SECTION - A

1. In each of the sub-questions (1.1 – 1.48), four/five alternatives, A, B, C and D(E) are provided of which ONLY ONE is correct. Indicate in your answer book the correct answer by writing the alphabet corresponding to the answer against the sub question.

1.1 The unit impulse response of a unit-feedback control system is given by

$$c(t) = -te^{-t} + 2e^{-t}, (t \geq 0)$$

the open loop transfer function is equal to

(a) $\frac{s+1}{(s+2)^2}$ (b) $\frac{2s+1}{s^2}$ (c) $\frac{s+1}{(s+1)^2}$ (d) $\frac{s+1}{s^2}$

1.2 Consider the unit step response of a unity feedback control system whose open lop transfer function is $G(s) = \frac{1}{s(s+1)}$. The maximum overshoot is equal to

(a) 0.143 (b) 0.153 (c) 0.163 (d) 0.173

1.3 For a feedback control system of type 2, the steady state error for a ramp input is:

(a) infinite (b) constant (c) zero (d) indeterminate

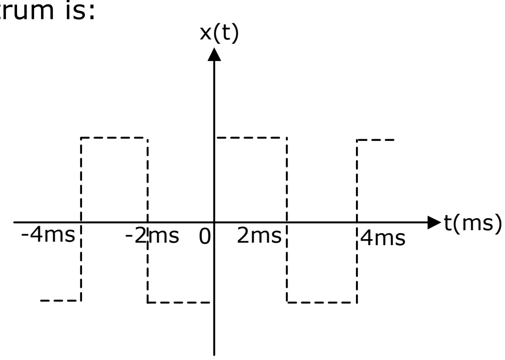
1.4 The closed loop transfer function of a control system is given by $\frac{C(s)}{R(s)} = \frac{1}{1+s}$. For the input r(t) = sin t, the steady state value of c(t) is equal to

(a) $\frac{1}{\sqrt{2}}\cos t$ (b) 1

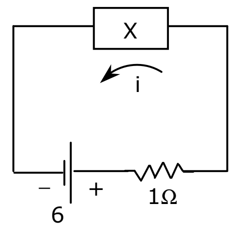
(c) $\frac{1}{\sqrt{2}}\sin t$ (d) $\frac{1}{\sqrt{2}}\sin\left(1 - \frac{\pi}{4}\right)$

1.5 A periodic rectangular signal, x(t) has the wave form shown in Fig.1.5. Frequency of the fifth harmonic of its spectrum is:

(a) 40 Hz
(b) 200 Hz
(c) 250 Hz
(d) 1250 Hz



1.6 In the circuit shown in Fig.1.6 X is an element, which always absorbs power. During a particular operations, it sets up a current of 1 amp in the direction shown and absorbs a power P_x. It is possible that X can absorb the same power P_x for another current i, the value of this current is



(a) $\left(3-\sqrt{14}\right)$ amps

(b) $\left(3+\sqrt{14}\right)$ amps

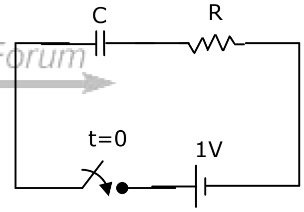
(c) 5 amps

(d) None of the above

1.7 A water boiler at home is switched on to the a.c. mains supplying power at 230 V/50 Hz. The frequency of instantaneous power consumed by the boiler is:

(a) 0 Hz (b) 50 Hz (c) 100 Hz (d) 150 Hz

1.8 In the series RC circuit shown in Fig.1.8, the voltage across C starts increasing the d.c. source is switched on. The rate of increase of voltage across C at the instant just after the switch is closed (i.e., at $t = 0^+$), will be



(a) zero

(b) infinity

(c) RC

(d) $\frac{1}{RC}$

1.9 The v-i characteristic as seen from the terminal-pair (A, B) of the network of Fig.1.9(a) is shown in Fig.1.9 (b). If an inductance of value 6 mH is connected across the terminal pair (A, B), the time constant of the system will be

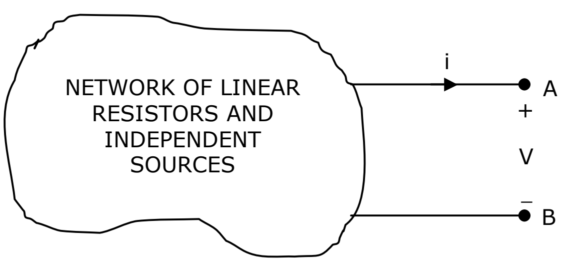


Fig.1.9(a)

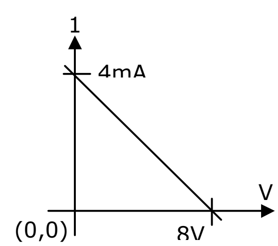


Fig.1.9(b)

(a) 3 μ sec

(b) 12 sec

(c) 32 sec

(d) unknown, unless the actual network is specified

1.10 Inside a hollow conducting sphere
(a) electric field is zero
(b) electric field is an non-zero constant
(c) electric field changes with the magnitude of the charge given to the conductor
(d) electric field changes with distance from the centre of the sphere

1.11 If v, w, q stand for voltage, energy and charge, then v can be expressed as
(a) $v = \frac{dq}{dw}$ (b) $v = \frac{dw}{dq}$ (c) $dv = \frac{dw}{dq}$ (d) $dv = \frac{dq}{dw}$

1.12 The energy stored in the magnetic field of solenoid 30 cm long and 3 cm diameter wound with 1000 turns of wire carrying a current of 10A is
(a) 0.015 joule (b) 0.15 joule (c) 0.5 joule (d) 1.15 joule

1.13 The function of oil in a transformer is
(a) to provide insulation and cooling
(b) to provide protection against lightning
(c) to provide protection against short circuit
(d) to provide lubrication

1.14 Auto-transformer is used in transmission and distribution
(a) when operator is not available
(b) when iron losses are to be reduced
(c) when efficiency considerations can be ignored
(d) when the transformation ratio is small

1.15 Keeping in view the requirement of parallel operation, which of the 3-phase connections given below are possible?
(a) delta-delta to delta-star (b) delta-delta to star-delta
(c) star-star to delta-delta (d) delta-star to star-delta

1.16 A 4-pole generator with 16 coil has a two layer winding. The pole pitch is
(a) 32 (b) 16 (c) 8 (d) 4

1.17 A 4-pole dynamo with wave wound armature has 51 slots containing 20 conductors in each slot. The induced emf is 357 volts and the speed is 8500 rpm. The flux per pole will be
(a) 3.5 mWb (b) 1.2 mWb (c) 14 mWb (d) 21 mWb

1.18 A cylindrical rotor synchronous motor is switched on the supply with its field windings shorted on themselves. It will

(a) not start

(b) start but not run at synchronous speed

(c) start as an induction motor and then run as synchronous motor

(d) start and run as a synchronous motor

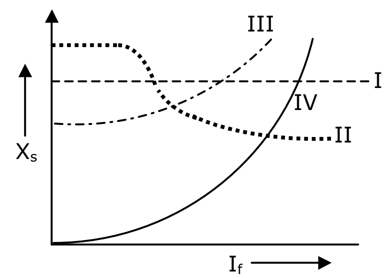
1.19. In Fig.1.19, the characteristic that corresponds to the variation of synchronous reactance of a synchronous motor with field current is:

(a) curve I

(b) curve II

(c) curve III

(d) curve IV



1.20. During hunting of synchronous motor

(a) negative phase sequence currents are generated

(b) harmonics are developed in the armature circuit

(c) damper bar develops torque

(d) field excitation increases

1.21. Unbalanced supply voltage given to a 3-phase, delta-connected induction motor will cause

(a) zero sequence currents (b) less heating of the rotor

(c) negative sequence component current (d) all of the above

1.22. When the supply voltage to an induction motor is reduced by 10%, the maximum torque will decrease by approximately

(a) 5% (b) 10% (c) 20% (d) 40%

1.23. An induction motor having full load of 60 Nm when delta-connected develops a starting torque of 120 Nm. For the same supply voltage, if the motor is changed to star-connection, the starting torque developed will be

(a) 40 Nm (b) 60 Nm (c) 90 Nm (d) 120 Nm

1.24. The torque speed characteristic of a repulsion motor resembles which of the following dc motor characteristic?

(a) Separately excited (b) Shunt

(c) Series (d) Compound

1.25 Which type of motor is most suitable for computer printer drive?
(a) Reluctance motor (b) Hysteresis motor
(c) Shaded pole motor (d) Stepper motor

1.26 In case of a split phase motor, the phase shift between currents in the two windings is around
(a) 30 degrees (b) 70 degrees (c) 90 degrees (d) 120 degrees

1.27 In an induction motor, if the air gap is increased
(a) speed will reduce (b) efficiency will improve
(c) power factor will be lowered (d) breakdown torque will reduce

1.28 Which semiconductor power device out of the following is not a current triggered device?
(a) Thyristor (b) G.T.O. (c) Triac (d) MOSFET

1.29 The Triac can be used only in
(a) inverter (b) rectifier
(c) multi-quadrant chopper (d) cycloconverter

1.30 Which of the following does not cause permanent damage of an SCR?
(a) High current (b) High rate of rise of current
(c) High temperature rise (d) High rate of rise of voltage

1.31 In a thyristor dc chopper, which type of commutation results in best performance?
(a) voltage commutation (b) current commutation
(c) load communication (d) supply commutation

1.32 In a 3-phase controlled bridge rectifier, with an increase of overlap angle, the output dc voltage
(a) decreases (b) increases
(c) does not change (d) depends upon load inductance

1.33 During a disturbance on a synchronous machine, the rotor swings from A to B before finally settling down to a steady state at point C on the power angle curve. The speed of the machine during oscillation is synchronous at point(s)
(a) A and B (b) A and C (c) B and C (d) only at C

1.34 If the reference bus is changed in two load flow runs with same system data and power obtained for reference bus taken as specified P and Q in the latter run
(a) the system losses will be unchanged but complex bus voltages will change
(b) the system losses will change but complex bus voltages remain unchanged
(c) the system losses as well as complex bus voltage will change
(d) the system losses as well as complex bus voltage will be unchanged

1.35 Resistance switching is normally employed in
(a) all breakers (b) bulk oil breakers
(c) minimum oil breakers (d) air blast circuit breakers

1.36 Which material is used in controlling chain reaction in a nuclear reactor?
(a) Thorium (b) Heavy water (c) Boron (d) Beryllium

1.37 For a 500 Hz frequency excitation, a 50 km long power line will be modeled as
(a) short line (b) medium line
(c) long line (d) data insufficient for decision

1.38 For an unbalanced fault, with paths for zero sequence currents, at the point of fault
(a) the negative and zero sequence voltages are minimum
(b) the negative and zero sequence voltages are maximum
(c) the negative sequence voltage is minimum and zero sequence voltage is maximum
(d) the negative sequence voltage is maximum and zero sequence voltage is minimum

1.39 If the fault current is 2000A, the relay setting is 50% and CT ratio is 400.5, the plug setting multiplier will be
(a) 25 A (b) 15 A (c) 50 A (d) 10 A

1.40 An advantage of a permanent magnet moving coil instrument is that it is
(a) free from friction error
(b) has high (torque/weight of the moving parts) ratio
(c) has low (torque/weight of the moving parts) ratio
(d) can be used on both a.c. and d.c.

1.41 The moving coil in a dynamometer wattmeter is connected
(a) in series with the fixed coil (b) across the supply
(c) in series with the load (d) across the load

1.42 For a given frequency, the deflecting torque of an induction ammeter is directly proportional to

(a) current^2 (b) current^3 (c) $\sqrt{\text{current}}$ (d) current

1.43 The scale of a voltmeter is uniform. Its type is:

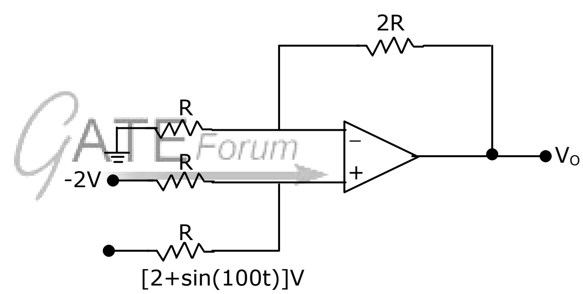
(a) moving iron (b) induction
(c) moving coil permanent magnet (d) moving coil dynamometer

1.44 The depletion region or space charge region or transition region in a semiconductor p-n junction diode has

(a) electrons and holes (b) positive ions and electrons
(c) positive ions and negative ions (d) negative ions and holes
(e) no ions, electrons or holes

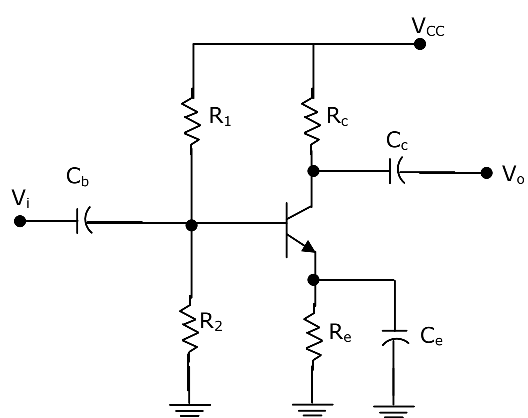
1.45 A non-inverting op-amp amplifier is shown in Fig.1.45. The output voltage V_0 is:

(a) $\left(\frac{3}{2}\right)\sin(100t)$
(b) 3 sin (100t)
(c) 2 sin (100t)
(d) None of the above



1.46 In the transistor amplifier shown in Fig.1.46, the ratio of small signal voltage gain, when the emitter resistor R_e is bypassed by the capacitor C_e to when it is not bypassed, (assuming simplified approximate h-parameter model for transistor) is:

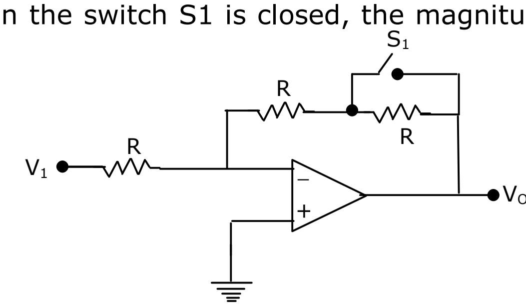
(a) 1
(b) h_{fe}
(c) $\frac{(1+h_{fe})R_e}{h_{ie}}$
(d) $1+\frac{(1+h_{fe})R_e}{h_{ie}}$



1.47 Let the magnitude of the gain in the inverting Op-amp amplifier circuit shown in Fig.1.47 be x with switch S1 open. When the switch S1 is closed, the magnitude of gain becomes

(a) $\frac{x}{2}$ (b) -x

(c) 2x (d) -2x



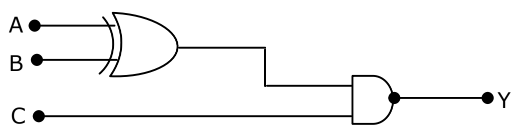
1.48 The Boolean expression for the output of the logic circuit shown in Fig.1.48 is

(a) $Y = \overline{AB} + AB + \overline{C}$

(b) $Y = \overline{AB} + AB + C$

(c) $Y = \overline{A}B + \overline{A}B + C$

(d) $Y = \overline{A}B + \overline{AB} + \overline{C}$



2. The question consists of 6 parts. Each part is accompanied by four answers of which one is correct. Indicate the correct answer by writing the alphabet A, B, C or D.

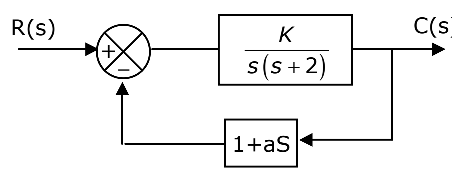
2.1 For the system shown in Fig.2.1, with a damping ratio ζ of 0.7 and an undamped natural frequency ω_n of 4 rad/sec, the values of K and a are

(a) K = 4, a = 0.35

(b) K = 8, a = 0.455

(c) K = 16, a = 0.225

(d) K = 64, a = 0.9



2.2. The unit impulse response of a system is given as c(t) = $-4e^{-t} + 6e^{-2t}$. The step response of the same system for t≥0 is equal to:

(a) $-3e^{-2t} - 4e^{-t} + 1$ (b) $-3e^{-2t} + 4e^{-t} - 1$

(c) $-3e^{-2t} - 4e^{-t} - 1$ (d) $3e^{-2t} + 4e^{-t} - 1$

2.3. A coil (which an be modeled as a series RL circuit) has been designed for high Q performance at a rated voltage and a specified frequency. If the frequency of operation is doubled, and the coil is operated at the same rated voltage, then the Q-factor and the active power P consumed by the coil will be affected as follows:

(a) P is doubled, Q is halved (b) P is halved, Q is doubled

(c) P remains constant, Q is doubled (d) P decreased 4 times Q is doubled

2.4. Out of the following factors for a d.c. machine,

(i) Interpole

(ii) Armature resistance

(iii) Armature

(iv) Reduction in field current

the factors that are responsible for decrease in the terminal voltage of a shunt generator are

(a) I, II and IV (b) II, III and IV (c) II, IV and I (d) III, IV and I

2.5. For equilateral spacing of conductors of an untransposed 3-phase line, we have

(a) balanced receiving end voltage and no communication interference

(b) unbalanced receiving end voltage and no communication interference

(c) balancing receiving end voltage and communication interference

(d) unbalanced receiving end voltage and communication interference

2.6. The voltage series feedback in a feedback amplifier leads to

(a) increase in band width, while the voltage gain becomes less sensitive to variations in components and device characteristics

(b) decrease in overall gain, while the input resistance decreases

(c) increase in distortion, while the output resistance decreases

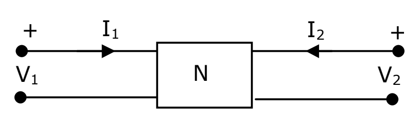
(d) decrease in input resistance, while the output resistance increases

3. This question contains five parts. In each part (3.1 to 3.5), three items are given on the left side and more than three on the right. For each item on the left, match a suitable answer from the list given on the right.

3.1 The performance of a general two-port network N shown in the Fig.3.1 can be described in terms of its z-parameters of h-parameters as indicated below:

$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$

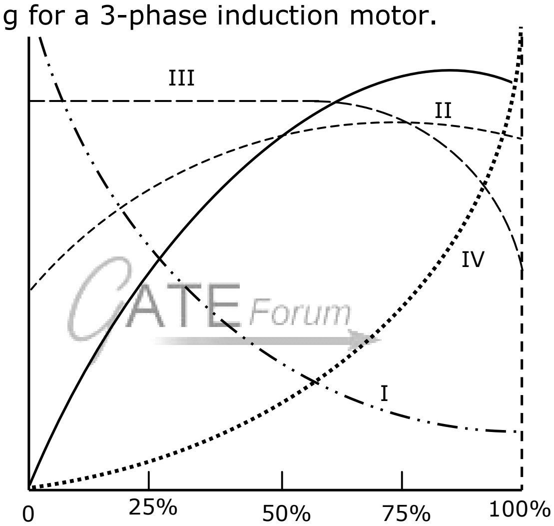
$$\begin{bmatrix} V_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix} \begin{bmatrix} I_1 \\ V_2 \end{bmatrix}$$



If the two-port is further characterized by additional constraints, a few conditions have to be satisfied by the parameters of the network. For each of the constraints specified in Table A, choose the appropriate condition to be satisfied, from amongst those listed in table B.

Table A	Table B
(a) Reciprocity at the ports	(P) $h_{11}h_{22} - h_{12}h_{21} = 1$
(b) Passivity at the ports	(Q) $z_{12} = -z_{21}$
(c) Electrical symmetry at the ports	(R) $h_{12} = h_{21}$
	(T) absence of negative resistors inside the 2-port
	(U) energy input to the network from the ports is non-negative for all conditions at the ports

3.2 Out of the several characteristics shown in Fig.3.2, identify the appropriate ones to match the following for a 3-phase induction motor.



x-axis	y-axis	
(a) Load	Efficiency	(P) curve I
(b) Speed	Current	(Q) curve II
(c) Speed	Power factor	(R) curve III
		(S) curve IV
		(T) curve V

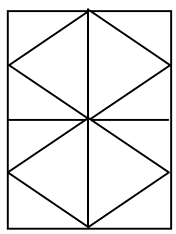
3.3 The per unit voltages of two synchronous machines connected through a lossless line are $0.95\angle 10°$ and $1.0\angle 0°$. Match the two sides in the following

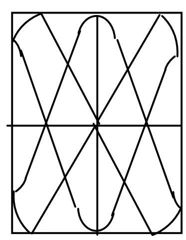
(a) Real power of Machine 1	(P) Positive real power
(b) Reactive power of Machine 1	(Q) Positive reactive power
(c) Power factor of Machine 1	(R) Negative real power
	(S) Negative reactive power
	(T) Leading power factor
	(U) Lagging power factor

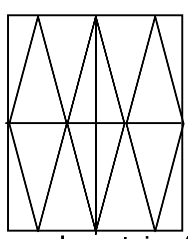
3.4 In a 8085 microprocessor, the following instructions may result in change of accumulator contents and change in status flags. Choose the correct match for each instruction.

		Contents of ACC	Cy flag	AC flag
(a) ANA r	(P)	unchanged	may by SET	unchanged
(b) XRA r	(Q)	unchanged	SET	SET
(c) CMP r	(R)	unchanged	SET	RESET
	(S)	may change	RESET	RESET
	(T)	may change	RESET	SET

3.5 In an oscilloscope, the input to the horizontal plates is a 100 Hz voltage signal. The Lissajous patterns (A), (B) and (C) will be generated when different frequency voltage signals are applied to vertical plates. Match each Lissajous pattern to the corresponding frequency fy.

(a)  (P) fy = 50

(b)  (Q) fy = 66.66

(c)  (R) fy = 125

(S) fy = 150

(T) fy = 200

(U) fy = 300

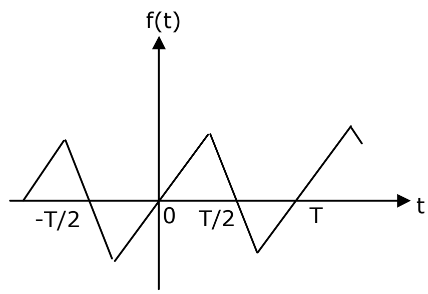
(a) Any general matrix A can be expressed as the sum of a symmetric matrix. A_s and skew symmetric matrix. A_{sk} in the form $A = A_s + A_{sk}$ given A as:

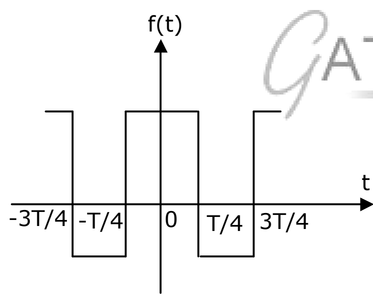
Given A as $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$, find the corresponding A_s and A_{sk}

(b) Express the rational function $F(s) = \frac{3}{(s+1)(s+2)^2}$ in terms of its partial fraction expansion.

(c) Fourier series representation of a periodic function, in general, contains sine and cosine terms corresponding to the fundamental frequency and several harmonic components. However, some of these harmonic components will be absent for specific types of periodic functions. Three periodic waveforms are shown in Table A; match the corresponding property listed in Table B.

Table A





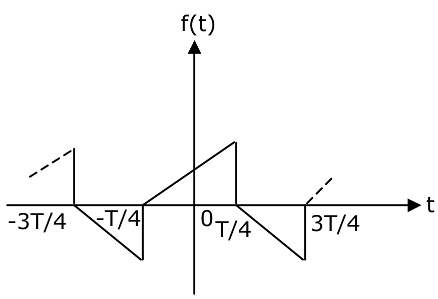


Table B

(1) both sine and cosine terms are presents in the Fourier series of f(t)

(2) only sine terms are present in the Fourier series of f(t)

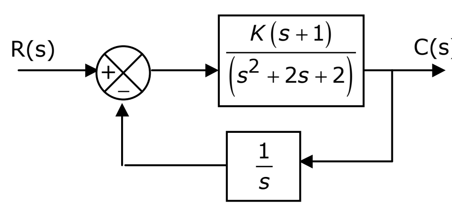
(3) Only cosine terms are present in the Fourier series of f(t).

5. Consider the closed loop control system shown in Fig.5. sketch the root loci diagram of the system for 0≤K≤∞.

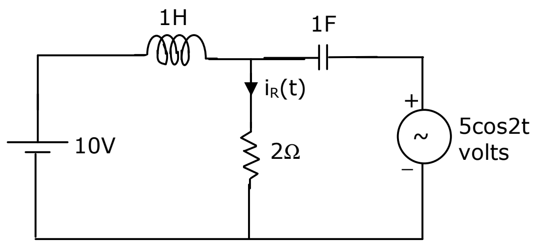
Show on the sketch the following:

(a) Asymptotes of root loci as s → ∞

(b) Intersection of the asymptotes



6. Find the current $i_R(t)$ through the resistor, when the network shown in Fig.6 in steady-state condition.



7. A 10 KW, 50 Hz, 0.8 power factor, 3-phase induction motor runs at 980 rpm at no load and at 960 rpm at full load. Windage, friction and iron losses are 320 W, armature resistance is 1.5 ohms per phase.

(a) What is the frequency of rotor currents at full load?

(b) What is the speed of the rotor field with respect to the rotor at full load?

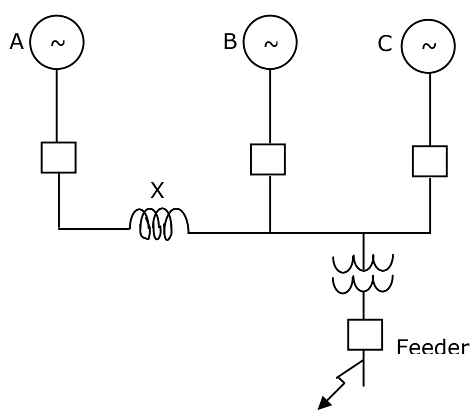
(c) What is the rotor copper loss at full load?

(d) What is the rotor copper loss at full load, if efficiency is 88%.

8. In the power system circuit diagram shown in Fig.8, the current limiting reactor X is to be chosen such that the feeder breaker rating does not exceed 425 MVA. The system data is as follows:

Feeder transformer reactance: 10% on 50 Mva base.

The generating source A, B, C have individual fault levels at 1000 MVA with respective generator breakers open. Ignore pre-fault currents and assume 1.0 p.u. voltages throughout before fault. Assume common base of 1000 MVA.



SECTION – B

Answer any TEN questions from this section. All questions carry equal marks.

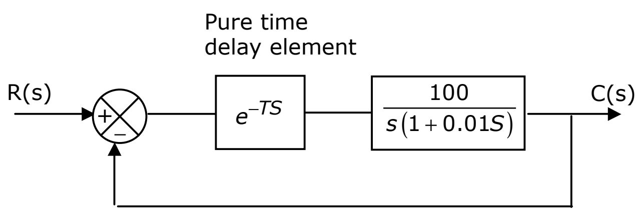
9. The polynomial $\left(1-s^{10}\right)$ has 10 roots. Find the following with respect to these roots. Justify your answers.
   (a) Number of real roots
   (b) Number of purely imaginary roots
   (c) Sum of the roots
   (d) Product of the roots
   (e) Number of rooted located in the left half of the complex s-plane

10. Consider a linear time-invariant system described by the differential equation

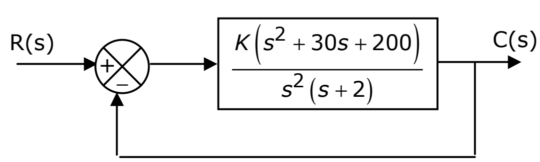
$$\frac{d^2c(t)}{dt^2}+3\frac{dc(t)}{dt}+2c(t)=r(t)$$

where c(t) is the output. The input r(t) is a unit step function.
   (a) Write the state equations of the system in vector matrix form
   (b) Find the state transition matrix $\phi(t)$
   (c) Determine the characteristic equation and the eigen values.

11. A closed loop control system is shown in Fig.11.
   (a) Sketch Nyquist locus for the system when T = 0
   (b) Using Nyquist criterion, determine the range of T for which the closed loop system is stable.



12. Consider the closed loop feedback control system shown in Fig.12.



Using Routh-Hurwitz criterion, determine the range of K for which the system is stable. Find also the number of roots of the characteristic equation that are in the right half of s-plane for K = 0.5.

13. A 25 KVA, 50 Hz, 1 phase, 24000/240 V distribution transformer has the followng parameters referred to the low voltage side:

Total series impedance	(0.1+j1.0)ohms
Shunt conductance	0.012 mho
Shunt susceptance	0.09 mho

(a) When the transformer is operated at 240 V and is supplying a unity power factor load, determine the maximum efficiency and the load at which it occurs.

(b) If the load is changed to a zero power factor load, calculate the load KVA at which both the primary supply voltage and secondary output voltage are at their nominal values.

14. A direct current series motor draws a line current of 100 amps from the mains while running at 1000 rpm. Its armature resistance is 0.15 ohm and the field resistance is 0.1 ohm. Assuming that the flux corresponding to a current of 25 amps is 40% of that corresponding to 100 amps, find the speed of the motor when it is drawing 25 A from 230 V supply.

15. A 10,000 KVA, 3 phase, star connected 11,000 V, 2 pole turbo-generator has a synchronous impedance of (0.0145 + j0.5) ohms per phase, the various losses in this generator are as follows:

Open circuit core loss at 11000 V	90 kW
Windage and friction loss	50 kW
Short circuit load loss at 525 A	220 kW
Field winding resistance	3 ohms
Field current	175 amps

Ignoring the change in field current, compute the efficiency at

(a) rated load 0.8 power factor leading

(b) half rated load, 0.9 power factor lagging

16. A 7.5 kW, 230 V, 3 phase, star connected 50 Hz, 4 pole squirrel cage inductance motor has its full load internal torque at a slip of 0.04. the parameters of the motor are:

R_1	0.36 ohm/phase
R_2	0.222 ohm/phase
$X_1 = X_2$	0.47 ohm/phase
X_m	15.5 ohms/phase

Assume that the shunt branch is connected across the supply terminal, find

(a) Maximum internal torque at rated voltage and frequency

(b) slip at maximum torque

(c) internal starting torque at rated voltage and frequency

17. A single phase a.c. regulator (back to back connected thyristors) has a resistive load of R = 20 ohms and input voltage (rms) 230 V, 50 Hz. The firing angles of botht he thyristors are same and equalt o 90°. Determine

(a) rms output voltage

(b) power dissipated in resistor

(c) supply power factor

(d) average current of the thyristor and

(e) rms current of the thyristor

18. An ideal chopper operating at a frequency of 500 Hz feeds an R-L load R = 30 ohms and L = 9 mH from a 48 V battery. The load is shunted by a free-wheeling diode. Battery is lossless. Assuming duty cycle of chopper to be 50%, compute

(a) peak load current

(b) minimum load current

(c) average load current

(d) average load voltage and

(e) current exertion in load current

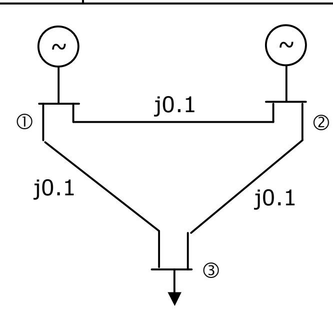
19. A 200V, 1500 rpm, 10 A separately exits dc motor has an armature resistance of 1 ohm. It is fed from a single-phase fully controlled bridge rectifier with an a.c. source voltage of 230 V (rms) 50 Hz. Assuming continuous load current compute.

(a) Motor speed at the firing angle of 30° and torque of 5 Nm.

(b) Developed torque at the firing angle of 45° and speed of 1000 rpm.

20. Using Gauss Seidel load flow method, find the bus voltages at the end of one interaction for the following 2 bus system. Line reactances are shown in Fig.20. ignore resistance and line charging. Assume initial voltage at all buses to be $1.0\angle 0$. Use 1.0 as acceleration factor. The bus data is given in the table below.

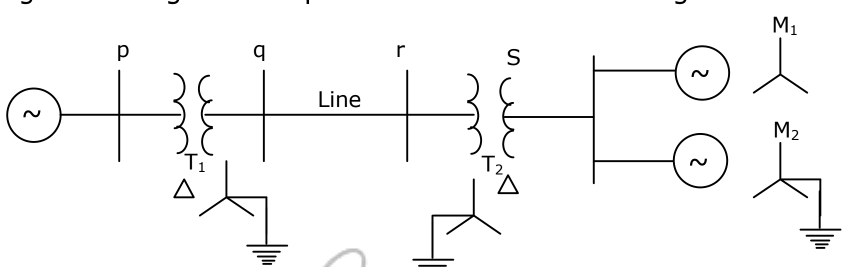
Bus No.	Specified P (p.u.)	Injections Q (p.u.)	Specified voltage (p.u.)
1	-	-	1.0
2	03	-	1.0
3	-0.5	0.2	-



21. A 6.6 kV, 10 MVA star connected alternator has a reactance of 2 ohms/phase and negligible resistance. Merz price protection is used for protection of winding. The neutral grounding resistance is 5 ohms. If only 10% of the winding is to remain unprotected. Determine the setting of the relay.

22. A generator is delivering rated power of 1.0 per unit to an infinite bus through a lossless network. A three-phase fault under this condition reduces P_{max} to 0 per unit. The value of P_{max} before fault is 2.0 per unit and 1.5 per unit after fault clearing. If the fault is cleared in 0.05 seconds, calculate rotor angles at intervals of 0.05 seconds from t = 0 seconds to 0.1 seconds. Assume H = 7.5 HJ/MVA and frequency to be Hz.

23. A single line diagram of a poer network is shown in Fig.23.



The system data is given in the table below:

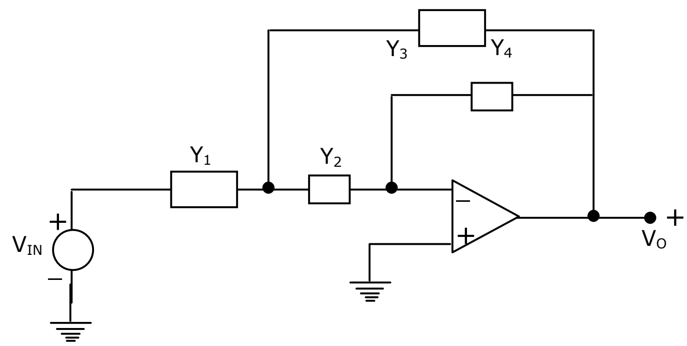
Element	Positive sequence	Negative sequence	Zero sequence
Generator G	0.10	0.12	0.050
Motor M_1	0.05	0.06	0.025
Motor M_2	0.05	0.06	0.025
Transformer T_1	0.07	0.07	0.070
Transformer T_2	0.08	0.08	0.080
Line	0.10	0.10	0.100

Generator ground reactance is 0.5 p.u.

(a) draw sequence networks

(b) find fault currents for a line to line fault on phases B and C at point q. Assume 1.0 p.u. per fault voltage throughout

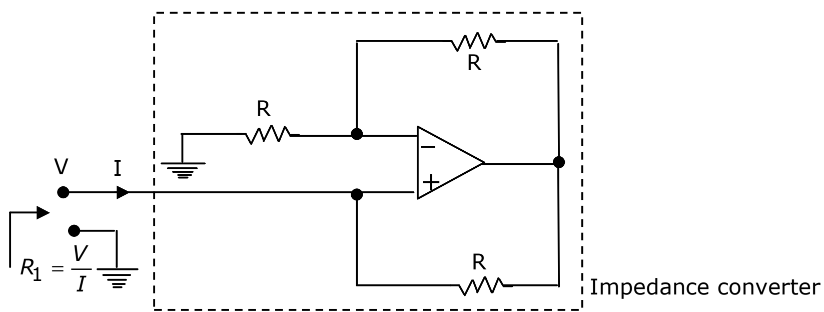
24. (a) Obtain the transfer function $\frac{V_o(s)}{V_{in}(s)}$ for the circuit shown in Fig.24. Assume the op-amp to be ideal. Y_i represents the admittance of branch i.



(b) If $Y_1 = sC_1, Y_4 = sC_4, Y_2 = G_2, Y_3 = G_3,$ what is the nature of the filter that will be realized by the circuit?

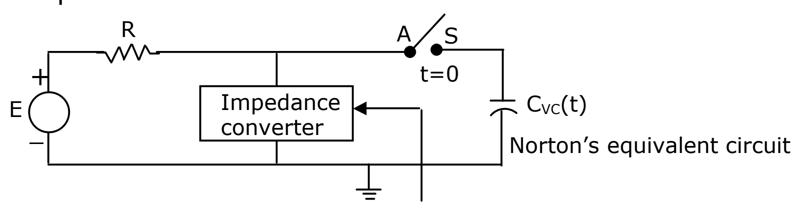
25. A 220 V, 3-phase, 10 kW induction motor has an efficiency of 62% at quarter load and a power factor of 0.45 lagging. The input power is measured by two wattmeter method. What will be the readings of these two wattmeter? Show the connections of these wattmeter indicating the polarity.

26. (a) Fig.26(a) shows an op-amp impedance converter. Find the input impedance R_i



(b) Draw the V-I characteristic of the impedance R_i computed in (a).

(c) The impedance converter is connected to a voltage source E_1 in series with a resistance R as shown in Fig.26(c). Draw the Norton's equivalent circuit looking into point A.



(d) A capacitor C is connected to the point A in Fig.26(c) through a switch S_1 at t = 0. Draw the time response of the voltage across the capacitor $v_c(t)$ for t≥0.

27. Fig.27 shows a self bias transistor amplifier using a silicon transistor with $V_{CC} = 20V, h_{FE} = 400$ and $V_{BE} = 0.65V$. The transistor should be biased at $V_{CE} = 10V$ and $i_c = 0.6mA$. Find the values of the resistances R_c, R_e, R_1 and R_2 such that it meets the following specifications over the temperature range 25°C to 145°C.

$Y_3 = G_3$

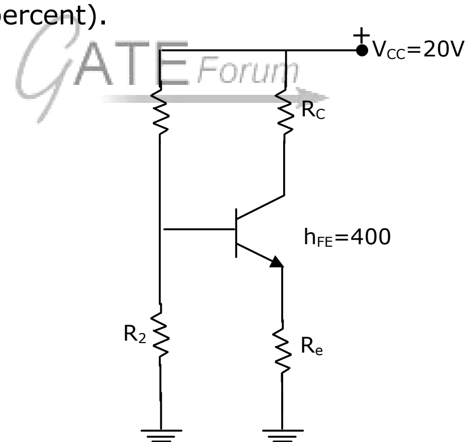
$\frac{\Delta I_C}{I_C} \leq 10\%$

V_{BE} at 25°C = 650±50mV

I_{CO} at 25°C = 5μA max.

I_{CO} at 145°C = 3.0 μA max.

Assume that the percentage change in I_C due to V_{BE} and I_{CO} is same (5 percent).



(a) Write the circuit diagram of a modulo 6 counter using J-K flip-flops.

(b) Using the modulo 6 counter in (a) realize a modulo 12 counter with a square wave output

(c) Machine the four variable logic function

$f(A,B,C,D) = \sum m(2,3,4,5,10,11,12,13)$ using Karnaugh map.