

GATE EE · Set 4: 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 word closest in meaning to **CANDID**.

- (A) Frank
- (B) Secretive
- (C) Rude
- (D) Shy

Q2. [NAT, 2 marks] A train 150 m long running at 54 km/h crosses a platform 300 m long. The time taken is _____ seconds.

Engineering Mathematics

Q3. [MCQ, 1 mark] The divergence of $F = x^2 \mathbf{i} + y^2 \mathbf{j} + z^2 \mathbf{k}$ at the point (1, 1, 1) is

- (A) 3
- (B) 6
- (C) 0
- (D) 9

Q4. [NAT, 2 marks] A random variable X follows a Poisson distribution with mean 2. $P(X = 0)$ is _____ (rounded to three decimal places).

Electric Circuits

Q5. [MCQ, 1 mark] In a balanced star-connected three-phase system, the line voltage is 400 V. The phase voltage is

- (A) 400 V
- (B) 230.9 V
- (C) 692.8 V
- (D) 133.3 V

Q6. [NAT, 2 marks] A 10 V source in series with 5Ω feeds node X. A 2 A current source also injects current into node X, and a 5Ω resistor connects X to ground. The voltage at node X is _____ V.

Electromagnetic Fields

Q7. [NAT, 2 marks] An infinite line charge of 1 nC/m lies in free space. The electric field at a distance of 0.5 m is _____ V/m (rounded to one decimal place).

- Q8.** [MCQ, 1 mark] Lenz's law is a consequence of the law of conservation of
- (A) charge
 - (B) energy
 - (C) momentum
 - (D) mass

Signals and Systems

- Q9.** [MCQ, 1 mark] The Fourier transform of the unit impulse $\delta(t)$ is
- (A) 1
 - (B) $\delta(\omega)$
 - (C) $1/(j\omega)$
 - (D) $2\pi\delta(\omega)$

- Q10.** [NAT, 2 marks] A causal sequence has Z-transform $X(z) = z/(z - 0.5)$. The value of $x[3]$ is _____.

Electrical Machines

- Q11.** [MCQ, 1 mark] The open-circuit (no-load) test on a transformer is mainly used to determine
- (A) core loss
 - (B) full-load copper loss
 - (C) winding resistance
 - (D) leakage reactance

- Q12.** [NAT, 2 marks] An induction motor develops a starting torque of 1.8 times full-load torque with direct-on-line starting. With a star-delta starter, the starting torque as a multiple of full-load torque is _____.

Power Systems

- Q13.** [MCQ, 1 mark] For a short transmission line represented by ABCD parameters, the value of C is
- (A) 0
 - (B) 1
 - (C) Z
 - (D) Y

- Q14.** [NAT, 2 marks] In a 3-disc suspension insulator string, the voltages across the discs are 8 kV, 9 kV and 11 kV. The string efficiency is _____ % (rounded to one decimal place).

Control Systems

- Q15.** [NAT, 1 mark] A unity-feedback system has $G(s) = 10 / [(s + 1)(s + 2)]$. The steady-state error for a unit step input is _____ (rounded to three decimal places).

Q16. [MCQ, 2 marks] A lead compensator $C(s) = (1 + 0.1s)/(1 + 0.01s)$ provides a maximum phase lead of approximately

- (A) 54.9°
- (B) 45.0°
- (C) 35.1°
- (D) 64.8°

Electrical & Electronic Measurements

Q17. [NAT, 2 marks] An energy meter has a constant of 600 rev/kWh. It supplies a load of 230 V, 10 A at unity power factor for 1 hour. The number of revolutions made is _____.

Analog and Digital Electronics

Q18. [MCQ, 1 mark] An ideal op-amp integrator has $R = 10 \text{ k}\Omega$ and $C = 1 \text{ }\mu\text{F}$, with zero initial output. For a 1 V DC input, the output after 10 ms is

- (A) -1 V
- (B) +1 V
- (C) -10 V
- (D) -0.1 V

Q19. [NAT, 2 marks] A Zener regulator has $V_{in} = 20 \text{ V}$, series resistor $200 \text{ }\Omega$, $V_Z = 10 \text{ V}$ and load $500 \text{ }\Omega$. The Zener current is _____ mA.

Power Electronics

Q20. [NAT, 1 mark] A three-phase full-wave uncontrolled (diode) bridge rectifier is fed from 415 V (line, rms). The average output voltage is _____ V (rounded to one decimal place).

Set 4: Answer Key and Solutions

Q	Type	Marks	Answer
1	MCQ	1	(A) Frank
2	NAT	2	30
3	MCQ	1	(B) 6
4	NAT	2	0.135 (accept 0.13 to 0.14)
5	MCQ	1	(B) 230.9 V
6	NAT	2	10
7	NAT	2	36.0 (accept 35.5 to 36.5)
8	MCQ	1	(B) energy
9	MCQ	1	(A) 1
10	NAT	2	0.125
11	MCQ	1	(A) core loss
12	NAT	2	0.6
13	MCQ	1	(A) 0
14	NAT	2	84.8 (accept 84.5 to 85.2)
15	NAT	1	0.167 (accept 0.16 to 0.17)
16	MCQ	2	(A) 54.9°
17	NAT	2	1380
18	MCQ	1	(A) -1 V
19	NAT	2	30
20	NAT	1	560.4 (accept 559 to 562)

Worked solutions

Q1. Answer: (A) Frank

Candid means open and honest.

Q2. Answer: 30

Speed = $54 \times 5/18 = 15$ m/s. Distance = $150 + 300 = 450$ m. Time = 30 s.

Q3. Answer: (B) 6

$\nabla \cdot \mathbf{F} = 2x + 2y + 2z = 6$ at (1, 1, 1).

Q4. Answer: 0.135 (accept 0.13 to 0.14)

$P(X = 0) = e^{-\lambda} = e^{-2} = 0.135$.

Q5. Answer: (B) 230.9 V

$V_{ph} = V_L/\sqrt{3} = 400/1.732 = 230.9$ V.

Q6. Answer: 10

KCL at X: $(V - 10)/5 + V/5 = 2$, so $2V - 10 = 10$ and $V = 10$ V.

Q7. Answer: 36.0 (accept 35.5 to 36.5)

$$E = \lambda / (2\pi\epsilon_0 r) = 10^{-9} / (2\pi \times 8.854 \times 10^{-12} \times 0.5) = 35.95 \text{ V/m.}$$

Q8. Answer: (B) energy

The induced current opposes its cause; otherwise energy would be created without work.

Q9. Answer: (A) 1

$$\int \delta(t) e^{-j\omega t} dt = e^0 = 1 \text{ for all } \omega.$$

Q10. Answer: 0.125

$$x[n] = (0.5)^n u[n], \text{ so } x[3] = 0.125.$$

Q11. Answer: (A) core loss

At rated voltage with no load, copper loss is negligible, so the wattmeter reads core loss.

Q12. Answer: 0.6

Star-delta reduces phase voltage by $1/\sqrt{3}$, so torque falls to $1/3$: $1.8/3 = 0.6$.

Q13. Answer: (A) 0

Shunt admittance is neglected in a short line, so $A = D = 1$, $B = Z$ and $C = 0$.

Q14. Answer: 84.8 (accept 84.5 to 85.2)

$$\eta = V_{\text{total}} / (n \times V_{\text{max}}) = 28 / (3 \times 11) = 84.8\%.$$

Q15. Answer: 0.167 (accept 0.16 to 0.17)

$$K_p = G(0) = 5. \quad e_{ss} = 1 / (1 + K_p) = 1/6 = 0.167.$$

Q16. Answer: (A) 54.9°

$$\alpha = 0.01/0.1 = 0.1. \quad \phi_m = \sin^{-1}[(1 - \alpha)/(1 + \alpha)] = \sin^{-1}(0.818) = 54.9^\circ.$$

Q17. Answer: 1380

$$\text{Energy} = 230 \times 10 \times 1 = 2.3 \text{ kWh.} \quad \text{Revolutions} = 2.3 \times 600 = 1380.$$

Q18. Answer: (A) -1 V

$$v_o = -(1/RC) \int v_{in} dt = -(1/0.01) \times 1 \times 0.01 = -1 \text{ V.}$$

Q19. Answer: 30

$$I_s = (20 - 10)/200 = 50 \text{ mA; } I_L = 10/500 = 20 \text{ mA; } I_Z = 50 - 20 = 30 \text{ mA.}$$

Q20. Answer: 560.4 (accept 559 to 562)

$$V_o = (3\sqrt{2}/\pi)V_{LL} = 1.35 \times 415 = 560.4 \text{ V.}$$