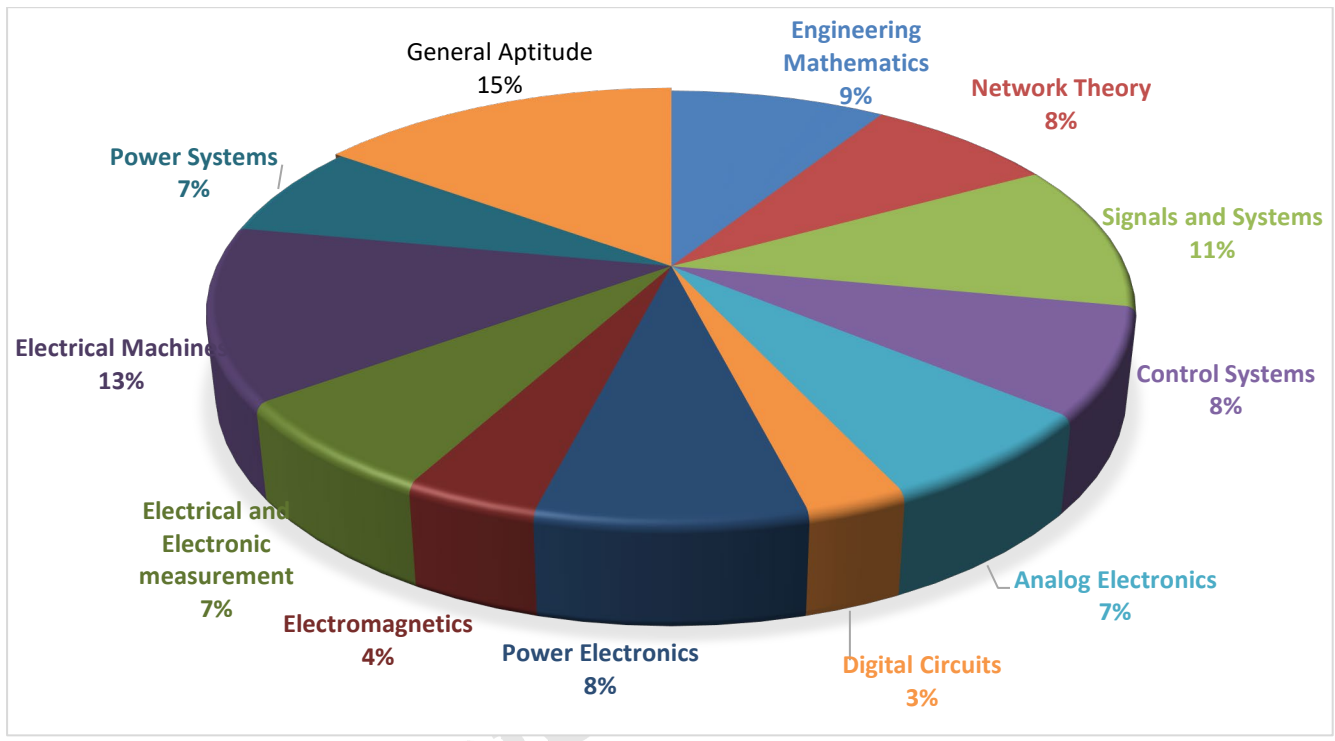




ANALYSIS OF GATE 2020
Memory Based

Electrical Engineering



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EE ANALYSIS-2020_Feb-08_Morning

SUBJECT	No. of Ques.	Topics Asked in Paper(Memory Based)	Level of Ques.	Total Marks
Engineering Mathematics	1 Marks: 3 2 Marks: 3	Vector calculus, Differential equation, Maxima, Probability, Matrix	Easy	9
Network Theory	1 Marks: 2 2 Marks: 3	Thevenin's theorem, Transient analysis	Average	8
Signals and Systems	1 Marks: 5 2 Marks: 3	Laplace transform, Z-transform, LTI	Average	11
Control Systems	1 Marks: 2 2 Marks: 3	SFG, Frequency response, Nyquist, Polar plot, RH criteria	Average	8
Analog Electronics	1 Marks: 1 2 Marks: 3	Diodes, OP-AMP, MOSFET	Difficult	7
Digital Circuits	1 Marks: 1 2 Marks: 1	Microprocessor, Sequential circuits	Easy	3
Power Electronics	1 Marks: 4 2 Marks: 2	Rectifier, Choppers, Inverter	Average	8
Electromagnetics	1 Marks: 0 2 Marks: 2	Electric field, Mutual inductance	Average	4
Electrical and Electronic measurement	1 Marks: 3 2 Marks: 2	Uncertainty(Error)	Average	7
Electrical Machines	1 Marks: 3 2 Marks: 5	DC machines, Transformer, Induction machines	Average	13
Power Systems	1 Marks: 3 2 Marks: 2	Load flow analysis, Transmission and Distribution	Difficult	7
General Aptitude	1 Marks: 5 2 Marks: 5	Word series, Data Interpretation, English-Grammar, permutation and combination	Easy	15
Total	65			100
Faculty Feedback	Overall paper was Moderate to difficult.			



GATE 2020 Examination* (Memory Based)

Electrical Engineering

Test Date: 8th Feb-2020

Test Time: 9.30 pm to 12.30 pm

Stream Name: Electrical Engineering

General Aptitude

Q.1 - Q.5 Carry One Mark each.

1. Select the words that fits analogy:

Do: Undo :: Trust:

- (A) Intrust
- (B) Untrust
- (C) Entrust
- (D) Distrust

[Ans. D]

2. This book, including all its chapters, _____ interesting. The students as well as instructor _____ in agreements about it.

- (A) is, was
- (B) is, are
- (C) were, was
- (D) are, are

[Ans. B]

3. If P, Q, R, S are 4 individuals how many teams of size exceeding one can be formed with Q as a member?

- (A) 5
- (B) 7
- (C) 8
- (D) 6

[Ans. B]

4. People were prohibited _____ their vehicles near the entrance of the main administrative building.

- (A) To park
- (B) To have parked
- (C) From parking
- (D) parking

[Ans. C]

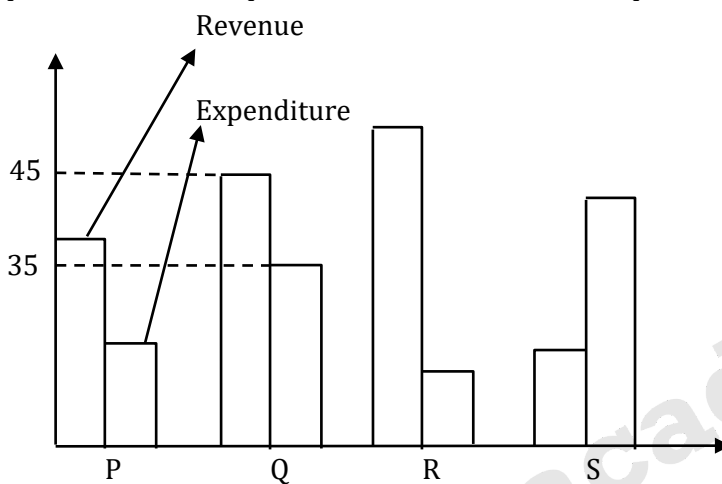
5. Stock markets _____ at the news of the cup.

- (A) Plugged
- (B) Plunged
- (C) Poised
- (D) probed

[Ans. B]

Q.6 - Q.10 Carry Two Mark each.

6. The revenue and expenditure of four companies P, Q, R and S is shown in the bar graph. Q has a profit of 10% on expenditure in 2014. Then the expenditure of Q in millions of Rs. is _____.



- (A) 34.1
- (B) 35.1
- (C) 33.7
- (D) 32.7

[Ans. A]

7. Next element of the series Z, WV, RQP, _____

- (A) LKJI
- (B) KJIH
- (C) NMLK
- (D) JIHG

[Ans. B]

8. The number of 37s (in same sequence) occurring between 1001 and 9999

- (A) 279
- (B) 299
- (C) 289
- (D) 280

[Ans. A]

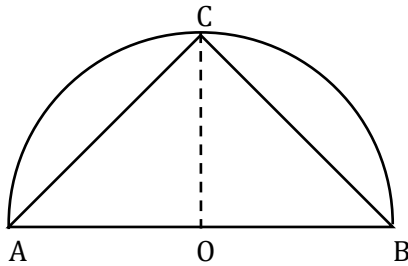


9. NPA is the asset that a customer borrows and holds it for a period of time without paying any interest. NPA of a bank is defined as non-profitable assets RBI has reduced the holding period for NPA thrice during 1993-2004. In 1993 it was 4 quarters. How many days is the holding period in 2004 _____ days?

- (A) 90
(B) 80
(C) 70
(D) 60

[Ans. A]

10. In the semicircle with "O" being the centre, the value of $\frac{\overline{AC} + \overline{CB}}{\overline{AB}} =$



[Ans. $\sqrt{2} : 1$]

Technical

Q.1 - Q.25 Carry One Mark each.

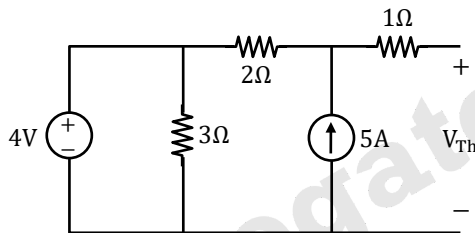
1. Consider a negative unity feedback system with forward path transfer function $G(s) = \frac{K}{(s+a)(s-b)(s+c)}$, where K, a, b, c are positive real numbers. For a Nyquist path enclosing the entire imaginary axis and right half of s -plane in the clock wise direction, the Nyquist plot of $(1+G(s))$, encircles the origin of $(1+G(s))$ plane once in the clock wise direction and never passes through the origin for a certain value of K . Then, the number of poles of $\frac{G(s)}{1+G(s)}$ lying in the open right half of the s -plane is _____

[Ans. *]Range: 2 to 2

2. A single 50 Hz synchronous generator on droop control was delivering 100 MW power to a system. Due to increase in load, generator power had to be increased 10 MW as a result of which system frequency dropped to 49.75 Hz. Further increase in load resulted in 49.25 Hz. Now power output in MW is _____

[Ans. *]Range: 129 to 131

3. The following circuit is given below. Determine the thevenin's voltage V_{Th} in volt is _____.



[Ans. *]Range: 14 to 14

4. For the differential equation $\frac{dy}{dx} = 2x - y$, given $y(0) = 1$ then value of y at $x = \ln 2$ is _____.

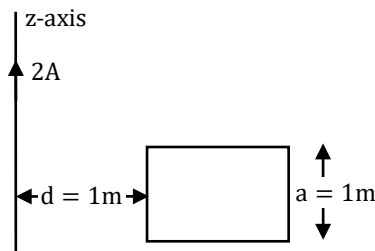
[Ans. *]Range: 0.7 to 0.9

5. For real number x and y with $y = 3x^2 + 3x + 1$, the maximum and minimum value of y for $x \in [-2, 0]$ are respectively.

- (A) $1, \frac{1}{4}$
 (B) $-2, -\frac{1}{2}$
 (C) $7, \frac{1}{4}$
 (D) $7, 1$

[Ans. C]

6. Consider a current carrying wire of $2A$ along z -axis. There is a square loop of side $a = 1m$ at a distance of $1m$ from current carrying wire. As shown in the figure. The mutual inductance between loop and wire is _____.



7. A common source amplifier with drain resistance (R_D) = $4.7\text{ K}\Omega$ is powered by 10 volts power supply assuming that the transconductance (g_m) = $500\mu\text{A/V}$ the voltage gain of amplifier is closest to
 (A) -2.44
 (B) 2.44
 (C) -6
 (D) -8
[Ans. A]

8. A sequence detector is designed to detect precisely 3 digital inputs, with overlapping sequences detectable. For the sequence (1, 0, 1) and input data (1, 1, 0, 1, 0, 0, 1, 1, 0, 1, 0, 1, 1, 0) the output is _____.
 (A) 010000001000
 (B) 110000110100
 (C) 010000010110
 (D) 010000010100
[Ans. D]

9. A single phase 4 kVA, 200 V/100 V, 50 Hz transformer has no load loss of 450 W. When HV side is fed with 160 V, 40 Hz supply then no load loss is 320 W. What is the no load loss when HV side is 100 W, 25 Hz.
[Ans. *]Range: 162 to 163

10. A cylindrical rotor synchronous generator delivering constant active power at a constant terminal voltage is delivering a current of $I = 100\text{ A}$ at a power factor of 0.9 lagging. A shunt reactor is connected so that the reactive power demand doubles then the new value of armature current is _____A
[Ans. *]Range: 125.1 to 125.3

11. A single 50 Hz synchronous generator on droop control was delivering 100 MW power to a system. Due to increase in load, generator power has to be increased by 10 MW, as a result of which, system frequency dropped to 49.75 Hz, further increase in load resulted in frequency drop to 49.25 Hz, now power output is _____ (in MW)

[Ans. *]Range: 130 to 130

12. A 3 phase, 50 Hz, 4 pole induction motor runs at no load with a slip of 1%. At full load the motor runs at a slip of 5%. The percentage speed regulation of the motor is _____

[Ans. *]Range: 3.9 to 4.1

13. A 3-phase cylindrical rotor synchronous generator has X_s and $R_a = 0$, V_A/E_b are per phase voltages. Which of the following is correct for P and Q

P. for any three phase balanced loading load across terminals V_A is always more than E_A

Q. for any three phase balanced lagging load across terminals V_A is always less than E_A

(A) P is false, Q is true

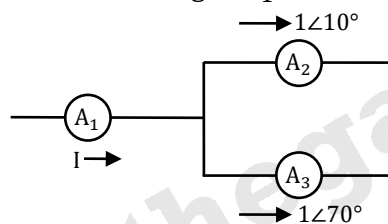
(B) P is true, Q is false

(C) P is true, Q is true

(D) P is false, Q is false

[Ans. A]

14. Following circuit is given below, where reading of A_2 & A_3 are $1\angle 10^\circ$ and $1\angle 70^\circ$. The rms current reading of A_1 is _____.



[Ans. *]Range: 1.71 to 1.75

15. A single phase full bridge rectifier R-L load with high inductance with $R = 10\Omega$. The rectifier is fed with 230 V, 50 Hz through cable of negligible resistance and inductor of 2.28 mH. If thyristor is triggered at $\alpha = 45^\circ$ the commutation overlap angle will be _____ (in degrees)

[Ans. *] Range: 5 to 5

16. Poles of system is given $(-2, 1)$ and $(2, -1)$ and zeros are given at $(2, 1)$ and $(-2, -1)$, then the system is

(A) All Pass Filter, Imaginary, Stable

(B) Low Pass Filter, Real, Stable

(C) High Pass Filter, Real, Unstable

(D) All Pass Filter, Real, Unstable

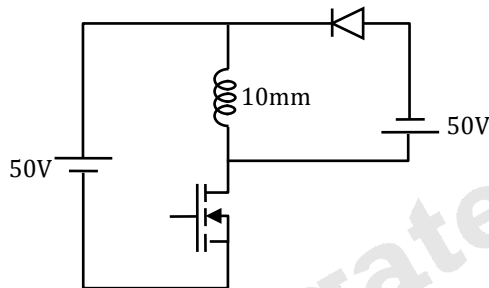
[Ans. D]

17. Which of the following statements is true about the two sided Laplace transform?
- (A) It exists for a signal that may or may not have Fourier Transform
- (B) It has no poles for any bounded signal that is non-zero only inside a finite time interval
- (C) If a signal can be expressed as a weighted sum of shifted one sided exponentials, then its Laplace Transform will have no poles
- (D) The number of finite poles finite zeros must be equal

[Ans. A]

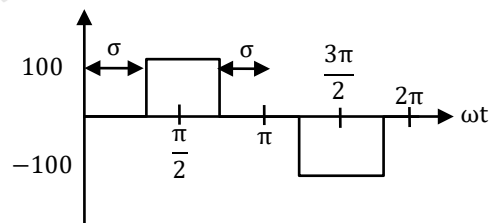
18. 1ϕ , 230 V, 50 Hz full bridge rectifier with R-L load with high value of Inductance. The two most dominant frequency component will be
- (A) 50 Hz, 150 Hz
- (B) 50 Hz, 100 Hz
- (C) 150 Hz, 250 Hz
- (D) 50 Hz, 0 Hz

19. In DC-DC converter switch Q switched at frequency of 10 kHz with $D = 0.6$. All the components are ideal and initial inductor current is zero. Energy stored in the inductor in mJ at the end of 10 switching cycle.



[Ans. 5 mJ]

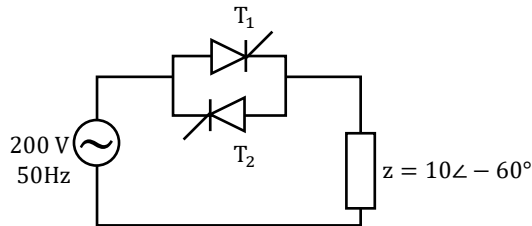
20. A single phase inverters 100V are controlled using quasi-square wave modulation scheme to produce an output waveform of $v(t)$ as shown. The angle σ is adjusted to entirely eliminate 3rd harmonic component. For the output voltage under this condition the magnitude of 5th harmonic component as percentage of the magnitude of fundamental component



[Ans. *] Range: 20 to 20



21. Thyristor T_1 triggered at α and T_2 triggered at $180 + \alpha$ with sinusoidal input. To control to load power over range 0 to 2 kW. The minimum range of variation in α is

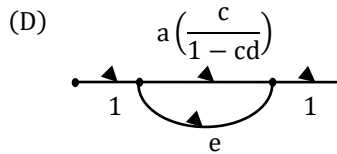
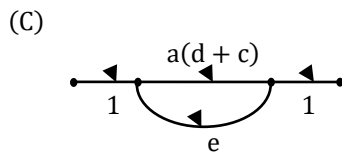
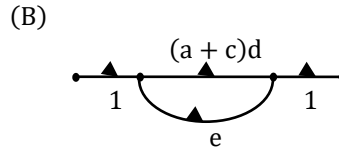
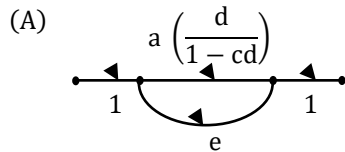
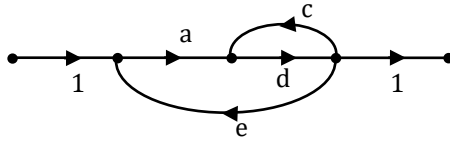


- (A) $0-120^\circ$
 (B) $0-60^\circ$
 (C) $60-120^\circ$
 (D) $60-180^\circ$
22. A non-ideal diode is biased with voltage of -0.03 V and diode current of I_1 is measured, the thermal voltage is 26 mV and Ideality factor for diode is $15/13$. The voltage at which the measured current increases to $1.5I_1$, is closest to

- (A) -0.09
 (B) -4.50
 (C) -0.02
 (D) -1.50

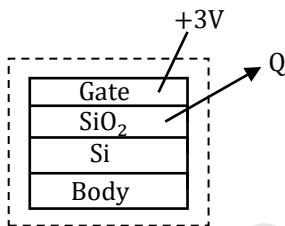
[Ans. C]

23. Which of the options is an equivalent representation of the SFG shown here?



[Ans. A]

24. The total charge within dashed region expressed as nQ is _____ C (Where n is integer).

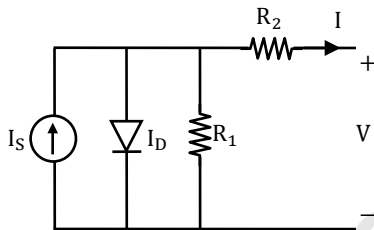


Q.26 - Q.55 Carry Two Mark each.

26. A cylindrical rotor synchronous generator with constant real power and constant voltage and current $I = 100$ A at $\cos \phi = 0.9$ lag. A reactor is connected so that reactive power doubles $I_{a \text{ new}}$ is _____ A
[Ans. *] Range: 124 to 126

27. Source is given such that it acts like ideal current source of 4A till terminal voltage is 10 V and after that acts like ideal voltage source of 10 V till current goes down i.e 0A. It is applied across rheostat, what will be the resistance voltage & current for maximum power transferred
 (A) $2.5\Omega, 10V, 4A$
 (B) $10\Omega, 0V, 4A$
 (C) $25\Omega, 5A, 5V$
 (D) $10\Omega, 0V, \infty A$
[Ans. A]

28. The circuit is based such that $V > 0$ & $I < 0$. Diode given is n_{cn} ideal such that $I_D = I_S \left(e^{\frac{V}{V_1}} - 1 \right)$. Then for maximum power transferred which statement is correct?



- (A) R_1 is large, R_2 is large
 (B) R_1 is small, R_2 is large
 (C) R_1 is small, R_2 is small
 (D) R_1 is large, R_2 is small
29. The value of following complex integral with C representing unit circle with centre at origin in counter clockwise is _____.

$$\int_C \frac{z^2 + 1}{z^2 - 2z} dz$$

- (A) $8\pi i$
 (B) πi
 (C) $-\pi i$
 (D) $-8\pi i$

[Ans. C]

30. The number of purely real elements in lower triangular representation of given 3×3 matrix obtained through the given decomposition is

$$\begin{bmatrix} 2 & 3 & 3 \\ 3 & 2 & 1 \\ 3 & 1 & 7 \end{bmatrix} = \begin{bmatrix} a_{11} & 0 & 0 \\ a_{12} & a_{22} & 0 \\ a_{13} & a_{23} & a_{33} \end{bmatrix} \begin{bmatrix} a_{11} & 0 & 0 \\ a_{12} & a_{22} & 0 \\ a_{13} & a_{23} & a_{33} \end{bmatrix}^T$$

- (A) 9
 (B) 8
 (C) 5
 (D) 7

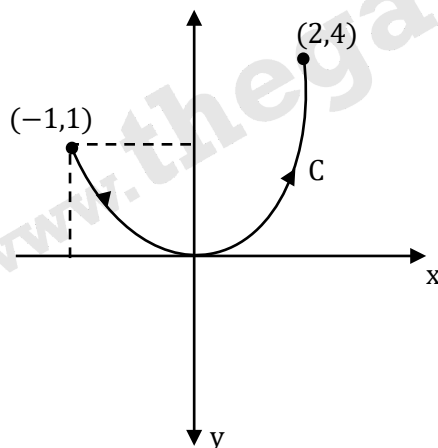
[Ans. D]

31. The vector function expressed by $f = \hat{a}_x(5y + k_1z) + \hat{a}_y(3z + k_2x) + \hat{a}_z(k_3y - 4x)$ represent conservative field where \hat{a}_x, \hat{a}_y & \hat{a}_z are unit vector along x, y, z direction. The value of $k_1, k_2, k_3 =$ _____.

- (A) $k_1 = 4, k_2 = 5, k_3 = 3$
 (B) $k_1 = 2, k_2 = 6, k_3 = 2$
 (C) $k_1 = 3, k_2 = 3, k_3 = 1$
 (D) $k_1 = 5, k_2 = 1, k_3 = 4$

[Ans. A]

32. Let say unit vector along direction x & y are \hat{a}_x and \hat{a}_y . A vector function is given by $\vec{F} = \hat{a}_xy - \hat{a}_yx$. The line integral of the above function $\int_C \vec{F} \cdot d\vec{l}$ along the curve C which follows the parabola $y = x^2$ shown below is _____.



[Ans. *]Range: -3 to -3

33. An 8085 microprocessor access two memory locations 2001 H and 2002 H that contains 8-bit numbers 98 H & B1H respectively. Program is as follows

```
LXI H 2001 H
MVI A 21 H
INX H
ADD M
INX H
MOV M, A
HLT
```

At the end of program, the memory location 2003 H contains the number in decimal form is

[Ans. *]Range: 210 to 210

34. A 250 V DC shunt motor with armature resistance of 0.2Ω and field resistance of 100Ω . It draws an upload current of 50 A at 1200 rpm. and load current is 50 A. If the flux per pole is decreased by 5% because of armature reaction. The brush drop is 1 V per brush at all operating conditions. The speed of motor under this load condition is _____

- (A) 1220
 (B) 1200
 (C) 1000
 (D) 900

[Ans. A]

35. Average and RMS value of signal $x(t) = x(t - T)$ are x_a and x_r respectively and average and RMS value of $y(t) = Kx(t)$ are y_a and y_r , respectively . Which of the statement is correct?

(A) $y_a = K x_a$
 $y_r = K x_r$

(B) $y_a = K^2 x_a$
 $y_r = K^2 x_r$

(C) $y_a = 0$
 $y_r = \sqrt{K} x_r$

(D) $y_a = \sqrt{K} x_a$
 $y_r = \sqrt{K} x_r$

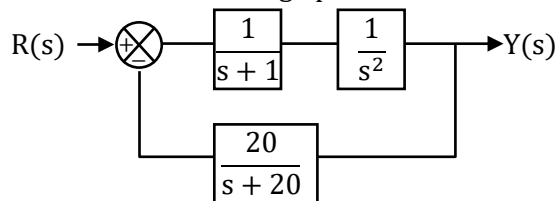
[Ans. A]

36. A stable real LTI system with single pole at P , has a transfer function, $u(s) = \frac{s^2+100}{s-P}$ with a dc gain of 5. The smallest positive frequency in rad/sec at unity gain is closest to

(A) 8.84
 (B) 11.08
 (C) 78.13
 (D) 112.87

[Ans. A]

37. Which of the following options is correct for the system shown below?



(A) 4th order and unstable
 (B) 4th order and stable
 (C) 3rd order and stable
 (D) 3rd order and unstable

[Ans. A]

38. Consider a negative unity feedback system with the forward path transfer function $TF = \frac{(s^2+s+1)}{s^3+2s^2+2s+1}$. The value of K for which the system will have some of its pole on imaginary axis is

(A) 9
 (B) 6
 (C) 7
 (D) 8

[Ans. D]

39. Consider a PMDC motor which is initially at rest. At $t = 0$, a dc voltage of 5V is applied to the motor. Its speed monotonically increases from 0 rad/sec to 6.32 rad/sec in 0.5 s and finally settles to 10 rad/sec. Assuming that the armature inductance of the motor is negligible, the transfer function of the motor is _____

(A) $\frac{10}{s+0.5}$
 (B) $\frac{10}{0.5s+1}$
 (C) $\frac{2}{s+0.5}$
 (D) $\frac{2}{0.5s+1}$

[Ans. D]

40. A non-ideal Si-based PN junction diode is tested by sweeping the bias applied across its terminals from -5V to +5V. The effective thermal voltage, V_T , for the diode is measured to be

$(2a \pm 2)$ mV. The resolution of the voltage source in the m/m range is 1mV. The % uncertainty in the measured current at a bias voltage of 0.02V is _____.

41. A signal $x[n]$ is given by $\left(\frac{1}{2}\right)^n I[n]$, where

$$I(n) = \begin{cases} 0, & n < 0 \\ \neq 0, & n > 0 \end{cases}$$

z-transform of $x[n - k]$ is $\frac{z^{-k}}{1 - \frac{1}{2}z^{-1}}$, then what will be ROC of $x(n - k)$?

- (A) $|z| < 2$
 (B) $|z| > 1/2$
 (C) $|z| > 2$
 (D) $|z| < 1/2$

[Ans. B]

42. $y(t) = x(t) * h(t)$ where $h(t)$ is the impulse response. Now $z(t) = |x(t)| * |h(t)|$ then which of the following is correct?

- (A) For all $t \in (-\infty, \infty)$, $z(t) > y(t)$
 (B) For all $t \in (-\infty, \infty)$, $z(t) < y(t)$
 (C) Except some interval $z(t) > y(t)$
 (D) Except some interval $z(t) < y(t)$

[Ans. C]

43. A resistor and capacitor are connected in series to 10V DC supply through a switch. The switch is closed at $t = 0$ and the capacitor voltage is found to cross 0V at $t = 0.4\tau$ where τ is time constant. The absolute value of % change required in initial capacitor voltage if the zero crossing has to happen at $t = 0.2\tau$ is _____ (upto two decimal)

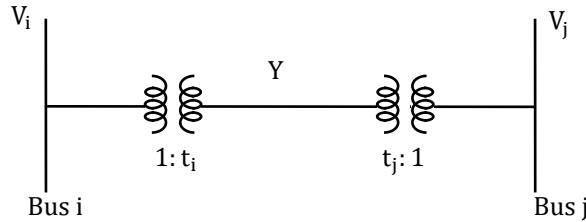
[Ans. 54.98]

44. Find the transfer function of permanent magnet DC motor. When it input 5 V the speed at 0.5 sec is 6.32 rads and steady state speed is 10 rads.

45. A 10 V DC voltage applied across a series RC circuit. In 0.4τ the voltage of capacitor crosses zero (where t is the time constant). If voltage across capacitor crosses zero at $0.2t$ then the percentage change in the initial value of the capacitor voltage is (Upto 2 decimal) _____%

[Ans. *] Range: 54.3 to 54.3

46. Two buses i and j connected with transmission line admittance Y at the two ends of ideal transformer with two ratio as shown, bus admittance matrix for the system is _____



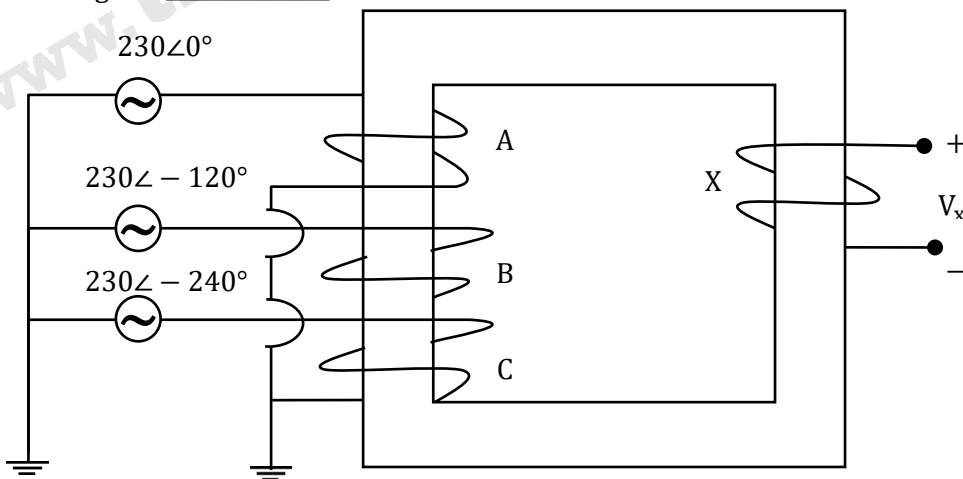
- (A) $\begin{bmatrix} t_i t_j Y & -t_i^2 Y \\ -t_i^2 Y & t_i t_j Y \end{bmatrix}$
- (B) $\begin{bmatrix} -t_i t_j Y & t_j^2 Y \\ t_i^2 Y & -t_i t_j Y \end{bmatrix}$
- (C) $\begin{bmatrix} t_i^2 Y & -t_i t_j Y \\ -t_i t_j Y & t_j^2 Y \end{bmatrix}$
- (D) $\begin{bmatrix} t_i t_j Y & -(t_i - t_j)^2 Y \\ -(t_i - t_j)^2 Y & t_i t_j Y \end{bmatrix}$

[Ans. C]

47. $\frac{d^2y}{dt^2} + 4y(t) = 6r(t)$.
The poles of the system are _____.

[Ans. $\pm 2i$]

48. Three windings A, B, and C all having 20 turns each is shown with the core and its winding configurations are to just indicate the sense of the winding but not to indicate the number of turns. The number of turns in the winding X is 2. The RMS value of open circuit induced in winding X is _____ V.



[Ans. 46 V_{rms}]

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