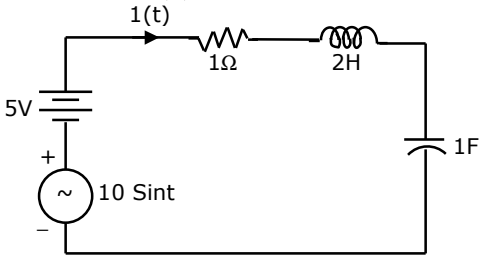
PART – II
SECTION - A

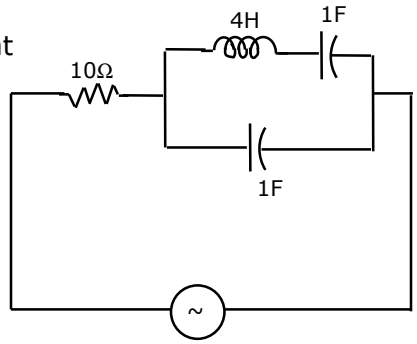
6.1. In the following circuit (figure) $i(t)$ under steady state is:

(a) zero
(b) 5
(c) $7.07 \sin t$
(d) $7.07 \sin(t - 45°)$



6.2 The following circuit (figure) resonates at

(a) all frequencies
(b) 0.5 rad/sec
(c) 5 rad/sec
(d) 1 rad/sec



6.3 Consider a second order system whose state space representation is of the form

$$X = Ax + Bu$$

If $x_1(t) = x_2(t)$, the system is:

(a) controllable
(b) uncontrollable
(c) observable
(d) unstable

6.4 $s(t)$ is step response and $h(t)$ is impulse response of a system. Its response $y(t)$ for any input $u(t)$ is given by

(a) $\frac{d}{dt}\int_0^t s(t-\tau)u(\tau)d\tau$
(b) $\int_0^t s(t-\tau)u(\tau)d\tau$
(c) $\int_0^t\int_0^t s(t-\tau_1)u(\tau_1)d\tau_1 d\tau$
(d) $\frac{d}{dt}\int_0^t h(t-\tau)u(\tau)d\tau$

6.5 The transfer function for the state variable representation

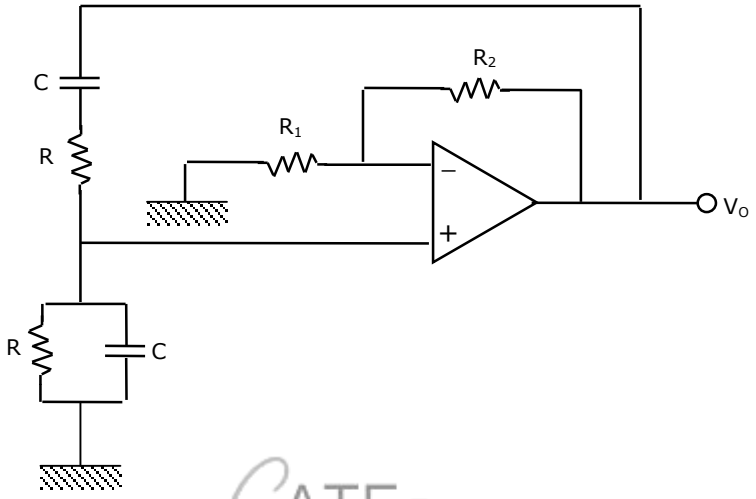
$X = Ax + Bu, y = CX + du$, is given by

(a) $D + C(sI - A)^{-1}B$
(b) $B(sI - A)^{-1}C + D$
(c) $D(sI - A)^{-1}B + C$
(d) $C(sI - A)^{-1}D + B$

6.6 Signal flow graph is used to obtain the

(a) stability of a system
(b) transfer function of a system
(c) controllability of a system
(d) observability of a system

6.7 A Wien bridge oscillator is shown in figure. Which of the following statements are true, if f is the frequency of oscillation?



(a) For R = 1 K, $C = \frac{1}{2\pi}\mu F, f = 1\ kHz$

(b) For R = 3 K, $C = \frac{1}{18\pi}\mu F, f = 3\ kHz$

(c) The gain of the op-amp state should be less than two for proper operation.

(d) The gain of the op-amp stage should be three for proper operation

6.8 A 10 bit A/D converter is used to digitize an analog signal in the 0 to 5 V range. The maximum peak to peak ripple voltage that can be allowed in the D.C. supply voltage is:

(a) nearly 100 mV
(b) nearly 50 mV
(c) nearly 25 mV
(d) nearly 5.0 mV

6.9 Three devices A, B and C have to be connected to a 8085 microprocessor. Device A has highest priority and device C has the lowest priority. In this context which of the following is correct assignment of interrupt inputs?

(a) A uses TRAP, B uses RST 5.5 and C uses RST 6.5

(b) A uses RST 7.5, B uses RST 6.5 and C uses RST 5.5

(c) A uses RST 5.5, B uses RST 6.5 and C uses RST 7.5

(d) A uses RST 5.5, B uses RST 6.5 and C uses TRAP

6.10 V_{RN}, V_{YN} and V_{BN} are the instantaneous line to neutral voltages and i_R, i_y and i_n are instantaneous line current sin a balanced three-phase circuit, the computation, $V_{RN}(i_Y - i_B) - (V_{YN} - V_{BN})i_R$ will yield a quantity proportional to

(a) the active power
(b) the power factor
(c) the reactive power
(d) the complex power

6.11 A CRO screen has ten divisions on the horizontal scale. If a voltage signal $5\sin(314t + 45°)$ is examined with a line base settings of 5 msec/div, the number of cycles of signal displayed on the screen will be

(a) 0.5 cycles (b) 2.5 cycles (c) 5 cycles (d) 10 cycles

6.12 A metal strain gauge has factor of two. Its nominal resistance is 120 ohms. If it undergoes a strain of 10^{-5}, the value of change of resistance in response to the strain is:

(a) 240 ohms
(b) 2×10^{-5} ohms
(c) 2.5×10^{-5} ohms
(d) 1.2×10^{-3} ohms

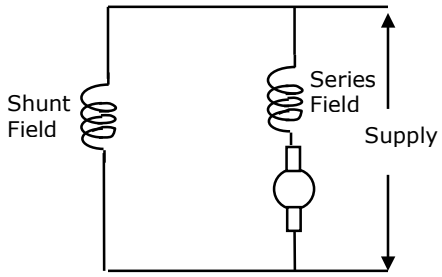
6.13 The line integral of the vector potential A around the boundary of a surface S represents

(a) flux through in the surface S
(b) flux density in the surface S
(c) magnetic density
(d) current density

6.14 A 220/440 V, 50 Hz, 5 kVA single phase transformer operates on 220 V, 40 Hz supply with secondary winding. Then

(a) the eddy current loss and hysteresis loss of the transformer decrease
(b) the eddy current loss and hysteresis loss of the transformer increase
(c) the hysteresis loss of the transformer increases while eddy current loss remains the same
(d) the hysteresis loss remain the same whereas eddy current loss decreases

6.15 A cumulative compounded long shunt motor is driving a load at a rated torque and rated speed. If the series field is shunted by a resistance equal to the resistance of the series field, keeping the torque constant,



(a) the armature current increases (b) the motor speed increases
(c) the armature current decreases (d) the motor speed decreases

6.16 A three phase alternator has negligible stator resistance. A short circuit test is conducted on this alternator. At a particular speed a field current of I_{f1} is required to drive the rated armature current. If the speed of the alternator is reduced to half, the field current required to maintain rated armature current

(a) would be equal to I_{f1} (b) would be equal to $2I_{f1}$
(c) would be equal to $\frac{I_{f1}}{2}$
(d) cannot be predicated due to insufficient data

6.17 A synchronous motor operates at 0.8 p.f. lagging. If the field current of the motor is continuously increased

(a) the power factor decreases upto a certain value of field current and thereafter it increases
(b) the armature current increases upto a certain value of field current and thereafter it decreases
(c) the power factor increases upto a certain value of field current and thereafter it decreases
(d) the armature current decreases upto a certain value of field current and thereafter it increases

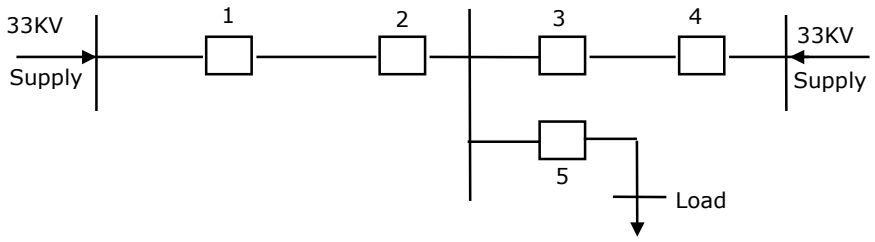
6.18 A three phase slip ring induction motor is fed from the rotor side with stator winding short circuited. The frequency of the currents flowing in the short circuited stator is:

(a) slip frequency (b) supply frequency
(c) frequency corresponding to rotor speed (d) zero

6.19. A three phase overhead transmission line has its conductors horizontally spaced with spacing between adjacent conductors equal to 'd'. if now the conductors of the line are rearranged to form an equilateral triangle of sides equal to 'd' then

(a) average capacitance and inductance will increase
(b) average capacitance will increase and inductance will increase
(c) average capacitance will increase and inductance will decrease
(d) surge impedance loading of the line increases

6.20. The distribution system shown in figure is to be protected by over current system of protection.



For proper fault discrimination directional over current relays will be required at locations

(a) 1 and 4 (b) 2 and 3 (c) 1, 4 and 5 (d) 2, 3 and 5

6.21. The transient stability of the power system can be effectively improved by

(a) excitation control (b) phase shifting transformer

(c) single pole switching of circuit breakers

(d) increasing the turbine valve opening

6.22. In load flow analysis, the load connected at a bus is represented as

(a) constant current drawn from the bus

(b) constant impedance connected at the bus

(c) voltage and frequency dependent source at the bus

(d) constant real and reactive drawn from the bus

6.23. The thermal resistance between the body of a power semiconductor device and the ambient is expressed as

(a) voltage across the device divided by current through the device

(b) average power dissipated in the device divided by the square of the RMS current in the device

(c) average power dissipated in the device divided by the temperature difference from body to ambient.

(d) temperature difference from body to ambient divided by average power dissipated in the device.

6.24. When a line commutated converter operates in the inverter mode

(a) it draws both real and reactive power from the A.C. supply

(b) it delivers both real and reactive power to the A.C. supply

(c) it delivers real power to the A.C. supply

(d) it draws reactive power from the A.C. supply

6.25 a chopper operating at a fixed frequency is feeding an R-L load. As the duty ratio of the chopper is increased from 25% to 75%, the ripple in the load current

(a) remains constant

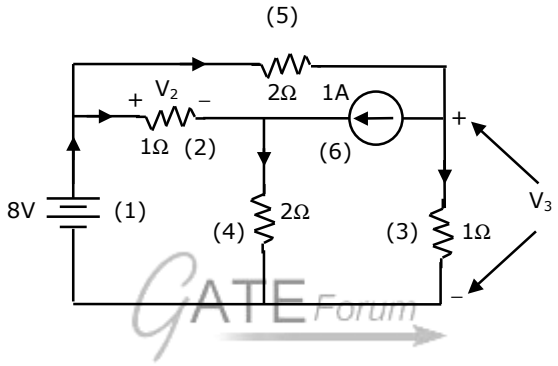
(b) decreases, reaches a minimum at 50% duty ratio and then increases

(c) increases, reaches a minimum at 50% duty ratio and then decreases

(d) keeps on increasing as the duty ratio is increased

SECTION – B

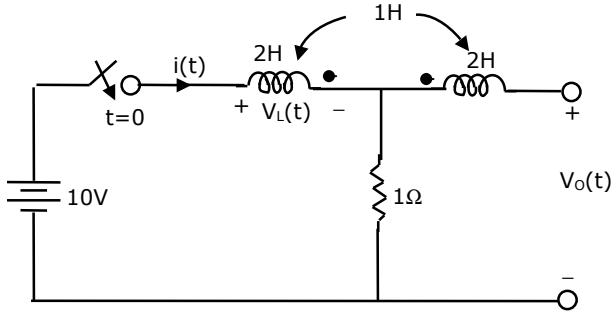
7.1 Determine the voltage V_2 and V_3 in the following circuit(figure below) using cutest analysis. Choose circuit elements marked 1 2 3 in the three for this purpose.



7.2. Consider circuit shown in figure. Determine $v_0(t)$ in terms of $i(t)$. Evaluate.

$$v_0(0^+), \left.\frac{dv_0}{dt}\right|_{t=0^+} \text{ and } \left.\frac{dv_L}{dt}\right|_{t=0^+}$$

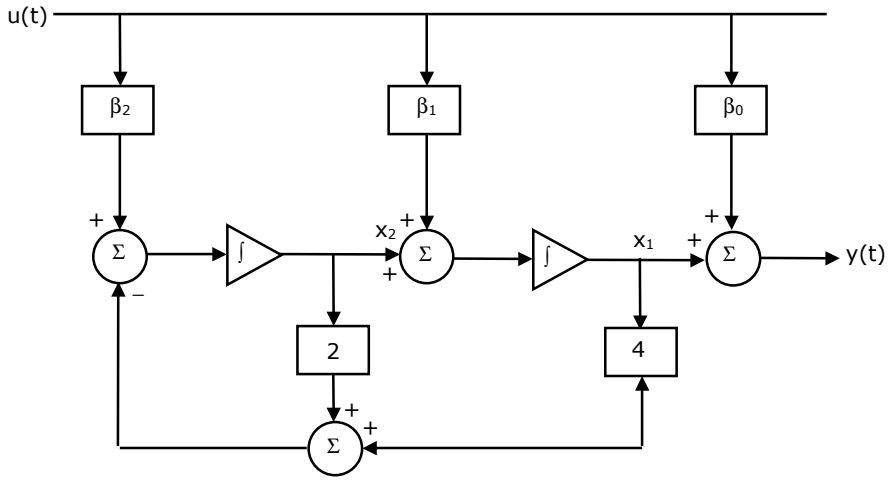
Assume that the switch is closed at $t = 0$.



7.3. A control system is described by the differential equation

$$\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + 4y = 3\frac{d^2u}{dt^2} + 5\frac{du}{dt} + 6u$$

Where, $y(t)$ is the output and $u(t)$ is the input. The realization of the system is shown in figure with β_i as unknown.



7.4. A unity feedback system has the open loop transfer function

$$G(s) = \frac{K}{s(s+1)(s+2)}$$

(i) Calculate the Break away point and the imaginary axis crossing points

(ii) Sketch the root loci as K varies from 0 to ∞.

(iii) Give the procedure for finding closed loop transfer function directly from the root locus diagram for a given damping ratio of dominant root pair.

7.5. A Schmitt trigger is shown in figure (a) and its characteristic is shown in figure (b). Here $V_{OH} = 10V, V_{OL} = -10V, V_{IH} = 5, V_{IL} = -5V$.

(i) If the input is $V_{in} = (1 + 7\sin\omega t)$ volts, where, ω = 200π radians/sec, calculate the time duration in each cycle for which the output of the Schmitt trigger remains at -10V level.

(ii) Draw the circuit diagram of an astable multi-vibrator using the Schmitt trigger in figure (a), a resistor () and a capacitor (C). if the period of this astable multi-vibrats is now to be doubled, what should be the new value of resistance.

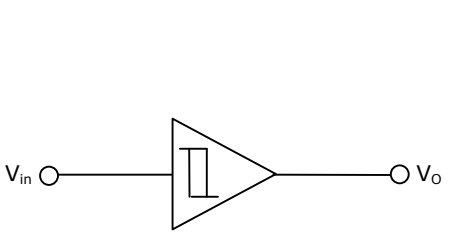


Fig.(a)

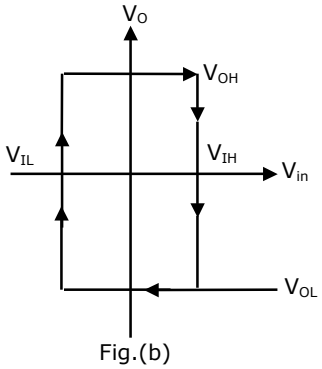


Fig.(b)

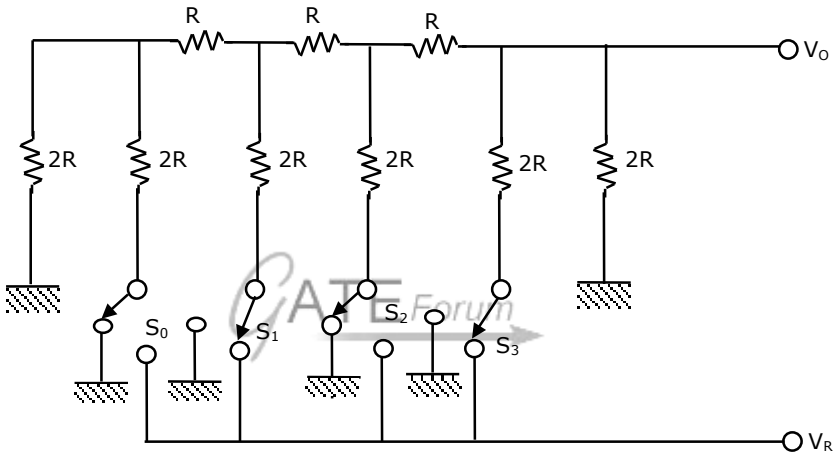
7.6. The output V_0 of an N-bit D/A converter is given by

$$V_0 = \left(2^{N-1}a_{N-1} + 2^{N-2}a_{N-2} + \ldots + 2^2 a_2 + 2^1 a_1 + a_0\right)K$$

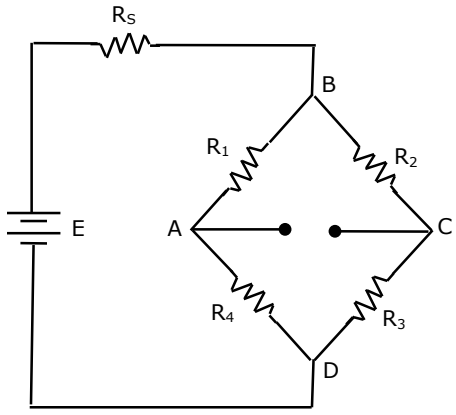
Where, K is a proportionality factor determined by the system parameters and where the coefficients a_j represent the binary word and $a_j = 1(0)$ if the j^{th} bit is $1(0)$.

(i) A 6-bit D/A converter gives $V_0 = 3.6V$ for the word 100100. find the value of V_0 for the word 110011.

(ii) For the R-2R ladder D/A converter (shown in figure) find the value of the output voltage V_0 where $V_R = 6$ Volts. Clearly show the steps in the calculations.



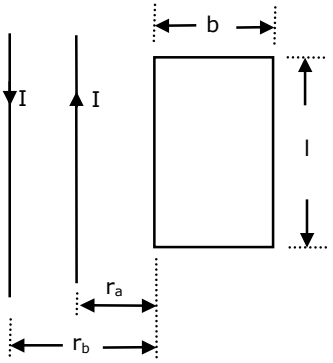
7.7. A bridge circuit is shown in figure.



(a) The output signal of the bridge is V_0. Looking into this part find an expression for the Thevenin equivalent resistance of the bridge.

(b) If $R_1 = R(1-x), R_4 = R(1+x)$ and $R_2 = R_3$, find an expression for the output voltage V_0 in terms of E and x. take $R_s = 0$ in this case.

7.8. A pair of long parallel wires carry a current of I amp in opposite direction in the plane of a closed rectangular loop of wire of dimensions l and b as shown in figure. Determine an expression for the induced electromotive force in the loop using Faraday's law of induction.



7.9. A 10 kW, 240V dc shunt motor draws a line current of 5.2A while running at no load speed of 1200 rpm from a240V dc supply. It has an armature resistance of 0.25 ohm and a field resistance of 160 ohm. Estimate the efficiency of the mtoro when it delivers rated load.

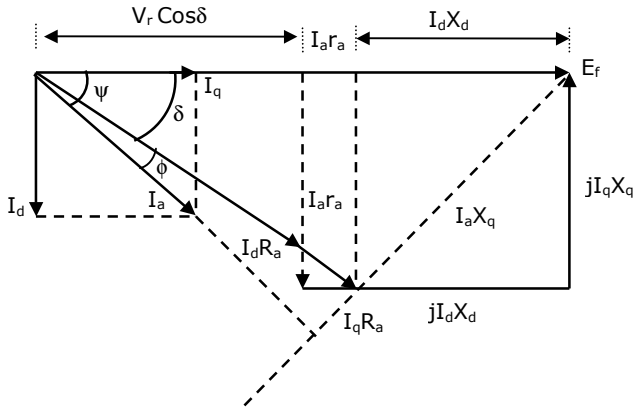
7.10. A 40 kW, 3-phase slip ring induction motor of negligible stator impedance runs at a speed of 0.96 times synchronous speed at rated torque. The slip at maximum torque is 4 times the full load value. If the rotor resistance of the motor is increased by 5 times, determine:

(a) the speed, power output and rotor copper loss at rated torque,

(b) the speed corresponding to maximum torque.

Neglect mechanical losses.

7.11. A 10 kVA, 380V, 50 Hz, 3-phase, star connected salient pole alternator has direct axis and quadrature axis reactances of 12 ohm and 8 ohm respectively. The armature has a resistance of 1Ω per phase. The generator delivers rated load at 0.8 p.f. lagging with the terminal voltage being maintained at rated value. If the load angle is 16.15°, determine

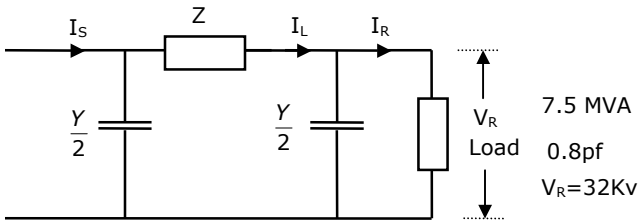


(a) the direct and quadrature axis components of armature current.

(b) excitation voltage of the generator.

7.12. A 33 kV single circuit, 3-phase transmission line has the ABCD parameters $A = D = 1\angle 0°, B = 11.18\angle 63.43°$ ohm.

The line is to deliver 7.5 MVA at 0.85 pf lagging at the load end. The receiving end voltage is 32 kV (line to line). How much active and reactive power is to be dispatched from the sending end?



7.13. A 3-phase, star connected generator supplies a star connected inductive load through a transmission line. The star point of the load is grounded and the generator neutral is ungrounded. The load reactance is j 0.5 p.u per phase and the line reactance is j 0.1 p.u. per phase. The positive, negative and zero sequence reactances of the generator are j 0.5, j0.5 and j0.05 p.u respectively.

7.14. A 3-phase fully controlled thyristor bridge converter is operated from an a.c. supply of 400 V rms line to line. When the converter is operated in the rectifier mode at a control angle α = 30°, the overlap angle (γ) due to the line reactance is 15°. Calculate the reduction in d.c. output voltage due to the overlap. If the converter operates in the inverter mode with a α = 120° and without any change in the d.c. load current, what will be the overlap angle (γ)

7.15. A separately excited d.c. motor has the following name plate data:

220 V, 100 A, 2200 rpm

The armature resistance is 0.1 ohm and inductance is 5 mH. The motor is fed by a chopper which is operating from a d.c. supply of 250 V. Due to restrictions in the power circuit, the chopper can be operated over a duty cycle range from 20% to 80%. Determine the range of speeds over which the motor can be opeated at rated torque.