

GATE EE · Set 2: Questions

20 questions · 30 marks · 45 minutes

Question types	MCQ: one correct option. MSQ: one or more correct options. NAT: numerical answer.
Marking	MCQ wrong answer: -1/3 (1-mark) or -2/3 (2-mark). No negative marks for MSQ or NAT.
Time	45 minutes. The answer key and worked solutions start on a new page.

General Aptitude

- Q1.** [MCQ, 1 mark] Choose the correct preposition: "She is senior _____ me by two years."
(A) than
(B) to
(C) from
(D) over

- Q2.** [NAT, 2 marks] A shopkeeper marks an article 40% above its cost price and then allows a discount of 10% on the marked price. His profit percentage is _____.

Engineering Mathematics

- Q3.** [MCQ, 1 mark] The rank of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 6 \\ 1 & 1 & 1 \end{bmatrix}$ is
(A) 1
(B) 2
(C) 3
(D) 0

- Q4.** [NAT, 2 marks] If $dy/dx + 2y = 0$ with $y(0) = 3$, the value of $y(1)$ is _____ (rounded to two decimal places).

Electric Circuits

- Q5.** [NAT, 2 marks] A 20 V DC source is switched at $t = 0$ onto a series circuit of $R = 10 \Omega$ and $L = 0.5 \text{ H}$ with zero initial current. The current at $t = 50 \text{ ms}$ is _____ A (rounded to two decimal places).

- Q6.** [MCQ, 1 mark] Three equal resistors of 30Ω connected in delta are converted to an equivalent star. Each star resistance is
(A) 10Ω
(B) 90Ω
(C) 30Ω
(D) 15Ω

Electromagnetic Fields

- Q7.** [NAT, 1 mark] The magnitude of the electric field at a distance of 1 m from a point charge of 1 nC in free space is _____ V/m (take $1/(4\pi\epsilon_0) = 8.99 \times 10^9$).

- Q8.** [MCQ, 1 mark] Two long parallel conductors carry currents in the same direction. The force between them is
- (A) attractive
 - (B) repulsive
 - (C) zero
 - (D) dependent only on distance, not on current

Signals and Systems

- Q9.** [MCQ, 2 marks] The system $y(t) = x(2t)$ is
- (A) linear and time-invariant
 - (B) linear and time-variant
 - (C) nonlinear and time-invariant
 - (D) nonlinear and time-variant
- Q10.** [NAT, 1 mark] The fundamental period of $x[n] = \cos(\pi n/4) + \sin(\pi n/6)$ is _____ samples.

Electrical Machines

- Q11.** [NAT, 1 mark] A 6-pole alternator runs at 1000 rpm. The frequency of the generated EMF is _____ Hz.
- Q12.** [NAT, 2 marks] A 220 V DC shunt motor has armature resistance 0.5Ω and runs at 1000 rpm drawing an armature current of 40 A. If the load increases so that the armature current becomes 60 A, with flux constant, the new speed is _____ rpm.

Power Systems

- Q13.** [NAT, 1 mark] A 400 kV transmission line has a surge impedance of 400Ω . Its surge impedance loading is _____ MW.
- Q14.** [MCQ, 2 marks] A generator with internal EMF 1.2 pu is connected to an infinite bus of 1.0 pu through a total reactance of 0.6 pu . When delivering 1.0 pu power, the load angle is
- (A) 30°
 - (B) 45°
 - (C) 60°
 - (D) 19.5°

Control Systems

- Q15.** [NAT, 2 marks] A unity-feedback system has $G(s) = 20 / [s(s + 5)]$. The steady-state error for a unit ramp input is _____.
- Q16.** [MCQ, 1 mark] For an open-loop transfer function with 3 poles and no finite zeros, the angles of the root-locus asymptotes are
- (A) $60^\circ, 180^\circ, 300^\circ$
 - (B) $0^\circ, 120^\circ, 240^\circ$
 - (C) $45^\circ, 135^\circ, 225^\circ$
 - (D) $90^\circ, 270^\circ$

Electrical & Electronic Measurements

Q17. [NAT, 2 marks] A PMMC instrument has full-scale current 1 mA and internal resistance 100 Ω . The shunt resistance needed to extend its range to 1 A is _____ Ω (rounded to three decimal places).

Analog and Digital Electronics

Q18. [MCQ, 1 mark] The minimum number of flip-flops required to build a mod-12 counter is
(A) 3
(B) 4
(C) 6
(D) 12

Q19. [NAT, 2 marks] A fixed-bias BJT circuit has $V_{CC} = 12$ V, $R_B = 565$ k Ω , $R_C = 2$ k Ω , $\beta = 100$ and $V_{BE} = 0.7$ V. The collector-emitter voltage V_{CE} is _____ V.

Power Electronics

Q20. [MSQ, 2 marks] Which of the following devices can be both turned ON and turned OFF through their gate terminal?
(A) SCR
(B) IGBT
(C) Power MOSFET
(D) Power diode

Set 2: Answer Key and Solutions

Q	Type	Marks	Answer
1	MCQ	1	(B) to
2	NAT	2	26
3	MCQ	1	(B) 2
4	NAT	2	0.41 (accept 0.40 to 0.41)
5	NAT	2	1.26 (accept 1.25 to 1.27)
6	MCQ	1	(A) 10 Ω
7	NAT	1	8.99 (accept 8.9 to 9.0)
8	MCQ	1	(A) attractive
9	MCQ	2	(B) linear and time-variant
10	NAT	1	24
11	NAT	1	50
12	NAT	2	950
13	NAT	1	400
14	MCQ	2	(A) 30°
15	NAT	2	0.25
16	MCQ	1	(A) 60°, 180°, 300°
17	NAT	2	0.100 (accept 0.099 to 0.101)
18	MCQ	1	(B) 4
19	NAT	2	8
20	MSQ	2	(B), (C)

Worked solutions

Q1. Answer: (B) to

Words such as senior, junior, superior and inferior take "to", not "than".

Q2. Answer: 26

Selling price = $1.40 \times 0.90 = 1.26 \times \text{cost price}$, so profit = 26%.

Q3. Answer: (B) 2

Row 2 = $2 \times \text{Row 1}$, so they are dependent. Row 3 is not a multiple of Row 1, so the rank is 2.

Q4. Answer: 0.41 (accept 0.40 to 0.41)

$y = 3e^{-2x}$, so $y(1) = 3e^{-2} = 0.406$.

Q5. Answer: 1.26 (accept 1.25 to 1.27)

$\tau = L/R = 0.05 \text{ s}$; final current = 2 A. $i(t) = 2(1 - e^{-t/\tau})$, so $i(0.05) = 2(1 - e^{-1}) = 1.264 \text{ A}$.

Q6. Answer: (A) 10 Ω

For a balanced network, $R_Y = R_{\Delta}/3 = 10 \Omega$.

Q7. Answer: 8.99 (accept 8.9 to 9.0)

$$E = kQ/r^2 = 8.99 \times 10^9 \times 10^{-9} / 1 = 8.99 \text{ V/m.}$$

Q8. Answer: (A) attractive

Parallel currents in the same direction attract; opposite directions repel.

Q9. Answer: (B) linear and time-variant

Scaling and superposition hold, so it is linear. A delayed input $x(t - t_0)$ gives $x(2t - t_0)$, but the delayed output is $x(2t - 2t_0)$, so it is time-variant.

Q10. Answer: 24

Periods are $2\pi/(\pi/4) = 8$ and $2\pi/(\pi/6) = 12$. $\text{LCM}(8, 12) = 24$.

Q11. Answer: 50

$$f = PN/120 = 6 \times 1000/120 = 50 \text{ Hz.}$$

Q12. Answer: 950

$$E_{b1} = 220 - 40 \times 0.5 = 200 \text{ V; } E_{b2} = 220 - 60 \times 0.5 = 190 \text{ V. } N_2 = 1000 \times 190/200 = 950 \text{ rpm.}$$

Q13. Answer: 400

$$\text{SIL} = V^2/Z_c = (400 \text{ kV})^2/400 \Omega = 400 \text{ MW.}$$

Q14. Answer: (A) 30°

$$P = (EV/X) \sin \delta \text{ gives } 1.0 = (1.2 \times 1.0/0.6) \sin \delta = 2 \sin \delta, \text{ so } \delta = 30^\circ.$$

Q15. Answer: 0.25

$$K_v = \lim_{s \rightarrow 0} sG(s) = 20/5 = 4. e_{ss} = 1/K_v = 0.25.$$

Q16. Answer: (A) 60°, 180°, 300°

$$\theta = (2k + 1)180^\circ/(P - Z) = (2k + 1) \times 60^\circ \text{ for } k = 0, 1, 2.$$

Q17. Answer: 0.100 (accept 0.099 to 0.101)

$$R_{sh} = I_m R_m / (I - I_m) = (0.001 \times 100)/0.999 = 0.1001 \Omega.$$

Q18. Answer: (B) 4

$$2^3 = 8 < 12 \leq 16 = 2^4, \text{ so 4 flip-flops are needed.}$$

Q19. Answer: 8

$$I_B = (12 - 0.7)/565k = 20 \mu\text{A}; I_C = 100 \times 20 \mu\text{A} = 2 \text{ mA. } V_{CE} = 12 - 2 \text{ mA} \times 2 \text{ k}\Omega = 8 \text{ V.}$$

Q20. Answer: (B), (C)

An SCR can be turned on by the gate but not turned off by it; a diode has no gate. IGBTs and MOSFETs are fully controllable.