s & 0 \\ 0 & s \end{bmatrix} - [A] = \begin{bmatrix} s & -1 \\ 5 & s+6 \end{bmatrix}$

or $[A] = \begin{bmatrix} 0 & 1 \\ -5 & -6 \end{bmatrix}$

34.(A) $v = \dfrac{E}{B} = \dfrac{200 \times 10^2}{0.2} = 10^5$

Separation $= 2(R_1 - R_2) = \dfrac{2V(m_2 - m_1)}{qB}$

$= \dfrac{(2 \times 10^5)(13 - 12)(1.67 \times 10^{-27})}{1.6 \times 10^{-19} \times 0.3}$

$= 0.69$ cm.

35.(C) There are five interrupt sources for the 8051, which means that they can recognize 5 different events that can interrupt regular program execution. Each interrupt can be enabled or disabled by setting bits of the IE register. Likewise, the whole interrupt system can be disabled by clearing the EA bit of the same register.

36.(B) Reverse current = Sensitivity × Illumination

or $I_R = m \times E = 37.4 \times 2.5 = 93.5 \ \mu A$

37.(B) Cardiac output CO in lit/min = Heart rate (beats/min) × Stroke, volume (L/beat)

$= 75 \times 50 \times \dfrac{1L}{1000ml}$

$= 3.75$'lit/min.

38.(D) $MCV = \dfrac{PCV \times 10}{RBC \text{ count in millions}/mm^3}$

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$$= \frac{0.45 \times 10^{-6}}{5} = 90 \text{ Cubic microns.}$$

39.(C) $\text{MCHC} = \dfrac{\text{Hb in 9 per 100 ml blood}}{\text{Volume of packed RBC}/100 \text{ ml blood}} \times 100$

$$= \frac{15}{45} \times 100 = 33.3\%$$

40.(D) Mass spectrometry can be used along with computer searches of databases to match amino acid sequences of protein samples being analysed with catalogued proteins. The most commonly used form of the technique is the MALDI-TOF (matrix-assisted laser desorption ionization-time-of-flight spectrometry). The proteins are hydrolysed into predictable peptides (by known proteases), ionised, and accelerated in an electric and magnetic field. Heavier ions drift more slowly than lighter ones. They are separated according to their mass-to-charge ratio. The molecular weight of the original protein can then be accurately measured. The amino acid sequence of a protein can also be determined with a tandem mass spectrometer by this method as well any post-translational modifications that may have occurred. This information is then used to search genomic databases.

41.(B) 0.8 - 500µm is in the IR spectroscopy range, 380 - 750nm is the visible spectroscopy range and 0.01 10nm is the X-ray range.

42.(C) In order to absorb light in the UV/visible spectrum, a molecule must possess a chromophore e.g. a benzene ring or conjugated double bonds. Chloral hydrate does not possess a chromophore.

43.(C) Darkness is observed when the light beams from the two legs are 180° out of phase.

As length of one leg is increased by $\dfrac{\lambda}{2}$, the path length (down and back) increases

by λ and the field of view changes from dark to bright to dark.

When 150 fringes pass, the leg is lengthened by

$$150\left(\frac{1}{2}\lambda\right) = (150)\,(240 \text{ nm})$$

$$= 36000 \text{ nm}$$

$$= 0.036 \text{ mm.}$$

44.(B) We know $\qquad 2(\mu - 1) = N\lambda$

or $\qquad t = \dfrac{N\lambda}{2(\mu - 1)}$

Here, N = 10, $\lambda = 5890 \times 10^{-10}$ m, $\mu = 1.5$

$\therefore \qquad t = \dfrac{10 \times 5890 \times 10^{-10}}{2 \times 0.50}$

$$= 5.89 \text{ }\mu\text{m.}$$

45.(C) Since condition for total internal reflection is fulfilled, therefore

$$\sin\theta_2 = \frac{n_1}{n_2}\sin\theta_1 = \frac{\sin 40°}{1.3} = 0.495$$

or $\theta_2 = 29.7°$.

Length along fiber to the first reflection,

$$I = \frac{d}{\sin\theta_2}$$

$$= \frac{2 \times 10^{-5}\,m}{0.495}$$

$$= 4.04 \times 10^{-5}m$$

Hence by the law of reflection, I also represents the length along the fibre between successive reflections,

$\therefore$ Number of reflections $= \dfrac{L}{I} = \dfrac{2m}{4.04 \times 10^{-5}\,m}$

$$= 49504 \approx 47000.$$

46.(C) The critical angle is determined by the interface between fibre and coating.

$\therefore$ $\sin\theta_c = \dfrac{n_3}{n_2} = \dfrac{1.512}{1.700} = 0.889$

or $\theta_c = 62.7°$

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47.(D) Required speed, $v = 5.93 \times 10^5 \sqrt{V} = 5.93 \times 10^5$

$$\sqrt{100000} = 1.38 \times 10^6 \, m/sec.$$

48.(A) The input R is at station A and so the input at station B made zero. Let the output be C_1. Since there is no input at station B, that summing point can be removed and the resultant block diagram will be as shown in figure .
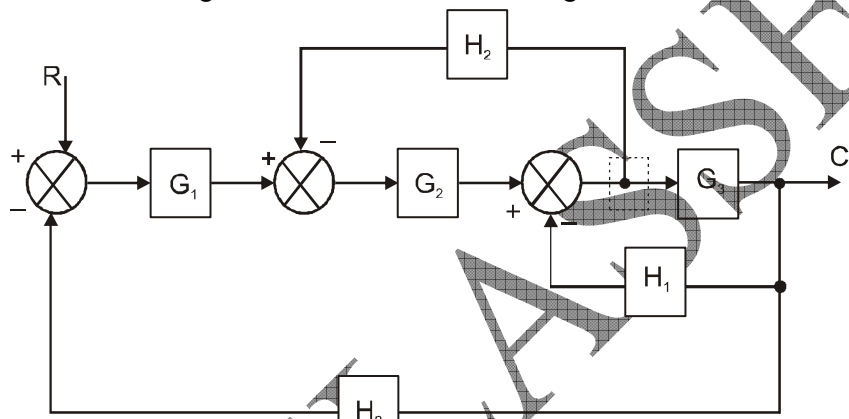
Fig.

Step 1. Moving the take-off point in Figure after block G_3, the block diagram will be as shown in Figure .
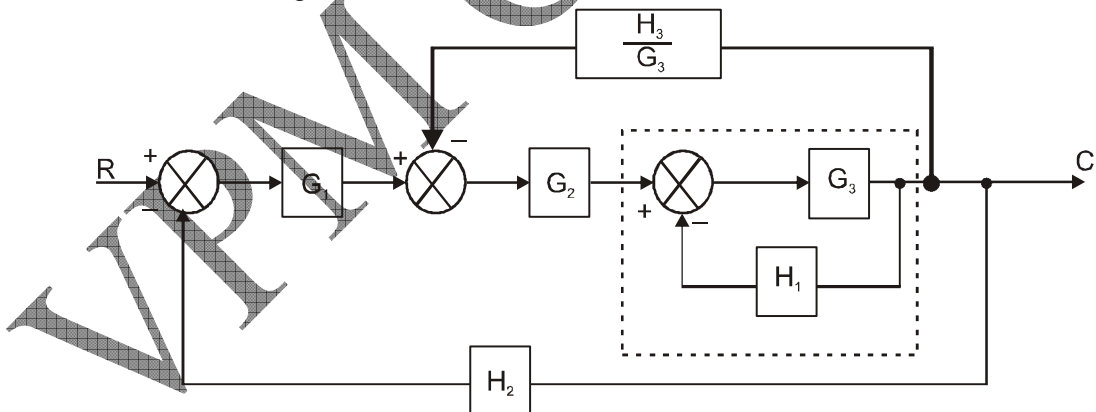
Fig

Step 2. Eliminating the inner loop in Figure and combining the result with G_2 and rearranging, the block diagram will be as shown in Figure .
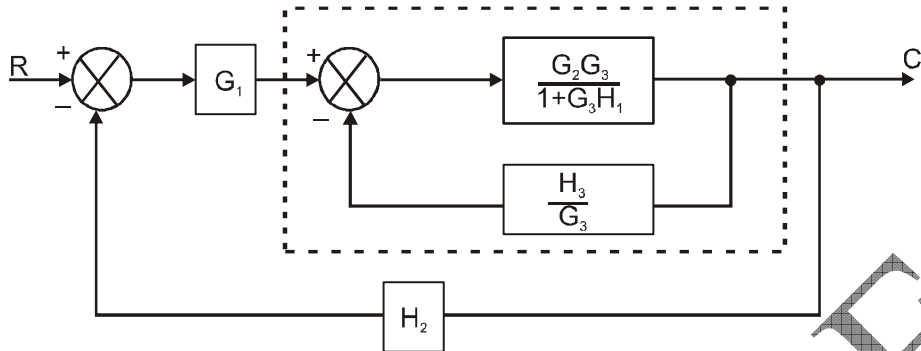
Fig.

Step 3. Eliminating the inner loop in Figure , the block diagram is as shown in Figure.
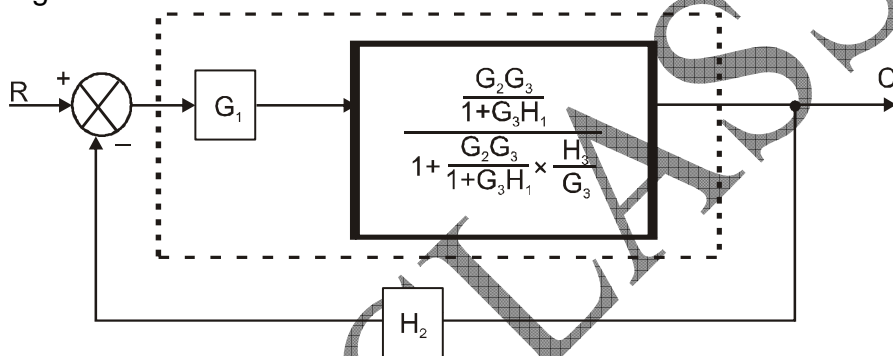
Fig.

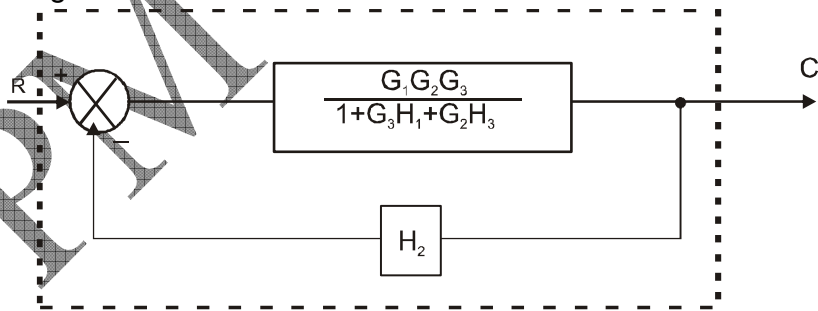**Step 4.** Combining the block in cascade in Figure , the block diagram will be as shown in Figure.

Fig.

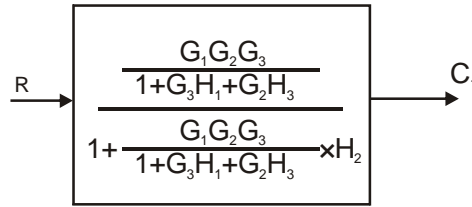**Step 5.** Eliminating the only loop in Figure , the block diagram will be as shown in Figure .

Fig.

Step 6. After simplification, the closed -loop transfer function is

$$\frac{C_1}{R} = \frac{G_1 G_2 G_3}{1 + G_3 H_1 + G_2 H_3 + G_1 G_2 G_3 H_2}$$

49.(B) The input R is at station B. So the input at station A is made zero. Let the output be C_2. Since the input at station A is zero, the corresponding summing point can be removed and a negative sign can be attached to the feedback path gain H_2. The resulting block diagram is shown in Figure.
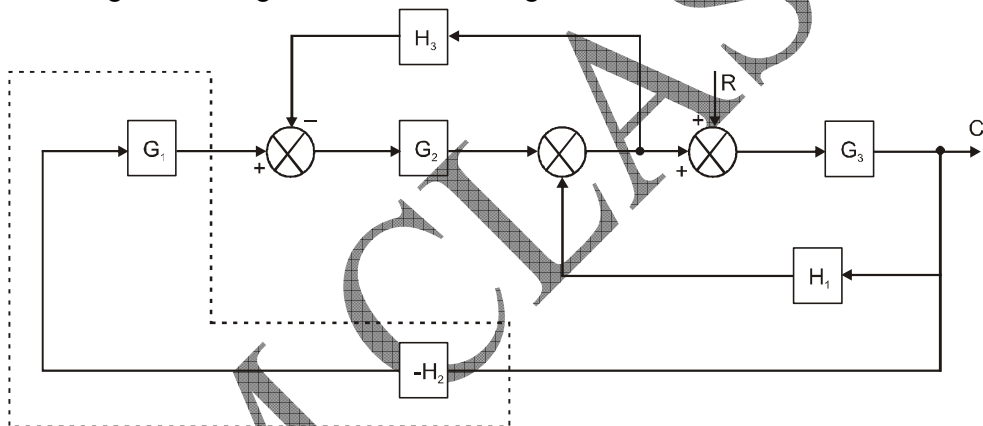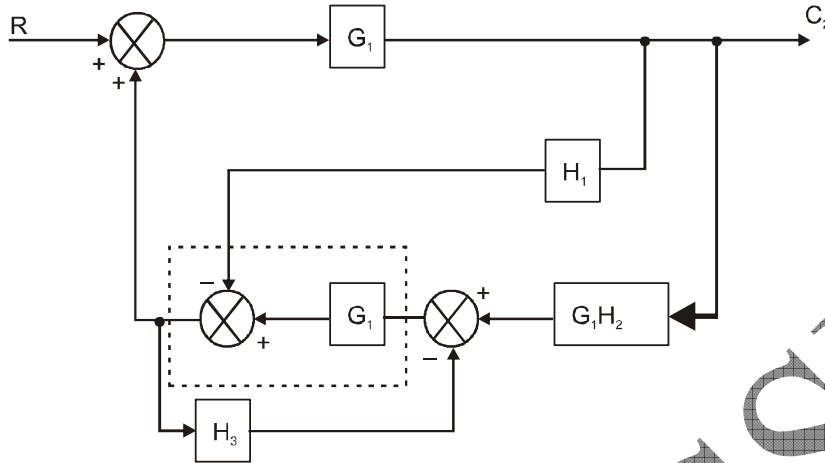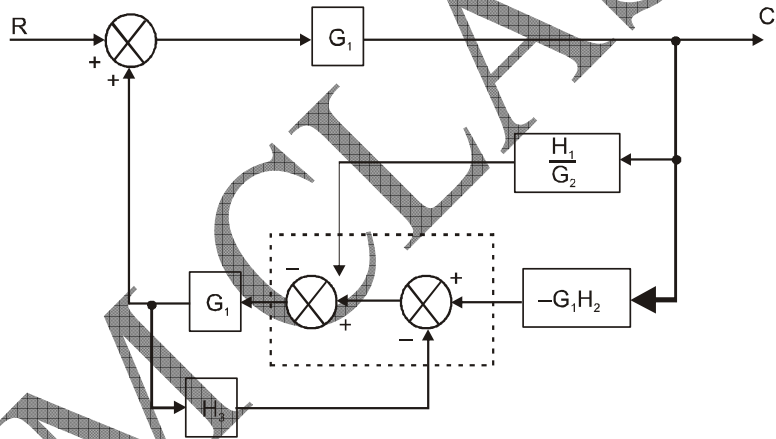

Fig.

Step1. Combining the block G_1 and $–H_2$ in cascade into a single block and rearranging the diagram in Figure , the resultant block diagram is as shown in Figure .

Fig.

Step 2. Moving the summing point before the block G_2 in Figure , the block diagram will be as shown in Figure .

Fig.

Step 3. Interchanging the summing points in Figure , the block diagram will be as shown in Figure
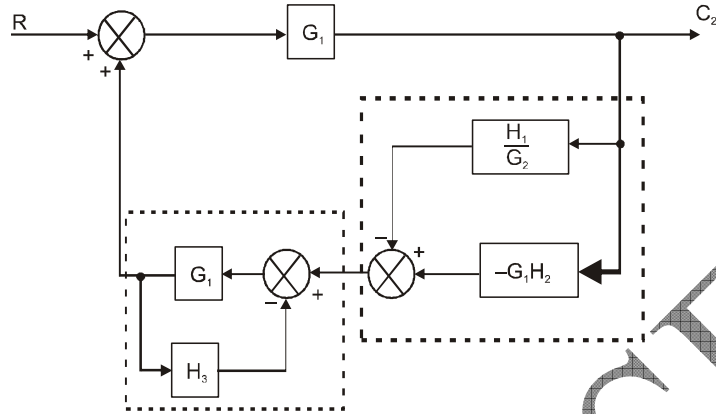
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Fig.

Step 4. Eliminating the loop and combining the parallel blocks in the feedback path in Figure , the block diagram will be as shown in Figure .
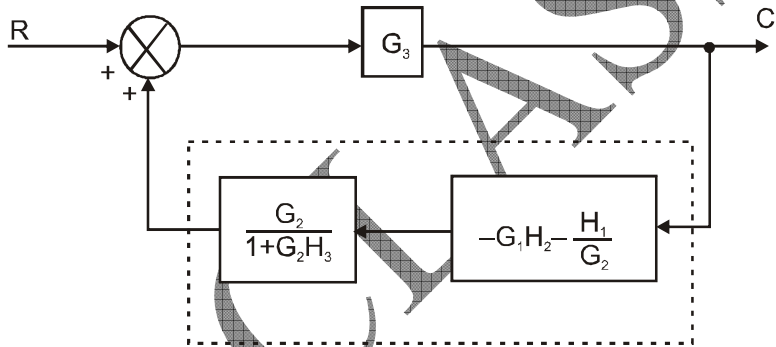

Fig.

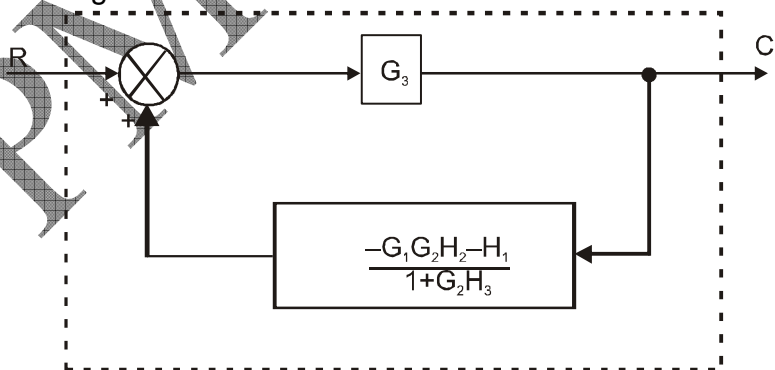**Step.5** Combining the two blocks in cascade in Figure , the block diagram will be as shown in Figure

Fig.

Step 6. Eliminating the loop in Figure , the transfer function will be as follows:

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$$\frac{C_2}{R} = \frac{G_3}{1 - \frac{G_3(-G_1G_2H_2 - H_1)}{1 + G_2H_3}} = \frac{G_3(1 + G_2H_3)}{1 + G_2H_3 + G_3H_1 + G_1G_2G_3H_2}$$

50.(B) X_1 eq $= \frac{j0.36}{2} = j0.18$

X_2 eq $= \frac{j0.30}{2} = j0.15$

Since the star point of the second generator is isolated, its zero sequence reactance does not come into picture. Therefore

$Z_{0eq} = j0.20 + 3 R_n = j0.2 + \frac{j0.30}{2} = j0.15 = (0.99 + j0.2)$

I_f (fault current for L- G fault)

$$I_a = 3I_{a1} = \frac{3E_a}{X_{1eq} + X_{2eq} + Z_{0eq}}$$

If $= \frac{3 \times 1}{j0.18 + j0.15 + j0.2 + 0.99} = \frac{3}{(j0.53 + 0.99)} = \frac{3(0.99 - i0.53)}{(0.99)^2 + (j0.53)^2}$

$= (2.35 - j 1.26) = 2.66$ p.u.

51.(A) From the above problem,

If $= 2.66$ p.u. $= 2.66 \times \frac{20 \times 10^6}{\sqrt{3} \times 11 \times 10^3} = 2792.27$ amp. $= 2.79$ kA.

52.(C) The transformation ratio is given as

$K = \frac{N_2}{N_1} = \frac{40}{500} = 0.08$

∴ Secondary emf, $E_2 = KE_1 = KV_1 = 0.08 \times 3000 = 240$ V.

53.(A) The maximum flux in the core is given by emf equation,

$\phi_m = \frac{E_1}{4.44 \times fN_1} = \frac{3000}{4.44 \times 50 \times 500} = 0.027 Wb$

54.(B) Since the secondary voltage is required to be constant. The secondary current remains the same whatever be the value of the power factor. The full - load secondary current I_2 can be calculated from the KVA rating.

$I_2 = \frac{50 KVA}{240 V} = 208.33 A$

∴ Load Impedance, $Z_L = \frac{V_2}{I_2} = \frac{240 V}{208.33}$

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$$\Rightarrow \qquad\qquad\qquad Z_L = 1.152\ \Omega$$

55.(C) Transformation ratio, $K = \dfrac{V_2}{V_1} = \dfrac{240}{2400} = 0.1$

The load impedance referred to the primary side,

$$Zeq = \frac{Z_L}{K^2} = \frac{1.152}{(0.1)^2} = 115.2\Omega$$

56.(B) No doubt, it was our own government but it was being run on borrowed ideas, using second hand solutions.

57.(B) Ratify: Approval:: duel: combat

58.(A) Total distance covered

$$= 35 + 270 + 80 = 385\ km.$$

$$= 1 + 3 + 2\frac{1}{2}\ hrs.$$

$$= 13/2\ hrs$$

Average speed $= \dfrac{D}{T} = \dfrac{385 \times 2}{13}$

$$= 59.23\ km/hr.$$

59.(B) Some critics believe that Satyajit Ray never quite came back to the great beginning he made in this path breaking film Pather Panchali. Its haunting images have endured decades of well-travelled bad prints to become a signpost in cinematic history.

60.(D) Generosity is nearly opposite to Valedictory.

61.(B) Count the number of squares in the figure and multiply it by 3.

62.(C) The portion of the immunoglobulin molecule which binds the Specific antigen is formed by the Amino terminal portions of both the H and L chains.

63.(C) 4 = good 7 = picture and 2 and 9 = are and faint respectively

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64.(D) $\dfrac{X}{1} + \dfrac{X}{2} + \dfrac{X}{4} = 35$ or $\dfrac{7X}{4}$

$= 35$ or $7X$

$= 35 \times 4$ or $X = 20$

65.(D) The increase in the total profits of company B in 1997 is 789%