GATE SOLUTIONS

ELECTRONICS & COMMUNICATION ENGINEERING

IES MASTER PUBLICATION

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PREFACE

The Graduate Aptitude Test in Engineering (GATE) is an All-India examination administered and conducted in eight zones across the country by the GATE Committee comprising of Faculty members from IISc, Bangalore and other seven IITs on behalf of the National Coordinating Board, Department of Education, Ministry of Human Resources Development.

The GATE score/rank is used for admissions to Post Graduate Programmes (ME, M.Tech, MS, direct PhD) in institutes like IIT and IISc, etc. with financial assistance offered by the Ministry of Human Resource Development. PSUs too use the GATE scores for recruiting candidates for various prestigious jobs with attractive remuneration.

The door to GATE exam is through previous year question papers. If you are able to solve question papers in access of 10 years, you are sure to clear the GATE exam, and open new vistas of career and learning.

The **Electronics & Communication Engineering GATE 2021** book from IES Master offers detailed topic-wise solutions for the past 34 years question papers. The emphasis is clearly on the understanding of concepts and building upon a holistic picture. So as you finish a topic, for instance, Basics of Network Analysis, you will find all the previous years' question papers with detailed explanation under that particular topic.

The approach has been to provide explanation in such a way that just by going through the solutions, students will be able to understand the basic concepts and will apply these concepts in solving other questions that might be asked in future exams.

Every care has been taken to bring an error-free book. However, comments, suggestions, and feedback for improvement in the future editions are most welcome.

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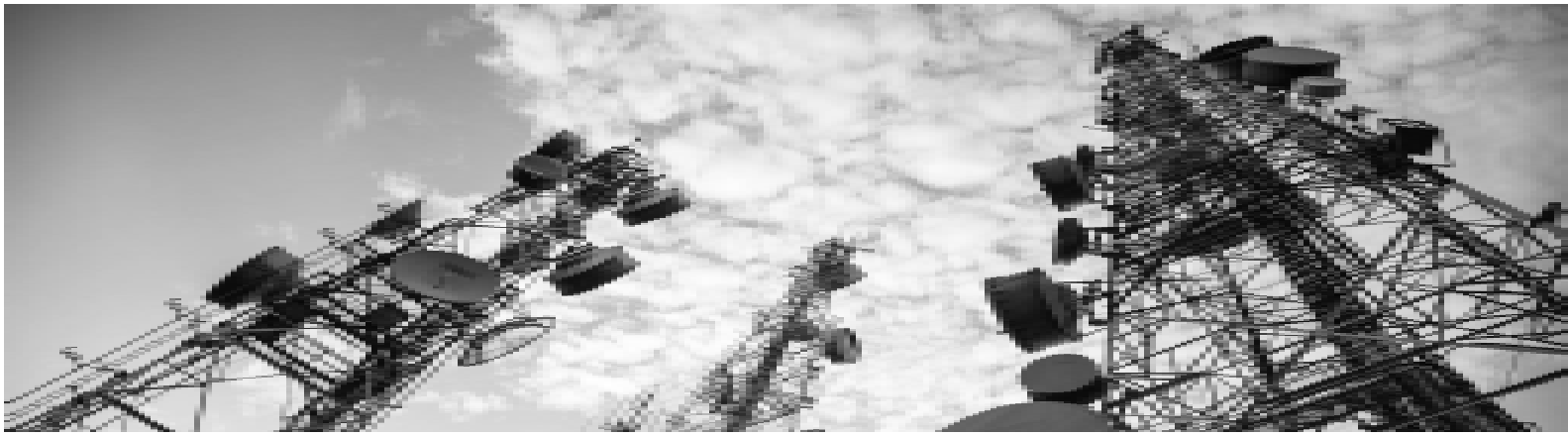
New Delhi

CONTENT



UNIT-1 NETWORK THEORY

SYLLABUS

Network solution methods : nodal and mesh analysis; Network theorem; superposition, Thevenin and Norton's, maximum power transfer; Wye-Delta transformation; Steady state sinusoidal analysis using phasors; Time domain analysis of simple linear circuits; solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2-port network parameters: driving point and transfer functions; State equations for network

CONTENTS

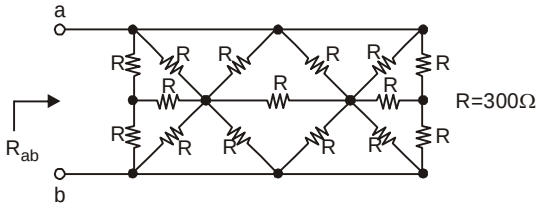
1 BASICS OF NETWORK ANALYSIS

1– Mark

1. A connection is made consisting of resistance A in series with a parallel combination of resistances B and C. Three resistors of the value 10Ω, 5Ω, 2Ω are provided. Consider all possible permutations of the given resistors into the positions A, B, C, and identify the configurations with maximum possible overall resistance, and also the ones with minimum possible overall resistance. The ratio of maximum to minimum value of the resistances (upto second decimal place) is _____

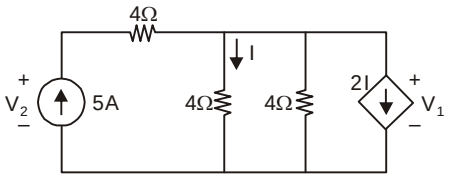
[GATE-2017]

2. In the network shown in the figure, all resistors are identical with $R = 300\Omega$. The resistance R_{ab} (in Ω) of the network is _____.



[GATE-2015]

3. In the given circuit, the values of V_1 and V_2 respectively are

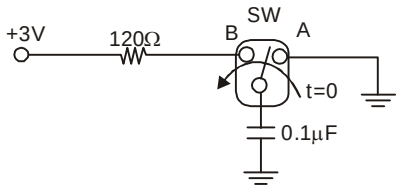


(a) 5V, 25V (b) 10V, 30V

(c) 15V, 35V (d) 0V, 20V

[GATE-2015]

4. In the circuit shown, the switch SW is thrown from position A to position B at time t = 0. The energy (in μJ) taken from the 3V source to charge the 0.1 μF capacitor from 0V to 3V is

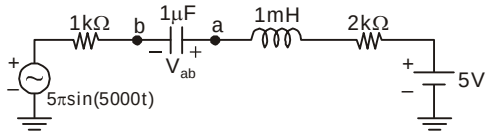


(a) 0.3 (b) 0.45

(c) 0.9 (d) 3

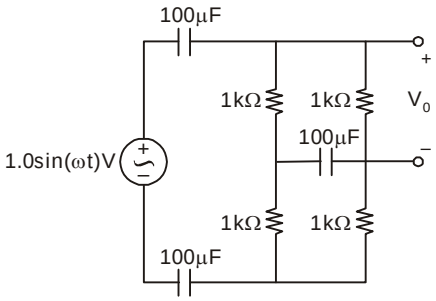
[GATE-2015]

5. In the circuit shown, the average value of the voltage V_{ab} (in Volts) in steady state condition is _____



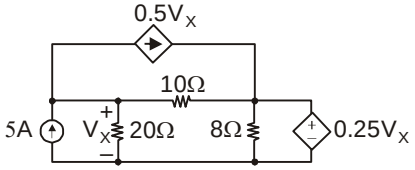
[GATE-2015]

6. At very high frequencies, the peak output voltage V_0(in Volts) is _____



[GATE-2015]

7. In the circuit shown, the voltage V_x (in Volts) is _____



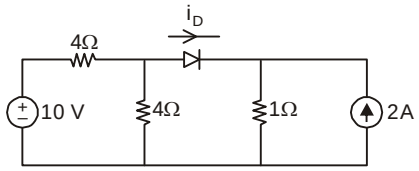
[GATE-2015]

(a) –105 V (b) +105 V
(c) – 15 V (d) + 15 V

[GATE-1993]

3– Marks

1. In the circuit shown, the current i_D through the ideal diode (zero cut in voltage and zero forward resistance) equals

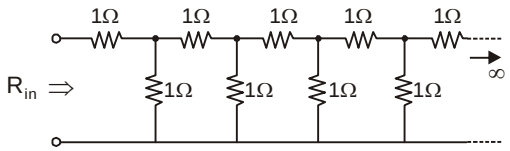


(a) 0 A (b) 4 A
(c) 1 A (d) None of the above

[GATE-1997]

5– Marks

1. Find the input resistance R_{in} of the infinite section resistive network shown in figure.



[GATE-1996]

ANSWER KEY

1 Mark

1. (2.14)
2. (100)
3. (a)
4. (c)
5. (5)
6. (0.5)
7. (8)
8. (2.8)
9. (a)
10. (0.5)
11. (c)
12. (b)
13. (b)
14. (a)
15. (c)
16. (a)
17. (d)
18. (a)
19. (c)
20. (a)
21. (d)
22. (a)
23. (b)
24. (c)
25. (b)
26. (a)
27. (d)
28. (a)
29. (d)
30. (a & d)

2 Marks

1. (8.00)
2. (a)
3. (1)
4. (d)
5. (5)
6. (–1A)
7. (1.5)
8. (20)
9. (29.09)
10. (2.504)
11. (10)
12. (0.4083)
13. (2.618)
14. (c)
15. (d)
16. (c)
17. (a)
18. (a)
19. (c)
20. (b)
21. (a)
22. (None of these)
23. (d)
24. (d)
25. (d)
26. (d)
27. (b)
28. (b)
29. (d)
30. (a)

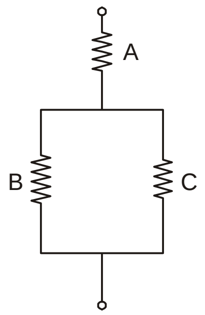
3 Marks

1. (c)

EXPLANATIONS

1– Mark

Sol–1: (2.14)



Resistor are 2, 5 and 10Ω

For maximum resistance B = 2, C = 5, A = 10

$$R_{max} = \frac{80}{7}$$

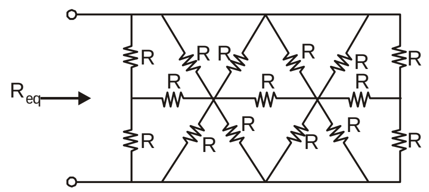
for minimum resistance,

A = 2, B = 5, C = 10

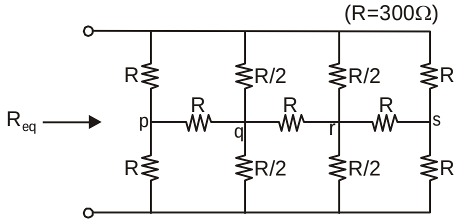
$$R_{min} = \frac{16}{3}$$

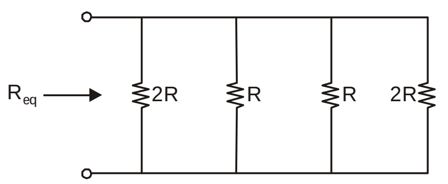
$$\frac{R_{max}}{R_{min}} = \frac{(80/7)}{(16/3)} = 2.14$$

Sol–2: (100)



(R=300Ω)



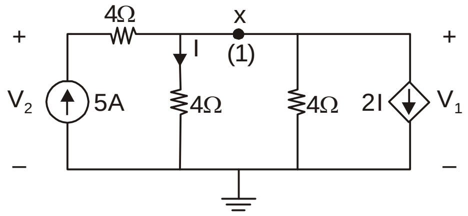


[Here, branch 'pqrs' is removed as no current flows through it, because it forms a balanced bridge]

$$\therefore \quad R_{eq} = (2R) \parallel (2R) \parallel R \parallel R$$

$$= R \parallel R \parallel R = \frac{R}{3} = 100\Omega$$

Sol–3: (a)



Applying nodal analysis at node (1), we get

$$5 = \frac{x}{4} + \frac{x}{4} + 2I$$

$$\Rightarrow \quad 5 = \frac{2x}{4} + 2 \times \frac{x}{4} \qquad [\because x = 4I]$$

$$\therefore \quad x = 5$$

$$\text{Now}, V_1 = 5V \qquad [\because x = V_1]$$

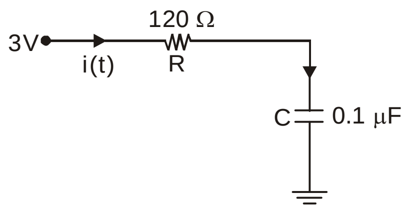
$$V_1 + 5 \times 4 - V_2 = 0$$

[KVL in the outermost loop]

$$\Rightarrow \quad V_2 = 5 + 5 \times 4 = 25 \text{ V}$$

Sol–4: (c)

Initially capacitor is uncharged. For $t > 0$, the circuit will be :



Current in RC circuit while charging is given by :

$$i(t) = \frac{V_0}{R} e^{-t/RC} \quad \text{where } V_0 = 3V$$

Power delivered by the source = P

$$= 3i(t) \qquad [\because P = V.I]$$

$$\text{Also, Energy} = \int_0^t P\,dt = \int_0^t 3i(t)\,dt$$

Capacitor gets fully charged at steady state i.e $t = \infty$.

$$\therefore \quad E = \int_0^\infty 3.\frac{V_0}{R} e^{-t/RC}\,dt$$

$$= \frac{3V_0}{R} \times \frac{(-1)}{(1/RC)} \left[e^{-t/RC}\right]_0^\infty$$