# GATE 2021 Examination* (Memory Based)

## Electrical Engineering

**Test Date: 7th Feb 2021**

**Test Time: 09:30 am to 12:30 pm**

**Stream Name: Electrical Engineering**

## General Aptitude

**Q.1 – Q.5 Carry One Mark each.**

1. Rectangular polygon having 10 sides⇒ Interior Angle between sides of polygon in degree is
   (A) 216
   (B) 396
   (C) 144
   (D) 324
   **[Ans. *]**

2. 7 Cars P, Q, R, S, T, U and V are parked in row not necessarily in that order. The cars T and U should be parked next to each other. The cars S and V also should be parked next to each other. Whereas P and Q can't be parked next to each other. Q and S must be parked next to each other. R is parked to the immediate right of V. T is parked to the left of U. Choose incorrect option.
   (A) There are 2 cars parked in between Q and V
   (B) V is the only car parked in between S and R
   (C) P is parked at extreme end
   (D) Q and R are not parked together.
   **[Ans. *]**

3. The people _____ were at demonstration were from all sections of society.
   (A) whom
   (B) who
   (C) which
   (D) whose
   **[Ans. *]**

4. Oasis is to sand as island is to _____.
   Identify similar logical relation
   (A) Mountain
   (B) Stone
   (C) Land
   (D) Water
   **[Ans. *]**

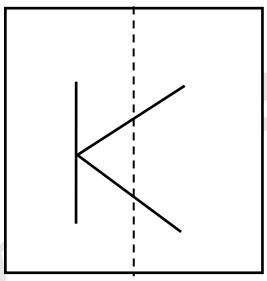
5. Students who pass the exam can't appear for the exam again. Students who fail the exam in 1st attempt must appear for the exam in the following year. Students always pass the exam in their 2nd attempt. Number of students who took the exam for the first time in year 2 and year 3 respectively are

| Year | Pass | Fail |
|---|---|---|
| Year 1 | 50 | 10 |
| Year 2 | 60 | 5 |
| Year 3 | 50 | 3 |

(A) 65 and 53
(B) 60 and 50
(C) 55 and 48
(D) 59 and 53
**[Ans. *]**

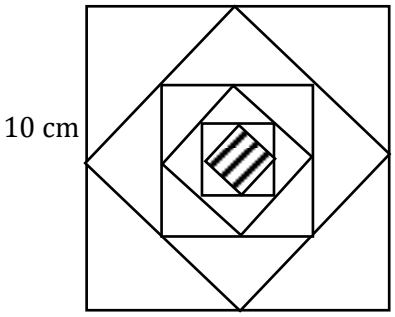
6. Which of the following numbers is exactly divisible by $(11^{13} + 1)$?
(A) $11^{33} + 1$
(B) $11^{52} + 1$
(C) $11^{26} + 1$
(D) $11^{29} + 1$
**[Ans. *]**

7. The triangle square sheet shown is folded along the dotted line. The folded sheet will look like



**[Ans. *]**

8. Area of smallest square (shaded) is




(A) 1.5625
(B) 6.25
(C) 12.50
(D) 3.125
**[Ans. *]**

9. X is a continuous random variable denoting the temperature measured. Range of Temperature is [0, 100] degree Celsius and Let the probability density function of X be $F(x) = 0.01$ for $0 \leq X \leq 100$. Mean of X is _____.
(A) 50
(B) 2.5
(C) 5
(D) 25
**[Ans. *]**

10. A

# Technical

1. Let p and q be real numbers such that $p^2 + q^2 = 1$. The given value of the matrix $\begin{bmatrix} p & q \\ q & -p \end{bmatrix}$ are
   (A) j and $-$ j
   (B) 1 and $-$ 1
   (C) pq and $-$ pq
   (D) 1 and 1
   **[Ans. *]**

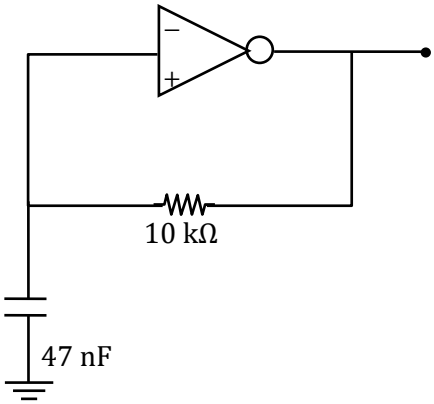
2. f(x) real valued $f^n, f'(x_0) = 0$ for some $x_0 \in (0,1), f''(x) > 0$ for all $x \in (0,1)$, Then f(x) has
   (A) exactly one local minima in (0,1)
   (B) One local maxima (0, 1)
   (C) 2 distinct local minima in (0,1)
   (D) No local minimum in (0,1)
   **[Ans. *]**

3. Suppose circles $x^2 + y^2 = 1$ and $(x-1)^2 + (y-1)^2 = r^2$ intersect each other orthogonally at the point (u, v). Then u + v =_____.
   **[Ans. *]**

4. Let $P(Z) = z^3 + (1+j)Z^2 + (2+j)Z + 3$ where Z is a complex number. Which of the following is true?
   (A) All the roots can't be real
   (B) Sum of roots of $P(Z) = 0$ is real number
   (C) The complex root of the equation $P(Z) = 0$ come in conjugate pairs
   (D) Conjugate {P(Z)} = P(Conjugate {Z} for all Z
   **[Ans. *]**

5. One sub-matrix of the Jacobian matrix J as shown below.
   $\begin{bmatrix} \Delta P \\ \Delta Q \end{bmatrix} = J \begin{bmatrix} \Delta\delta \\ \Delta\gamma \end{bmatrix}$, where $J = \begin{bmatrix} N & S \\ M & R \end{bmatrix}$
   The dimension of the sub matrix M is
   (A) $N_L \times N - 1$
   (B) $N_L \times (N - 1 + N_L)$
   (C) $(N-1) \times (N - 1 + N_L)$
   (D) $(N-1) \times (N - 1 - N_2)$
   **[Ans. *]**

**6.** A CMOS Schmitt trigger inverter has a low output level of 5V. It has ijp threshold of 1.6 V and 2.4 V. The frequency of the oscillator is _____ Hz. [Neglect input C &




**7.** A 16-bit syn-binary up counter is clocked with true. The 2 most SB are OR-ed together to form an o/p γ.M/m shows that γ is periodic and duration for which γ remains high in each period is 24m sec. The force is _____Hz.
**[Ans. *]**

**8.** In a $1-\phi$ transformer $P_i = 2500$ watts at nominal voltage of 440 volts and frequency at 50Hz the iron -Loss is 850 walts at 220 volts and 25 Hz . Then at nominal voltage and frequency , the $P_h$ $P_e$ loss respectively are :-
(A) 600 walts ,250walts
(B) 250walts;600 walts
(C) 900 walts;1600 walts
(D) 1600 wlats;900 walts
**[Ans. *]**

**9.** A charge of 1μC is at the origin of Cartesian Coordinate System. A second charge of 10μC is moved from (0, 10, 0) to (5, 5, 5) to (5, 0, 0). Calculate the total work done in moving the charge.

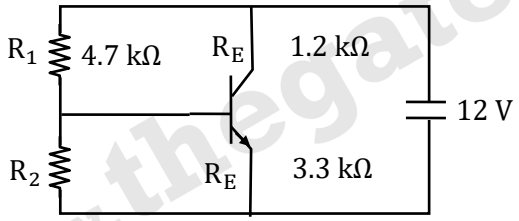
**10.** A 1μ point charge of origin. If a 2nd point charge of 10μC is moved from (0, 10, 0) to (5, 5, 5) and subsequently to (5, 0, 0) the total work done is _____mJ

**11.** One columns of point charge moving with a uniform velocity $10\,\hat{x}$ m/s enters the region $x \geq 0$ having $\vec{B} = (10y\hat{x} + 10x\hat{y} + 10\hat{z})$T. The magnitude of force on the charge at $x = 0+$ is _____ N.

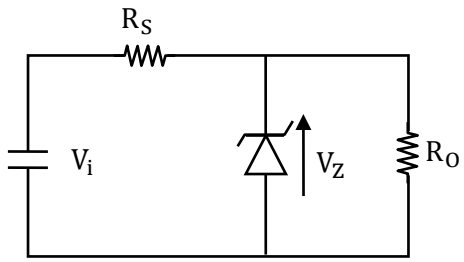
11. $h_1(n) = S(n-1) + S(n+1), h_2(n) = \delta(n) + \delta(n-1)$ connected in cascade. The impulse response of the cascade system
(A) $S(n-2) + S(n-1) + S(n) + S(n+1)$
(B) $S(n-1)S(n) + S(n+1)S(n-1)$
(C) $\delta(N)\delta(n-01) + \delta(n-2)\delta(n+1)$
(D)
**[Ans. *]**

12. $y(t) = \max Q, x(t)$, then system is
(A) Linear and time invariant
(B) Linear and time variant
(C) Non-linear and time variant
(D) Non-linear and time-variant
**[Ans. *]**

13. B pf PNP $= 100 \cdot B_{BE} = -0.7V$. The voltage across $R_C$ will be 5V when $R_2$ is _____ kΩ.



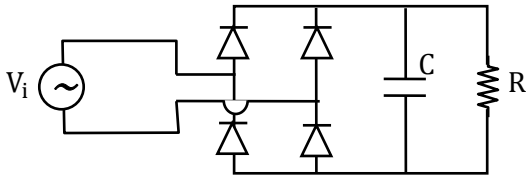

14. In CRT shown, a 5V Zener diode is used to regulate the voltage across load $R_o$. The input is an un regulated Ac volt. with a minimum value of EV and max$^m$ value of BV. The value of $R_S$ is EΩ. The Zener diode has a max$^m$ rated power dissipation of 2.5W. The num$^m$ value of $R_0$ is _____ Ω.



15. Which one of the following vector functions represents a magnetic field $\overline{B}$ ? ($\hat{x}\hat{y}$, and $\hat{z}$ are unit vectors along x-axis, y-axis and z-axis respectively)
(A) $10x\hat{x} - 30z\hat{y} + 20y\hat{z}$
(B) $10x\hat{x} + 20y\hat{y} - 30z\hat{z}$
(C) $10y\hat{x} + 20x\hat{y} - 10z\hat{z}$
(D) $10z\hat{x} + 20y\hat{y} - 30x\hat{z}$

16. Inductance is measured by.
(A) Sulfuring
(B) Kelvin
(C) Wein
(D) Maxwell

17. $V_i = 250V \pm 20\%$. The worst-case peak-inverse voltage seen across any diode is _____ V.

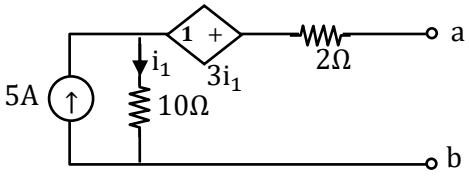



18. Consider table

| Constructional feature | M/C type | Mitigation |
|---|---|---|
| (P) Damper bars | (S) Induction motor | (X) Hunting |
| (Q) Skewed rotor slots | (T) Transformer | (Y) Magneting locking |
| (R) Compensating winding | (U) Syn m/c | (Z) Armature reaction |
| | (V) DC m/c | |

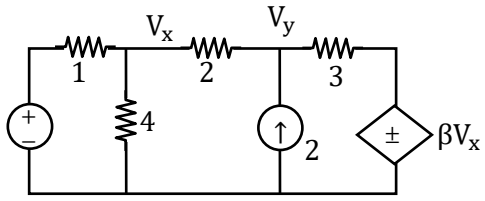
The correct combination is
(A) PUX,QVY,RTZ
(B) PVX,QUZ,RTY
(C) PTY,QVZ,RSX
(D) PUX,QSY,RVZ

19. $V_{TH}$ and $Z_{TH}$ seen $b_y$ ab is

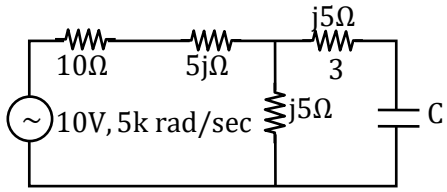



(A) 5V in series with 2Ω
(B) 10V in series with 12Ω
(C) 35V in series with 2Ω
(D) 65V in Series with 15Ω

20. For $V_y = 0V$, the β should be_____.




21. The value of C that makes current $I = 0$ is _____μF.




22. A slag generator having a source resistance of 50Ω is set to generate 1 kHz sinewave open circuit terminal voltage of 10V peak to peak. Connecting a capacitor across the terminals reduces the voltage to 8V peak to peak. The value of these capacitor is _____ μF.

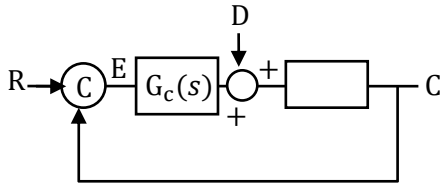
23. Let $(-1-j), (3-j), (3+j)$ and $(-1+j)$ be the vertices of rectangle C in complex plane then $\oint_C \frac{dz}{z^2(z-4)}$ is
(A) 0
(B) $j\frac{\pi}{2}$
(C) $-j\frac{\pi}{8}$
(D) $-j\frac{\pi}{10}$
**[Ans. *]**

24. Let A be $10 \times 10$, such that $A^5$ is a null matrix and Let I be $10 \times 10$. Then $|A + I|$ is _____.
**[Ans. *]**

25. In open interval (0, 1), the $p(x) = x^4 + 4x^3 + 2$ has
(A) 2 real roots
(B) 1 real roots
(C) No real roots
(D) 3 real roots
**[Ans. *]**

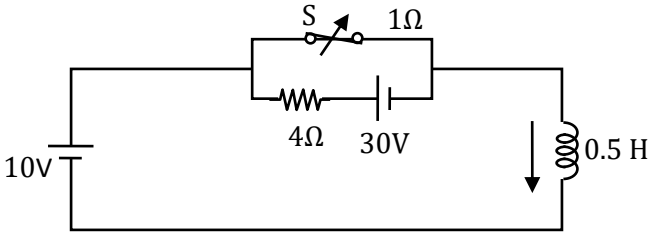
27. $G_p(s) = \frac{2.2}{(1+0.15)(1+0.45)(1+1.25)}$

$G_c(s) = \frac{K(1+T_1 s)}{(1+T_2 s)}$. It is desired the where D(s)is unit step, less $\leq 0.1$ $K_{min}$_____.

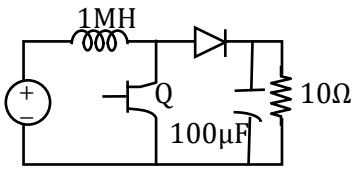



28. $8.2e^{-10t} \cdot 10 \cdot 8e^{-10t} \cdot 10(1-e^{-2t})$

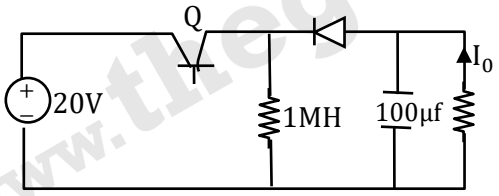
$i_L(t) = ?$



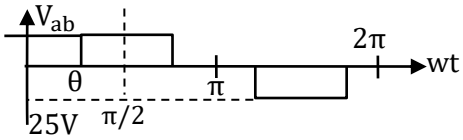

29. $f = 25KhZ$, $d = 0.6$. Under steady stock $R_{in}$ as seen by the source _____Ω




30. $f = 25kHZ, D = 0.75, I_{avg}$ is _____ A

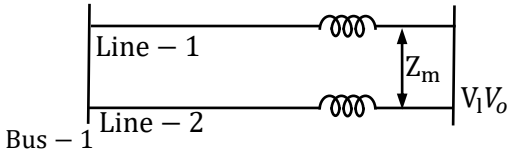



31. Symmetric square waveform across 'ab' as shown. To achieve $m_a = 0.8$, the $\theta$ in degree _____.




32. Consider large II plate C. The gap 'd' between the plates is filled with a dielectric slab of relative permittivity 5. The plates are initially charged to a V volt then disconnected from source. If dielectric is pulled out completely, then the ratio of the new electric field $E_2$ in the gap to the original electric field $B_1$ is _____.

33. in fig $X_S = 1.5$ jPu. each line be $Z_m = 10$. SPU. Given $\delta > 6$, Max$^m$ steady state real power that can be transfers from bus-1 to bus-2



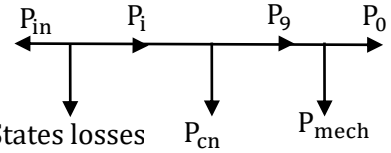

34. Let f(t) be an even function. Let the Fourier transform f(t) be defined as $F(\omega) = \int_{-\infty}^{\infty} f(t)e^{-j\omega t}\,dt$. Suppose $\frac{dF(\omega)}{d\omega} = -\omega F(\text{omega})$ for allow and $F(0) = 10$ then

(A) $F(0) >$
(B) $F(0) < 1$
(C) $F(0) = 0$
(D) $F(0) = 1$
**[Ans. *]**

35. Cascade System $Z^2(z-a)^{-2}$ is
(A) $n^2a^nx(n)$
(B) $z^{2n}x(n)$
(C) $n^{-1}a^nx(n)$
(D) $(n+1)a^nu(x)$

36. $x(t) = 0$ for $|t| > 1$, and $x(t) = 1 - |t|$ for $|t| \leq 1$. Let x(t) be defined as $x(\omega) = \int_{-\infty}^{\infty} x(t)e^{-j\omega t}dt$. The maximum magnitude of $x(\omega)$ is _____
**[Ans. *]**

37. The power input to a 500v ,50Hz ,6-pole 3 phase induction motor running at 975 RPM is 40 Pw .The total stator losses are 1 Kw .if the total friction and windage losses are 2.025 kW .Then the efficiency is _____ %



38. $W_{i1} = 2500$ W, T/F: 440V, 50 Hz
$W_{i2} = 850$ W 220, 25 Hz
$W_{i3} = 440$Vm 50 Hz

39. Belt driven D.C shunt Gen. supplying 100 kW D>C Bus bar but suddenly belt broken & stator takes 10 kW from bus bar $v_{BUS} = 200V. N_g = 300$ r. p. m. $N_m$ =?

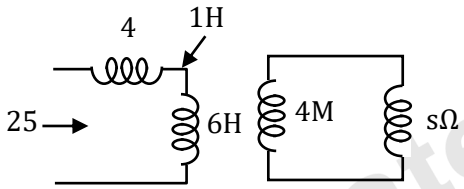
40. 3φ SRIM which has 8D, 50 Hz supply. $R_{rotor} = 0.08\ \Omega, N_{max} = 650$ rpm. Then $R_{ex}$? to get at starting.

41. Which of the following sequency is correct . Hunting magnetic locking Armature reaction

| | |
|---|---|
| Damper winding | Induction motor |
| Skewed rotor slots | Transformer |
| Compensating winding | Synchronous Motor |
| | Dc Motor |

42. An 8 pole, 50 Hz, $3-\phi$ SRIM has an $R_{eff} = 0.085\ \Omega$/ph. Its speed at maximum is 650 RPM. The addition rectifier that must be inserted to achieve maximum torque at start is _____ Ω.

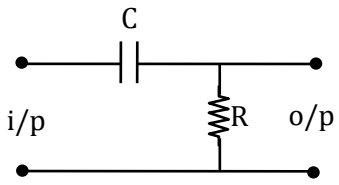
43. $Z_{in}$ =?



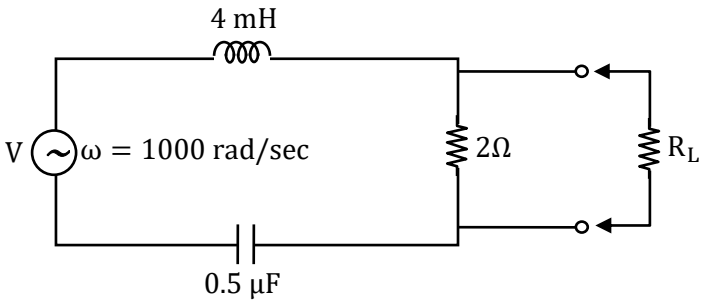

(A) $65 + 4$
(B) $75 + 4$
(C) $\frac{25s^2 + 46s + 20}{4s + 5}$
(D) $\frac{235^2 + 465 + 20}{4s + 5}$

44. A counter is constructed with 3D − difference. The input-output poles are $(D_0, Q_0), (D_1, Q_1)$and $(D_2, Q_2)$ where subscript 0 denotes the LSB. The dp sequence is desired to be the Gray code sequence, 000, 001, 011, 010, 110, 111, 101 and 100 repeating periodically. The expression for $D_1$ is
(A) $\bar{Q}_2 Q_0 + Q_1 \bar{Q}_0$
(B) $Q_2 Q_1 Q_0$
(C) $Q_2 Q_1 + \bar{Q}_2 \bar{Q}_1$
(D) $Q_2 Q_0 + Q_1 \bar{Q}_0$

45. 100 Hz Square wove, switching between OC and 5V, is applied to a CR HPF. The o/p vtg ware form across the resistor is 6.2V peak to peak. if R = 820Ω, then the value of C is_____μF.




46. In the circuit shown, for maximum power to be delivered to $R_L$, its value should be _____ Ω.



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