

GATE EE · Set 5: 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] Fill in the blank: "Neither the teacher nor the students _____ present."
(A) was
(B) were
(C) is
(D) has been

- Q2.** [NAT, 2 marks] A can finish a job in 10 days and B in 15 days. Working together, they finish it in _____ days.

Engineering Mathematics

- Q3.** [MCQ, 1 mark] The system $x + y = 2$, $2x + 2y = 5$ has
(A) a unique solution
(B) no solution
(C) infinitely many solutions
(D) exactly two solutions

- Q4.** [NAT, 2 marks] The value of the double integral $\int_0^1 \int_0^x xy \, dy \, dx$ is _____.

Electric Circuits

- Q5.** [NAT, 1 mark] The energy stored in a 10 μF capacitor charged to 100 V is _____ J.
- Q6.** [MCQ, 2 marks] A parallel RLC circuit has $R = 100 \, \Omega$, $L = 1 \, \text{mH}$ and $C = 10 \, \mu\text{F}$. Its resonant frequency and quality factor are
(A) 1591.5 Hz, $Q = 10$
(B) 1591.5 Hz, $Q = 0.1$
(C) 10000 Hz, $Q = 10$
(D) 159.2 Hz, $Q = 10$

Electromagnetic Fields

- Q7.** [NAT, 2 marks] A conductor 0.2 m long carrying 10 A is placed in a uniform field of 0.5 T at 30° to the field. The force on it is _____ N.

Q8. [MCQ, 1 mark] At a charge-free boundary between two perfect dielectrics, which quantities are continuous?

- (A) Tangential E and normal D
- (B) Normal E and tangential D
- (C) Normal E only
- (D) Tangential D only

Signals and Systems

Q9. [NAT, 1 mark] The energy of the signal $x(t) = e^{-2t}u(t)$ is _____.

Q10. [MCQ, 2 marks] An LTI system has $H(s) = 1/(s - 1)$ with ROC $\text{Re}(s) < 1$. The system is

- (A) causal and stable
- (B) non-causal and stable
- (C) causal and unstable
- (D) non-causal and unstable

Electrical Machines

Q11. [NAT, 1 mark] The synchronous speed of an 8-pole, 60 Hz motor is _____ rpm.

Q12. [NAT, 2 marks] A 4-pole lap-wound DC generator has 500 conductors and flux 0.02 Wb per pole and runs at 1200 rpm. The generated EMF is _____ V.

Power Systems

Q13. [MCQ, 1 mark] The Ferranti effect in long transmission lines refers to

- (A) receiving-end voltage exceeding sending-end voltage at light or no load
- (B) corona loss at high voltage
- (C) skin effect at high frequency
- (D) voltage drop due to inductive load

Q14. [NAT, 2 marks] In a three-phase system, the line currents are $I_a = 10\angle 0^\circ$ A, $I_b = 0$ and $I_c = 0$. The magnitude of the zero-sequence current is _____ A (rounded to two decimal places).

Control Systems

Q15. [MCQ, 1 mark] Adding a PI controller in cascade with a type-0 plant

- (A) eliminates steady-state error for a step input
- (B) reduces the system type
- (C) eliminates error for a parabolic input
- (D) always improves transient response

Q16. [NAT, 2 marks] A system has state matrix $A = \begin{bmatrix} 0 & 1 \\ -6 & -5 \end{bmatrix}$. Its undamped natural frequency is _____ rad/s (rounded to two decimal places).

Electrical & Electronic Measurements

Q17. [MCQ, 1 mark] A Lissajous pattern on a CRO touches 3 horizontal tangent lines and 2 vertical tangent lines. If the horizontal-plate frequency is 100 Hz, the vertical-plate frequency is

- (A) 150 Hz
- (B) 66.7 Hz
- (C) 300 Hz
- (D) 200 Hz

Analog and Digital Electronics

Q18. [NAT, 1 mark] The decimal equivalent of $(1101.101)_2$ is _____.

Q19. [MSQ, 2 marks] Which of the following are effects of negative feedback in an amplifier?

- (A) Bandwidth increases
- (B) Gain becomes more stable
- (C) Gain increases
- (D) Distortion decreases

Power Electronics

Q20. [NAT, 2 marks] A single-phase full-bridge inverter operates in square-wave mode from a 220 V DC source. The rms value of the fundamental output voltage is _____ V.

Set 5: Answer Key and Solutions

Q	Type	Marks	Answer
1	MCQ	1	(B) were
2	NAT	2	6
3	MCQ	1	(B) no solution
4	NAT	2	0.125
5	NAT	1	0.05
6	MCQ	2	(A) 1591.5 Hz, $Q = 10$
7	NAT	2	0.5
8	MCQ	1	(A) Tangential E and normal D
9	NAT	1	0.25
10	MCQ	2	(B) non-causal and stable
11	NAT	1	900
12	NAT	2	200
13	MCQ	1	(A) receiving-end voltage exceeding sending-end voltage at light or no load
14	NAT	2	3.33 (accept 3.3 to 3.4)
15	MCQ	1	(A) eliminates steady-state error for a step input
16	NAT	2	2.45 (accept 2.44 to 2.46)
17	MCQ	1	(A) 150 Hz
18	NAT	1	13.625
19	MSQ	2	(A), (B), (D)
20	NAT	2	198 (accept 197 to 199)

Worked solutions

Q1. Answer: (B) were

With neither/nor, the verb agrees with the nearer subject (students, plural).

Q2. Answer: 6

Combined rate = $1/10 + 1/15 = 1/6$ per day, so 6 days.

Q3. Answer: (B) no solution

The left sides are proportional (ratio 2) but the right sides are not ($5 \neq 4$), so the equations are inconsistent.

Q4. Answer: 0.125

Inner integral = $x \times x^2/2 = x^3/2$. $\int_0^1 x^3/2 \, dx = 1/8$.

Q5. Answer: 0.05

$W = \frac{1}{2}CV^2 = 0.5 \times 10^{-5} \times 10^4 = 0.05 \text{ J}$.

Q6. Answer: (A) 1591.5 Hz, Q = 10

$$f_0 = 1/(2\pi\sqrt{LC}) = 1591.5 \text{ Hz. For parallel RLC, } Q = R\sqrt{C/L} = 100 \times 0.1 = 10.$$

Q7. Answer: 0.5

$$F = BIl \sin \theta = 0.5 \times 10 \times 0.2 \times 0.5 = 0.5 \text{ N.}$$

Q8. Answer: (A) Tangential E and normal D

$$E_{t1} = E_{t2} \text{ always; } D_{n1} - D_{n2} = \rho_s = 0.$$

Q9. Answer: 0.25

$$E = \int_0^\infty e^{-4t} dt = 1/4.$$

Q10. Answer: (B) non-causal and stable

The ROC lies to the left of the pole, so the system is anti-causal. It includes the $j\omega$ axis, so it is stable.

Q11. Answer: 900

$$N_s = 120f/P = 120 \times 60/8 = 900 \text{ rpm.}$$

Q12. Answer: 200

$$E = P\phi ZN/(60A). \text{ For lap winding } A = P = 4: E = 0.02 \times 500 \times 1200/60 = 200 \text{ V.}$$

Q13. Answer: (A) receiving-end voltage exceeding sending-end voltage at light or no load

Line charging current through series inductance raises the receiving-end voltage.

Q14. Answer: 3.33 (accept 3.3 to 3.4)

$$I_0 = (I_a + I_b + I_c)/3 = 10/3 = 3.33 \text{ A.}$$

Q15. Answer: (A) eliminates steady-state error for a step input

The integrator adds a pole at the origin, raising the system type to 1.

Q16. Answer: 2.45 (accept 2.44 to 2.46)

$$\text{Characteristic equation: } s^2 + 5s + 6 = 0, \text{ so } \omega_n = \sqrt{6} = 2.45 \text{ rad/s.}$$

Q17. Answer: (A) 150 Hz

$$f_y/f_x = (\text{horizontal tangencies})/(\text{vertical tangencies}) = 3/2, \text{ so } f_y = 150 \text{ Hz.}$$

Q18. Answer: 13.625

$$1101 = 13 \text{ and } .101 = 0.5 + 0.125 = 0.625.$$

Q19. Answer: (A), (B), (D)

Negative feedback trades gain for bandwidth, stability and lower distortion. Gain decreases.

Q20. Answer: 198 (accept 197 to 199)

$$V_{1,\text{rms}} = 4V_{\text{dc}}/(\pi\sqrt{2}) = 0.9 \times 220 = 198 \text{ V.}$$