Practice Book

*for*

# GENCO, TRANSCO & DISCOMs

## Electrical Engineering

**Technical Section** **Non-Technical Section**

*Including* **Previous Solved Papers of AP, TS : GENCO and TRANSCO**

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**Practice Book for GENCO, TRANSCO & DISCOMs: Electrical Engineering**



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# Preface

**B. Singh** (Ex. IES)

**GENCO, TRANSCO & DISCOMs** has been always preferred by engineers due to job stability and opportunity to work in their home state. This examination is conducted from time to time but not every year. MADE EASY team has made deep study of previous exam papers and observed that a good percentage of questions are of repetitive in nature, therefore previous years papers are advisable to solve before a candidate takes the exam. This book is useful for all power generation, transmission and distribution companies, state engineering services and other competitive exams for engineering graduates.

This edition of the book is prepared with due care to provide complete solutions to all questions with accuracy. I would like to give credit of publishing this book to MADE EASY Team for their hard efforts in collecting practice questions & solving previous years papers of AP, TS : GENCO and TRANSCO.

I have true desire to serve student community by providing good source of study and quality guidance. I hope this book will be proved an important tool to succeed in GENCO, TRANSCO and DISCOMs as well as other competitive exams. Any suggestions from the readers for improvement of this book are most welcome.

With Best Wishes

**B. Singh**

CMD, MADE EASY

# Contents

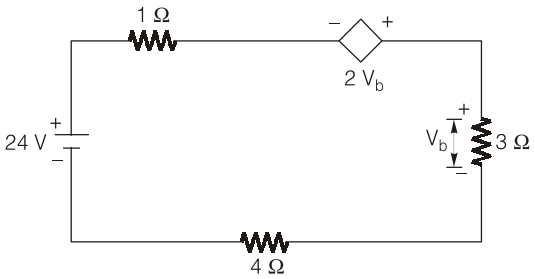
## Practice book for GENCO, TRANSCO & DISCOMs



■■■■

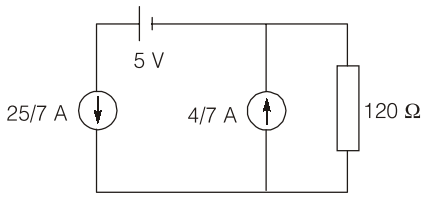
# 1 Electrical Circuits

**Q.1** The current in the given circuit with a dependent voltage source is



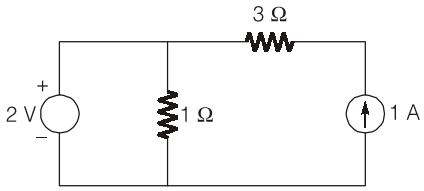

(a) 10 A (b) 12 A
(c) 14 A (d) 16 A

**Q.2** The current through 120 ohm resistor in the circuit shown in the figure below is



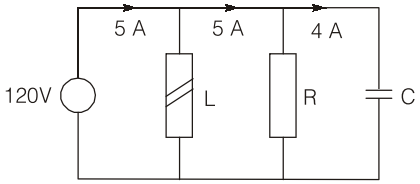

(a) 1 A (b) 2 A
(c) 3 A (d) 4 A

**Q.3** For the circuit given in figure below the power delivered by the 2 volt source is given by



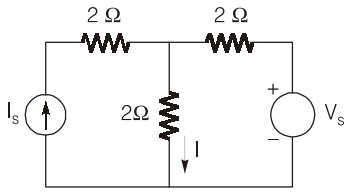

(a) 4 W (b) 2 W
(c) – 2W (d) – 4W

**Q.4** In the circuit shown in the given figure,




The current through the inductor L is
(a) 0 A (b) 3 A
(c) 4 A (d) 8 A

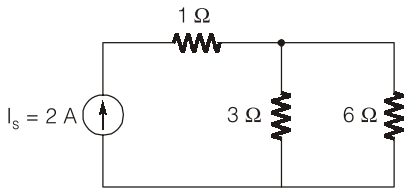
**Q.5** For the circuit shown below, the value of $V_s$ is 0 when I = 4 A. The value of I when $V_s$ = 16 V, is




(a) 6 A (b) 8 A
(c) 10 A (d) 12 A

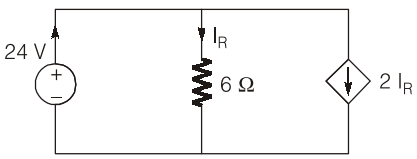
**Q.6** In a network made up of linear resistors and ideal voltage sources, values of all resistors are doubled. Then the voltage across each resistor is
(a) Doubled
(b) Halved
(c) Decreases four times
(d) Not changed

**Q.7** For the circuit shown below, what is the voltage across the current source $I_s$ ?




(a) 0 (b) 2 V
(c) 3 V (d) 6 V

**Q.8** Consider the circuit in the below figure. What is the power delivered by the 24 V source?



(a) 96 W (b) 144 W
(c) 192 W (d) 288 W

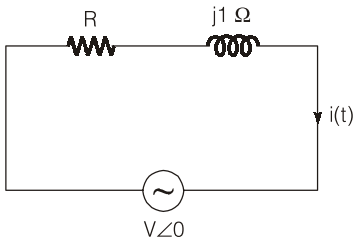
**Q.9** Consider the following statements on mesh and nodal analysis:

1. Networks that contain many series-connected elements, voltage sources or meshes having common current sources (super meshes) are more suitable for mesh analysis than for nodal analysis.
2. Networks with parallel connected elements, current sources or nodes connected by voltage sources are more suitable for nodal analysis than mesh analysis.
3. A circuit with fewer nodes than meshes is better analyzed using mesh analysis, while a circuit with fewer meshes, than nodes is better analyzed using nodal analysis.

Which of the statements given above are correct?

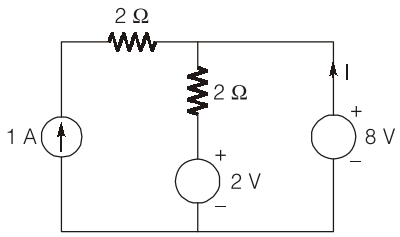
(a) 1 and 2 (b) 2 and 3
(c) 1 and 3 (d) 1, 2 and 3

**Q.10** For the network shown below, if the current $i(t) = \sqrt{2}\sin(\omega t - 30°)$, then what is the value of R?



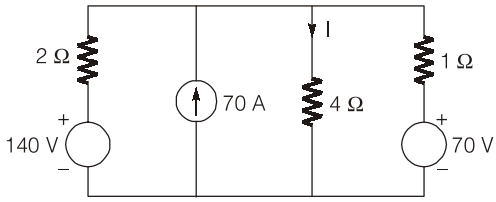

(a) 1 Ω (b) 3 Ω
(c) $\sqrt{3}\,\Omega$ (d) $3\sqrt{3}\,\Omega$

**Q.11** In the circuit shown below, what is the value of the current I?



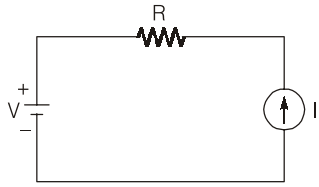

(a) 1 A (b) 2 A
(c) 3 A (d) 4 A

**Q.12** What is the value of the current I in the circuit shown below?



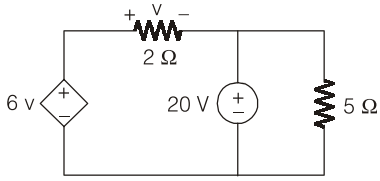

(a) 20 A (b) 25 A
(c) 30 A (d) 36 A

**Q.13** For the network shown in the figure below, what is the voltage across the current source?



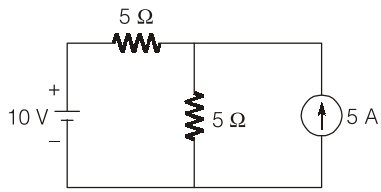

(a) V – RI (b) V + RI
(c) Zero (d) RI – V

**Q.14** What is the current through the 2 Ω resistance for the circuit as shown below?



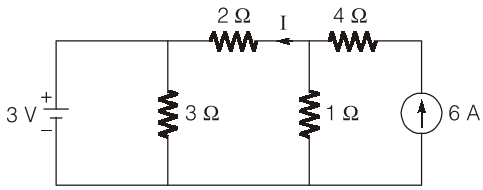

(a) 5A (b) 4A
(c) 3A (d) 2A

**Q.15** What is the voltage across the current source for the below shown circuit?




(a) 5.0 V (b) 7.5 V
(c) 12.5 V (d) 17.5 V

**Q.16** For the circuit as shown below, what is the value of I?



## Answer Key | Electrical Circuits

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | (b) | 37. | (b) | 73. | (c) | 109. | (d) | 145. | (d) |
| 2. | (c) | 38. | (b) | 74. | (a) | 110. | (d) | 146. | (d) |
| 3. | (b) | 39. | (a) | 75. | (a) | 111. | (d) | 147. | (b) |
| 4. | (d) | 40. | (c) | 76. | (d) | 112. | (a) | 148. | (b) |
| 5. | (b) | 41. | (c) | 77. | (d) | 113. | (d) | 149. | (b) |
| 6. | (d) | 42. | (c) | 78. | (b) | 114. | (a) | 150. | (a) |
| 7. | (d) | 43. | (a) | 79. | (d) | 115. | (c) | 151. | (b) |
| 8. | (d) | 44. | (a) | 80. | (c) | 116. | (b) | 152. | (c) |
| 9. | (a) | 45. | (d) | 81. | (a) | 117. | (a) | 153. | (a) |
| 10. | (c) | 46. | (c) | 82. | (b) | 118. | (c) | 154. | (c) |
| 11. | (b) | 47. | (c) | 83. | (d) | 119. | (b) | 155. | (b) |
| 12. | (c) | 48. | (b) | 84. | (c) | 120. | (b) | 156. | (a) |
| 13. | (b) | 49. | (c) | 85. | (a) | 121. | (b) | 157. | (b) |
| 14. | (d) | 50. | (d) | 86. | (d) | 122. | (b) | 158. | (c) |
| 15. | (d) | 51. | (b) | 87. | (b) | 123. | (a) | 159. | (b) |
| 16. | (d) | 52. | (c) | 88. | (b) | 124. | (c) | 160. | (c) |
| 17. | (b) | 53. | (c) | 89. | (c) | 125. | (b) | 161. | (c) |
| 18. | (d) | 54. | (a) | 90. | (b) | 126. | (b) | 162. | (c) |
| 19. | (d) | 55. | (c) | 91. | (d) | 127. | (a) | 163. | (c) |
| 20. | (c) | 56. | (a) | 92. | (c) | 128. | (c) | 164. | (b) |
| 21. | (b) | 57. | (c) | 93. | (a) | 129. | (a) | 165. | (a) |
| 22. | (d) | 58. | (b) | 94. | (d) | 130. | (a) | 166. | (b) |
| 23. | (d) | 59. | (d) | 95. | (c) | 131. | (b) | 167. | (d) |
| 24. | (d) | 60. | (a) | 96. | (d) | 132. | (b) | 168. | (c) |
| 25. | (b) | 61. | (b) | 97. | (b) | 133. | (d) | 169. | (b) |
| 26. | (b) | 62. | (d) | 98. | (c) | 134. | (d) | 170. | (b) |
| 27. | (c) | 63. | (b) | 99. | (b) | 135. | (a) | 171. | (c) |
| 28. | (b) | 64. | (c) | 100. | (b) | 136. | (a) | 172. | (b) |
| 29. | (a) | 65. | (c) | 101. | (c) | 137. | (a) | 173. | (d) |
| 30. | (a) | 66. | (a) | 102. | (c) | 138. | (d) | 174. | (d) |
| 31. | (c) | 67. | (b) | 103. | (c) | 139. | (a) | 175. | (b) |
| 32. | (b) | 68. | (b) | 104. | (a) | 140. | (a) | 176. | (a) |
| 33. | (b) | 69. | (d) | 105. | (d) | 141. | (b) | 177. | (c) |
| 34. | (b) | 70. | (c) | 106. | (b) | 142. | (b) | 178. | (b) |
| 35. | (d) | 71. | (d) | 107. | (d) | 143. | (c) | 179. | (b) |
| 36. | (c) | 72. | (c) | 108. | (d) | 144. | (b) | 180. | (b) |
| 181. | (a) | 217. | (d) | | | | | | |
| 182. | (b) | 218. | (c) | | | | | | |
| 183. | (a) | 219. | (b) | | | | | | |
| 184. | (c) | 220. | (d) | | | | | | |
| 185. | (b) | 221. | (a) | | | | | | |
| 186. | (c) | 222. | (c) | | | | | | |
| 187. | (a) | 223. | (d) | | | | | | |
| 188. | (c) | 224. | (b) | | | | | | |
| 189. | (c) | 225. | (d) | | | | | | |
| 190. | (a) | 226. | (a) | | | | | | |
| 191. | (c) | 227. | (c) | | | | | | |
| 192. | (b) | 228. | (d) | | | | | | |
| 193. | (a) | 229. | (d) | | | | | | |
| 194. | (b) | 230. | (a) | | | | | | |
| 195. | (a) | 231. | (c) | | | | | | |
| 196. | (c) | 232. | (d) | | | | | | |
| 197. | (d) | 233. | (c) | | | | | | |
| 198. | (a) | 234. | (a) | | | | | | |
| 199. | (a) | 235. | (b) | | | | | | |
| 200. | (c) | 236. | (c) | | | | | | |
| 201. | (b) | 237. | (b) | | | | | | |
| 202. | (b) | 238. | (c) | | | | | | |
| 203. | (d) | 239. | (c) | | | | | | |
| 204. | (d) | 240. | (a) | | | | | | |
| 205. | (d) | 241. | (b) | | | | | | |
| 206. | (c) | 242. | (d) | | | | | | |
| 207. | (b) | 243. | (d) | | | | | | |
| 208. | (d) | 244. | (c) | | | | | | |
| 209. | (a) | 245. | (d) | | | | | | |
| 210. | (b) | 246. | (b) | | | | | | |
| 211. | (a) | 247. | (c) | | | | | | |
| 212. | (c) | 248. | (a) | | | | | | |
| 213. | (c) | | | | | | | | |
| 214. | (c) | | | | | | | | |
| 215. | (c) | | | | | | | | |
| 216. | (a) | | | | | | | | |

## Explanations | Electrical Circuits

1. **(b)**

Applying KVL in the loop

$24 - 1I + 2V_b - V_b - 4I = 0$

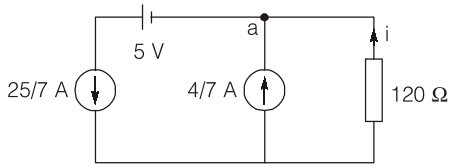
where $V_b = 3I$

$\Rightarrow \quad 24 - 5I + V_b = 0$

$\Rightarrow \quad 24 - 5I + 3I = 0$

$I = 12$ A

2. **(c)**

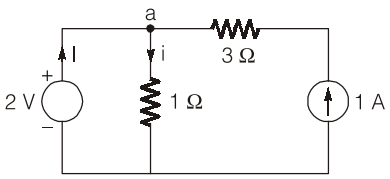



By applying KCL at node a

$$i = \frac{25}{7} - \frac{4}{7} = 3 \text{ A}$$

Voltage source in series with constant current source will behave like short circuit.

3. **(b)**




From figure $\quad i = \frac{2}{1} = 2\,\text{Amp}$

By applying KCL at node a

$I = i - 1 = 2 - 1 = 1$ Amp

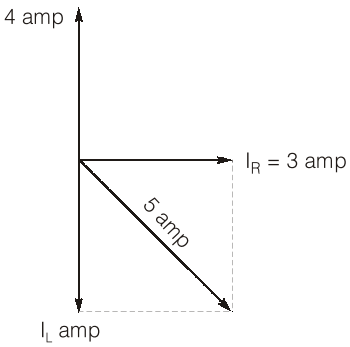
i.e. the current delivered by voltage source = 1 amp.

∴ power delivered by voltage source

$= 2 \times 1 = 2$ W

4. **(d)**

$I_R = \sqrt{5^2 - 4^2} = 3$ Amp

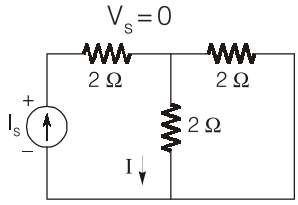



$(I_L - 4)^2 + 3^2 = 5^2$

$I_L = 8$ amp

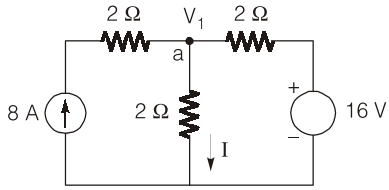
5. **(b)**

When $V_s = 0$




$$I = \frac{I_s}{2}$$

$\Rightarrow \quad I_s = 2I = 2 \times 4 = 8$ A




When $V_s = 16$ V

Applying KCL node a

$$-8 + \frac{V_1}{2} + \frac{V_1 - 16}{2} = 0$$

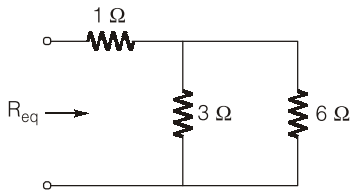
$V_1 = 16$ V

$$I = \frac{V_1}{2} = \frac{16}{2} = 8 \text{ A}$$

6. **(d)**

Ideal voltage source keeps the terminal voltage constant so accordingly current will change and the voltage across each resistor is unchanged following superposition principle.

7. **(d)**




$R_{eq} = 1 + (3 \parallel 6) = 3\ \Omega$

Voltage across current source

$I_s R_{eq} = 2 \times 3 = 6$ V

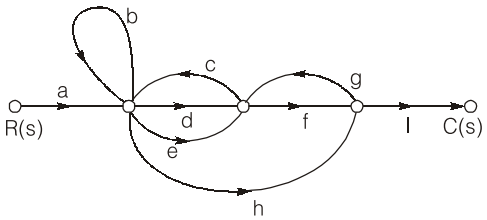
8. **(d)**

$$I_R = \frac{24}{6} = 4 \text{ A}$$

Current delivered by the voltage source.

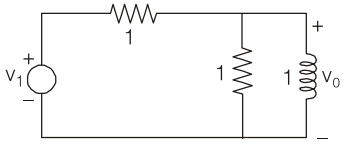
# 2 Control Systems

**Q.1** The number of forward paths and the number of non-touching loop pairs for the signal flow graph given in the figure below are, respectively.




(a) 1, 3 (b) 3, 2
(c) 3, 1 (d) 2, 4

**Q.2**




Select the correct transfer function $v_0(s)/v_1(s)$ from the following for the given network.

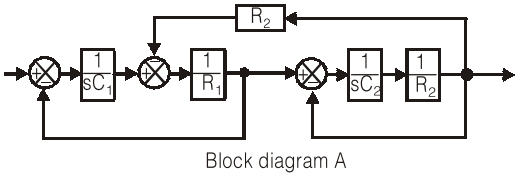
(a) $\frac{2}{s(s+1)}$ (b) $\frac{s}{(s+2)}$

(c) $\frac{s}{(2s+1)}$ (d) $\frac{2s}{(s+1)}$

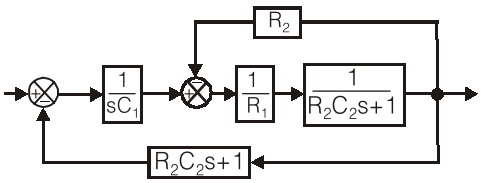
**Q.3** Which one of the following statements is NOT correct?

(a) The action of bellows in pneumatic control system is similar to that of a spring
(b) The flapper valve converts large changes in the position of the flapper into small changes in the back pressure
(c) The common name of pneumatic amplifier is pneumatic relay
(d) The transfer function of a pneumatic actuator is of the form $\frac{A}{Ms^2+fs+K}$

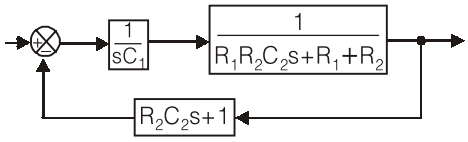
**Q.4** Consider the following three block diagram A, B and C shown below :




Block diagram A




Block diagram B

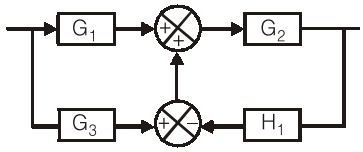



Block diagram C

Which one of the following statements is correct in respect of the above block diagrams?

(a) Only A and B are equivalent
(b) Only A and C are equivalent
(c) Only B and C are equivalent
(d) A, B and C are equivalent

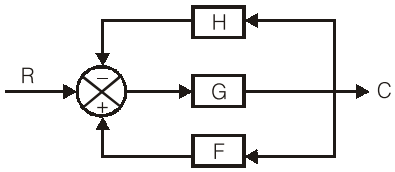
**Q.5** What is the overall transfer function of the block diagram given below ?




(a) $\frac{G_1G_2+G_2G_3}{1+G_2H_1}$ (b) $\frac{G_1G_3+G_2G_3}{1+G_3H_1}$

(c) $G_1G_2+G_2G_3$ (d) $\frac{G_1G_3+G_2G_3}{1+G_2G_3H_1}$

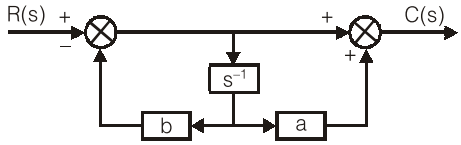
**Q.6** For the feedback system shown in the figure below, which one of the following expresses the input output relation C/R of the overall system?




(a) $\frac{G}{1-FG+GH}$ (b) $\frac{G}{1+FG-GH}$

(c) $\frac{FG}{1+FGH}$ (d) $\frac{GH}{1-FGH}$

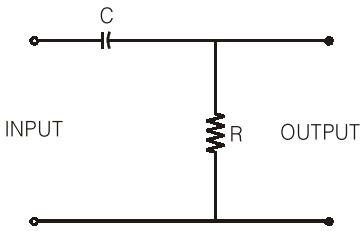
**Q.7** The block diagram for a particular control system is shown in the below figure. What is the transfer function C(s)/R(s) for this system?




(a) $\frac{s+a}{s-b}$ (b) $\frac{s+a}{s+b}$

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

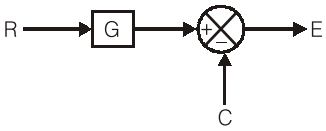
**Q.8** The transfer function for the diagram shown below is given by which one of the following?



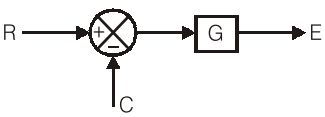

(a) 1/(1 + sRC) (b) sRC/(1 + sRC)

(c) sRC/(1 – sRC) (d) 1 + sRC

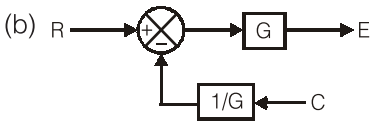
**Q.9** Which one of the following block diagrams is equivalent to the below shown block diagram?



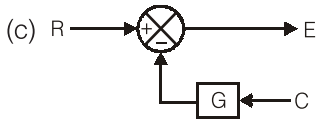

(a)



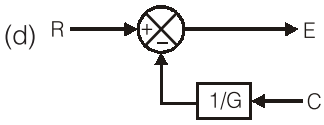

(b)



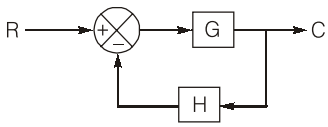

(c)



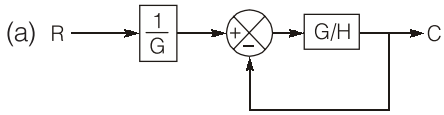

(d)



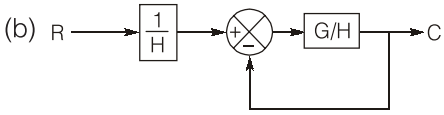

**Q.10** The below shown feedback control system has to be reduced to equivalent unity feedback system. Which one of the following is equivalent?



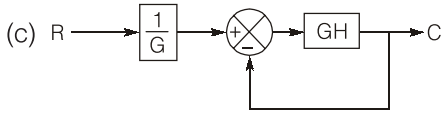

(a)



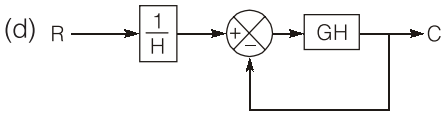

(b)



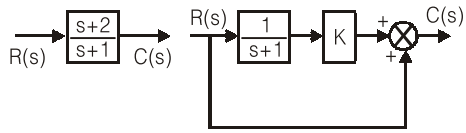

(c)




(d)




**Q.11** For what value of K, are the two block diagrams as shown below equivalent?




(a) 1 (b) 2

(c) (s + 1) (d) (s + 2)

**Q.12** Match **List-I** with **List-II** and select the correct answer using the code given below the lists:

| List-I | List-II |
|---|---|
| A. Mass | 1. Capacitor |
| B. Damper | 2. Voltage |
| C. Spring | 3. Resistor |
| D. Force | 4. Inductor |

## Explanations | Control Systems

**1. (c)**

Forward path = adfl, aefl, ahl

Non touching loop pairs = (fg and b) one pair only.

**2. (c)**

Applying nodal analysis

$$V_1 - V_0 = V_0 + \frac{V_0}{s}$$

$$V_1 = 2V_0 + \frac{V_0}{s}$$

$$V_1 = V_0\left(\frac{2s+1}{s}\right)$$

$$\therefore \quad \boxed{\frac{V_0}{V_1} = \frac{s}{2s+1}}$$

**3. (b)**

Pneumatic Flapper valve converts small changes in the position of the flapper into large changes in the back pressure.

**4. (d)**

Block diagram 'B' can be obtained from 'A' and 'C' can be obtained from 'B'

**5. (a)**

$$T(s) = (G_1 + G_3)\frac{G_2}{1+G_2H_1} = \frac{G_1G_2 + G_2G_3}{1+G_2H_1}$$

**6. (a)**

Solving positive feedback

$$T.F. = \frac{G}{1-GF}$$

Now solving negative feedback path

$$T.F_1 = \frac{\frac{G}{1-GF}}{1+\frac{GH}{1-GF}}$$

$$\boxed{T.F_1 = \frac{G}{1-GF+GH}}$$

**7. (b)**

Only one loop & two path so using Mason's gain formulae.

$$\frac{C(s)}{R(s)} = \frac{1+s^{-1}a}{1-\left(-bs^{-1}\right)} = \frac{1+\frac{a}{s}}{1+\frac{b}{s}} = \frac{s+a}{s+b}$$

**8. (b)**

$$T.F. = \frac{V_0}{V_i} = \frac{R}{R+\frac{1}{Cs}} = \frac{RCs}{1+RCs}$$

**9. (b)**

$$E = RG - C$$

Which is satisfied by (b) option.

**10. (d)**

$$C = R\left(\frac{G}{1+GH}\right)$$

Which is satisfied by (d) option

$$C = \frac{R}{H} \times \left[\frac{GH}{1+GH}\right] = R\left[\frac{G}{1+GH}\right]$$

**11. (a)**

$$\frac{C(s)}{R(s)} = \frac{k}{s+1} + 1 = \frac{k+s+1}{s+1}$$

Comparing with $\frac{C(s)}{R(s)} = \frac{s+2}{s+1}$

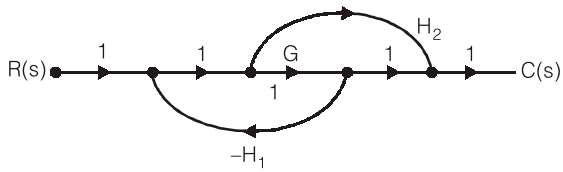
$$\therefore \quad k = 1$$

**12. (d)**

| | Voltage analogy | Current analogy |
|---|---|---|
| Force | Voltage | Current |
| Mass | Inductor | Capacitor |
| Spring | 1/C | 1/L |
| Damper | R | 1/R |

Hence, option (d) is correct.

**13. (b)**




$$\frac{C(s)}{R(s)} = \frac{P_1\Delta_1 + P_2\Delta_2}{\Delta}$$

$$= \frac{G + H_2}{1-(-GH_1)}$$

Hence, option (b) is correct.

# 3 Analog & Digital Electronics

**Q.1** **Assertion (A):** The intrinsic carrier concentration of Si at room temperature is more than that of GaAs.

**Reason (R):** Si is an indirect bandgap semiconductor while GaAs is a direct bandgap semiconductor.

(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

**Q.2** Match **List-I** (Parameter) with **List-II** (Variation) and select the correct answer using the code given below the lists:

**List-I**
**A.** Electron mobility around room temperature
**B.** Energy gap
**C.** Intrinsic carrier concentration
**D.** Mole density (gm/mole)

**List-II**
**1.** Increases with temperature
**2.** Decreases with temperature
**3.** Remains constant as temperature is varied

**Codes:**

| | A | B | C | D |
|---|---|---|---|---|
| (a) | 2 | 1 | 1 | 1 |
| (b) | 1 | 2 | 1 | 3 |
| (c) | 2 | 2 | 1 | 3 |
| (d) | 2 | 2 | 1 | 1 |

**Q.3** For an n-type semiconductor having any doping level, which of the following hold(s) good:

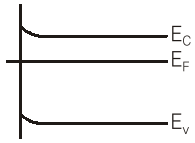
1. $p_n N_D = n_i^2$
2. $p_p N_D = n_i^2$
3. $n_n N_D = n_i^2$
4. $p_n n_n = n_i^2$

Select the correct answer using the code given below:

(a) 1 and 4 (b) 2 and 4
(c) 3 and 4 (d) Only 4

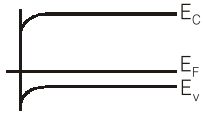
**Q.4** Match **List-I** (Metal-semiconductor band diagram under equilibrium) with **List-II** (Type of contact) and select the correct answer using the code given below the lists:

**List-I**

**A.**



**B.**



**C.**



**D.**



**List-II**
**1.** Rectifier to n-type
**2.** Ohmic to n-type
**3.** Rectifier to p-type
**4.** Ohmic to p-type

**Codes:**

| | A | B | C | D |
|---|---|---|---|---|
| (a) | 1 | 4 | 2 | 3 |
| (b) | 1 | 4 | 3 | 2 |
| (c) | 4 | 1 | 3 | 2 |
| (d) | 4 | 1 | 2 | 3 |

**Q.5** Match **List-I** (Semiconductor Property) with **List-II** (Corresponding Unit) and select the correct answer using the code given below the lists:

| **List-I** | **List-II** |
|---|---|
| **A.** Carrier mobility | **1.** eV(electron volt) |
| **B.** Diffusion length | **2.** $m^2$/V-sec |
| **C.** Diffusion-coefficient | **3.** m |
| **D.** Energy gap | **4.** $m^2$/s |

**Codes:**

| | A | B | C | D |
|---|---|---|---|---|
| (a) | 4 | 2 | 3 | 1 |
| (b) | 2 | 3 | 4 | 1 |
| (c) | 2 | 3 | 1 | 4 |
| (d) | 4 | 2 | 1 | 3 |

## Answer Key | Analog & Digital Electronics

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | (b) | 38. | (d) | 75. | (c) | 112. | (b) | 149. | (d) | 186. | (b) | 223. | (d) |
| 2. | (c) | 39. | (a) | 76. | (a) | 113. | (b) | 150. | (c) | 187. | (a) | 224. | (d) |
| 3. | (a) | 40. | (c) | 77. | (b) | 114. | (a) | 151. | (d) | 188. | (a) | 225. | (b) |
| 4. | (a) | 41. | (c) | 78. | (c) | 115. | (a) | 152. | (a) | 189. | (c) | 226. | (c) |
| 5. | (b) | 42. | (d) | 79. | (a) | 116. | (c) | 153. | (b) | 190. | (c) | 227. | (a) |
| 6. | (b) | 43. | (b) | 80. | (b) | 117. | (c) | 154. | (d) | 191 | (b) | 228. | (a) |
| 7. | (b) | 44. | (a) | 81. | (c) | 118. | (a) | 155. | (a) | 192. | (b) | 229. | (b) |
| 8. | (b) | 45. | (b) | 82. | (b) | 119. | (c) | 156. | (d) | 193. | (a) | 230. | (d) |
| 9. | (d) | 46. | (c) | 83. | (d) | 120. | (c) | 157. | (c) | 194. | (d) | 231. | (d) |
| 10. | (b) | 47. | (a) | 84. | (c) | 121. | (b) | 158. | (d) | 195. | (d) | 232. | (a) |
| 11. | (c) | 48. | (b) | 85. | (b) | 122. | (c) | 159. | (b) | 196. | (b) | 233. | (c) |
| 12. | (d) | 49. | (c) | 86. | (b) | 123. | (a) | 160. | (d) | 197. | (d) | 234. | (c) |
| 13. | (c) | 50 | (c) | 87. | (b) | 124. | (d) | 161. | (d) | 198. | (b) | 235. | (a) |
| 14. | (b) | 51 | (b) | 88. | (a) | 125. | (d) | 162. | (d) | 199. | (d) | 236. | (a) |
| 15. | (b) | 52. | (b) | 89. | (b) | 126. | (a) | 163. | (c) | 200. | (b) | 237. | (c) |
| 16. | (d) | 53. | (a) | 90. | (a) | 127. | (a) | 164. | (a) | 201. | (a) | 238. | (d) |
| 17. | (a) | 54. | (d) | 91. | (b) | 128. | (a) | 165. | (a) | 202. | (b) | 239. | (a) |
| 18. | (a) | 55. | (d) | 92. | (b) | 129. | (a) | 166. | (d) | 203. | (c) | 240. | (a) |
| 19. | (d) | 56. | (b) | 93. | (d) | 130. | (c) | 167. | (d) | 204. | (c) | 241. | (d) |
| 20. | (c) | 57. | (a) | 94. | (b) | 131. | (d) | 168. | (c) | 205. | (c) | 242. | (c) |
| 21. | (c) | 58. | (c) | 95. | (d) | 132. | (c) | 169. | (a) | 206. | (c) | 243. | (d) |
| 22. | (d) | 59. | (d) | 96. | (c) | 133. | (a) | 170. | (a) | 207. | (d) | 244. | (c) |
| 23. | (c) | 60. | (c) | 97. | (a) | 134. | (c) | 171. | (d) | 208. | (a) | 245. | (a) |
| 24. | (d) | 61. | (b) | 98. | (b) | 135. | (b) | 172. | (c) | 209. | (d) | 246. | (b) |
| 25. | (a) | 62. | (c) | 99. | (b) | 136. | (d) | 173. | (c) | 210. | (d) | 247. | (c) |
| 26. | (d) | 63. | (c) | 100. | (d) | 137. | (c) | 174. | (b) | 211. | (b) | 248. | (a) |
| 27. | (c) | 64. | (b) | 101. | (b) | 138. | (c) | 175. | (b, d) | 212. | (a) | 249. | (b) |
| 28. | (c) | 65. | (b) | 102. | (d) | 139. | (a) | 176. | (b) | 213. | (b) | 250. | (a) |
| 29. | (b) | 66. | (a) | 103 | (c) | 140. | (a) | 177. | (a) | 214. | (c) | 251. | (c) |
| 30. | (c) | 67. | (c) | 104. | (b) | 141. | (c) | 178. | (d) | 215. | (c) | 252. | (d) |
| 31. | (d) | 68. | (b) | 105. | (b) | 142. | (b) | 179. | (c) | 216. | (c) | 253. | (c) |
| 32. | (d) | 69. | (b) | 106. | (c) | 143. | (c) | 180. | (d) | 217. | (a) | 254. | (c) |
| 33. | (a) | 70. | (b) | 107. | (a) | 144. | (d) | 181. | (a) | 218. | (b) | 255. | (c) |
| 34. | (a) | 71. | (b) | 108. | (c) | 145. | (c) | 182. | (a) | 219. | (d) | 256. | (b) |
| 35. | (b) | 72. | (b) | 109. | (d) | 146. | (a) | 183. | (d) | 220. | (d) | 257. | (d) |
| 36. | (c) | 73. | (b) | 110. | (c) | 147. | (d) | 184. | (d) | 221. | (b) | | |
| 37. | (b) | 74. | (a) | 111. | (b) | 148. | (b) | 185. | (b) | 222. | (c) | | |

## Explanations | Analog & Digital Electronics

1. (b)
Both the statements are true but R is not the correct explanation of A because there is no relation in intrinsic concentration with direct band gap or indirect band gap.

2. (c)
Mobility $\mu \propto T^{-m}$, m is a constant depending on crystal and type of doping.
So decreases with temperature.
Energy gap
$$E_g = E_{go} - \beta(T - T_0)$$
$\beta$ – is a constant.
T is temperature at which $E_g$ is to be found
$E_{go}$ – energy gap at 0 K
$T_0 \rightarrow 0$ K
$E_g$ decreases with rise in temperature
Intrinsic carrier concentration $\propto T^{3/2}$
increases with temperature.

3. (a)
$n_n = N_D$ so $p_n.n_n = n_i^2$
$\Rightarrow p_n.N_D = n_i^2$

4. (a)
In case of rectifier gap between $E_c$ to $E_v$ will be large in case of Ohmic contact gap between $E_c$ to $E_v$ will be small and in n-type case $E_f$ will be close to $E_c$ and in p-type $E_F$ will be close to $E_v$.

5. (b)
Diffusion length – meter
Energy gap – eV

6. (b)
Both statements are correct but reason for A is that in a direct bandgap material during recombination energy is emitted in the form of light (99%).

7. (b)
For an n-type semi conductor
$$p_n = \frac{n_i^2}{N_D}$$
Where, $p_n$ is the concentration of holes.
$N_D$ is the concentration of donor atoms.
and $n_i$ is the intrinsic concentration.

8. (b)
Current, $i = neA V_d$

9. (d)
A is wrong because avalanche breakdown takes place due to a large no. of breaking of covalent bonds across the junction due to impact ionization due to highly energetic $e^{-s}$ collide with negative ions and excite $e^-$ from negative ion.

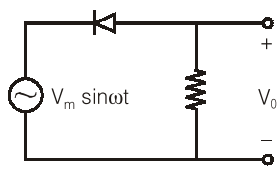
10. (b)
In case of F.B. photo diode it is insensitive to incident light and behave as a normal diode so diode current remains same irrespective of intensity of incident light.

11. (c)
Bridge rectifier requires comparatively small transformers as required for centre tap full wave rectifier and this is due to no requirement of centre tapping at all.
Also PIV for diodes in bridge rectifier is $V_m$ while in centre tap full wave rectifier it is $2V_m$, so less peak inverse voltage.

12. (d)
Photodiodes are used under reverse-bias condition not forward-bias condition.

13. (c)
For step-graded junction $C_T \propto V^{-1/2}$ and for linearly graded junction $C_T \propto V^{-1/3}$

14. (b)
$$C_D = \frac{\tau}{r_d} = \frac{\tau I}{\eta V_T}$$ ; as p-side is heavily doped ($p^+$) than the n-side, so that the current at the junction is entirely due to holes.

15. (b)


For positive half cycle of input diode D will be off and output will be zero. and for negative half of input diode D will be on and we will get the output equal to input as

# 4 Measurements and Instrumentation

**Q.1** An analog voltage signal whose highest significant frequency is 1 kHz is to be coded with a resolution of 0.01 percent for a voltage range of 0–10 V. The minimum sampling frequency and the minimum number of bits should respectively be

(a) 1 kHz and 12 (b) 1 kHz and 14
(c) 2 kHz and 12 (d) 2 kHz and 14

**Q.2** Consider the following statements about the D'Arsonval Movement :

1. It is best suited for d.c. current measurement
2. It responds to the average value of current
3. It measures the r.m.s. value of a.c. currents
4. It could be used for power measurements

Which of these statements is/are correct?

(a) Only 1 (b) 1 and 2
(c) 2 and 3 (d) 1, 2 3 and 4

**Q.3** Two meters X and Y require 40 mA and 50 mA, respectively, to give full-scale deflection, then

(a) sensitivity can not be judged with given information
(b) both are equally sensitive
(c) X is more sensitive
(d) Y is more sensitive

**Q.4** What is the correct sequence of the following types of ammeters and voltmeters with increasing accuracy?

1. Moving iron
2. Moving-coil permanent magnet
3. Induction

Select the correct answer using the codes given below :

(a) 1, 3, 2 (b) 1, 2, 3
(c) 3, 1, 2 (d) 2, 1, 3

**Q.5** Consider the following statements associated with moving iron instruments :

1. These can be used in d.c. as well a.c. circuits
2. The scale is non-uniform
3. The moving iron is placed in a field of a permanent magnet.

Which of these statements are correct?

(a) 1, 2 and 3 (b) 1 and 2
(c) 2 and 3 (d) 1 and 3

**Q.6** A 12 bit A/D converter has a range 0–10 V. What is the approximate resolution of the converter?

(a) 1 mV (b) 2.5 mV
(c) 2.5 $\mu$V (d) 12 mV

**Q.7** What should be the main characteristic(s) of the null detector in a bridge measurement?

1. Accuracy 2. Precision
3. Sensitivity 4. Resolution

Select the correct answer using the code given below

(a) Only 1 and 2 (b) Only 2 and 3
(c) Only 3 and 4 (d) Only 3

**Q.8** When reading is taken at half scale in the instrument, the error is

(a) exactly equal to half of full-scale error
(b) equal to full-scale error
(c) less than full-scale error
(d) more than full-scale error

**Q.9** Which of the following factors limit the deflection of the pointer of a PMMC instrument to about 90°?

1. Its damping mechanism
2. Linearity of the magnetic field in which the coil moves
3. Control spring arrangement
4. Shape of the pole shoe of the horseshoe magnet

Select the correct answer using the code given below:

(a) Only 1 and 3 (b) Only 2 and 4
(c) Only 2 and 3 (d) Only 1 and 4

2. Environmental errors.
3. Observational errors.

Hence, option (c) is correct.

**18. (a)**

Significant figures convey actual information regarding the magnitude and the measurement precision of a quantity.

**19. (d)**

Air friction and fluid friction provide damping torque.

**20. (a)**

Null type instruments require many manipulations before null conditions are obtained and hence are apparently not suitable for dynamic measurements wherein the measured quantity changes with time. On the other hand, deflection type of instruments can follow the variations of the measured quantity more rapidly and hence are more suitable for dynamic measurements on account of their faster response.

Hence, option (a) is correct.

**21. (c)**

Air friction does not require the use of permanent magnet whose introduction may lead to distortion of operating field. This damping is used whose operating field is weak.

**eg.:** Moving iron, dynamometer, hot wire.

In fluid friction, oil which is required for damping can be used for insulation purpose. So it is suitable for high voltage instruments or electrostatic type.

**22. (d)**

PMMC ammeter is suitable for only dc applications and gives average value of current.

**23. (a)**

While selecting instruments, particular case should be taken as regards the range. The values to be measured should not lie in the lower third of the range. This is particularly important if the meter accuracy is specified in terms of the full scale deflection.

Hence, option (a) is correct.

**24. (d)**

PMMC instruments are used only for measuring DC quantity.

**25. (b)**

In PMMC the damping torque is produced by movement of the aluminium former, moving in the magnetic field of the permanent magnet.

**26. (b)**

The PMMC instruments have high torque to weight ratio of moving parts.

**27. (b)**

Three types of forces are needed for the satisfactory operation of any indicating instrument. These are

1. Deflecting force
2. Controlling force
3. Damping force

**28. (d)**

Thermistors are highly sensitive, non linear elements i.e.

$$R_{T_1} = R_{T_2} e^{\beta\left(\frac{1}{T_1}-\frac{1}{T_2}\right)}$$

**29. (c)**

At very high frequency, thermocouple type instruments are used.

**30. (a)**

$$\frac{E_L}{E_0} = \frac{49.5}{50} = \frac{1}{1+\frac{100K\Omega}{Z_L}} \Rightarrow Z_L \approx 10\,M\Omega$$

**31. (c)**

For full-wave rectifier type of instruments $V_{avg}$ = 0.9 V where $V = V_m / \sqrt{2}$.

**32. (a)**

Bigger size mirror results in increased inertia constant J.

$$f_n = \frac{1}{2\pi}\sqrt{\frac{K}{J}} \quad \& \quad A = \frac{GI_m}{\sqrt{(D\omega)^2 + (K - J\omega^2)^2}}$$

as J increases both $f_n$ & A decrease.