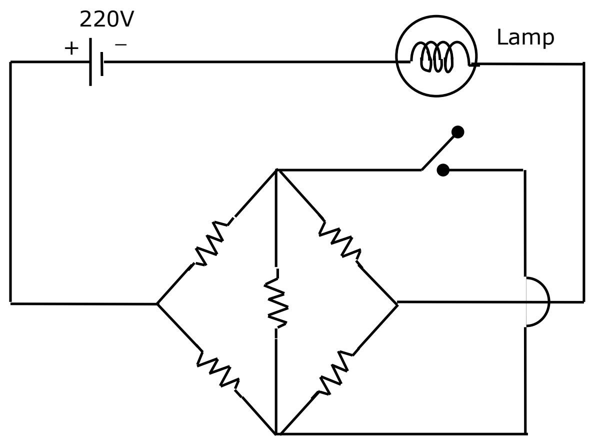
PART - A

OBJECTIVE TYPE

1.1 All resistances in the circuit in figure are of R ohms each. The switch is initially open. What happens to the lamp's intensity when the switch is closed?



(a) increases
(b) decreases
(c) remains the same
(d) answer depends on the value of R

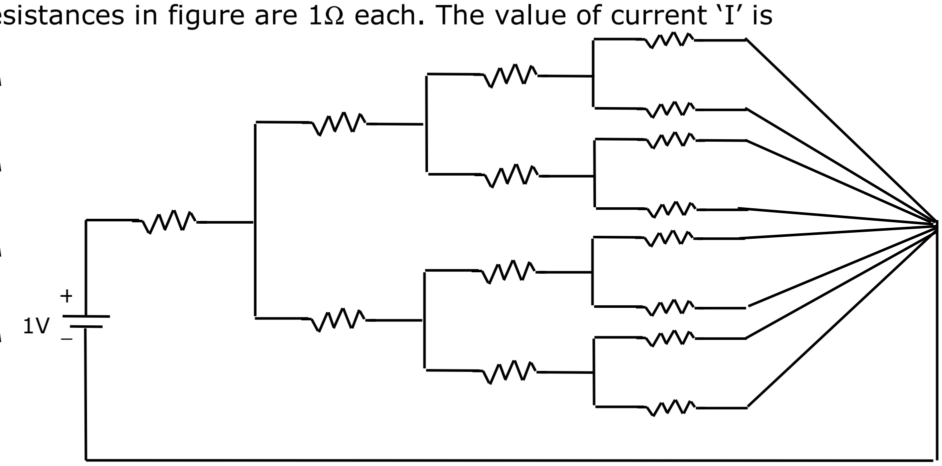
1.2 All the resistances in figure are 1Ω each. The value of current 'I' is

(a) $\frac{1}{15}A$

(b) $\frac{2}{15}A$

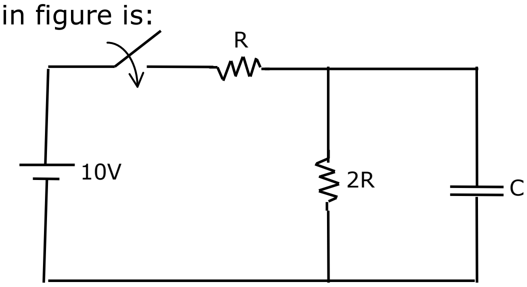
(c) $\frac{4}{15}A$

(d) $\frac{8}{15}A$



1.3 The time constant of the network shown in figure is:

(a) 2 RC
(b) 3 RC
(c) $\frac{RC}{2}$
(d) $\frac{2RC}{3}$



1.4 A unity feedback system has the open-loop transfer function

$$G(s) = \frac{1}{(s-1)(s+2)(s+3)}$$

The Nyquist plot of G encircles the origin

(a) Never (b) Once (c) Twice (d) Thrice

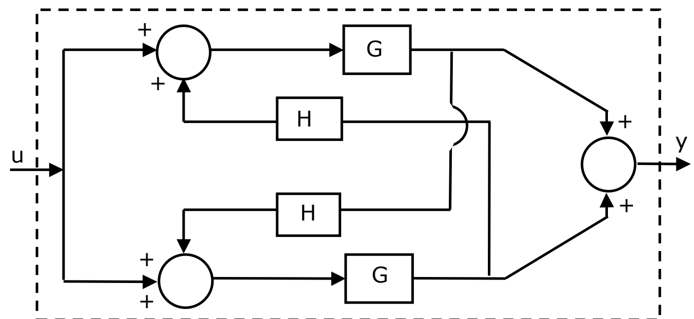
1.5 The Nyquist plot encloses the origin only once from the above figure. Hence choice B is correct. The overall transfer function of the system in figure is:

(a) $\frac{G}{1-GH}$

(b) $\frac{2G}{1-GH}$

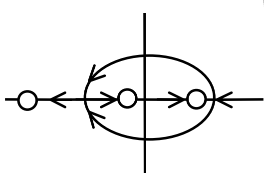
(c) $\frac{GH}{1-GH}$

(d) $\frac{2G}{1-H}$

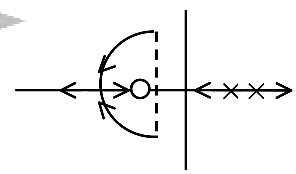


1.6 Which of the following figure(s) represent valid root loci in the s-plane for positive K? Assume that the system has a transfer function with real co-efficients.

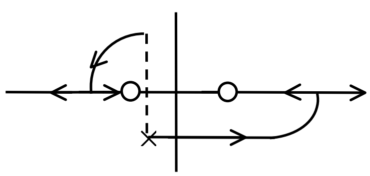
(a)



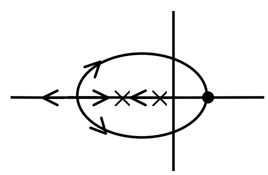
(b)



(c)



(d)



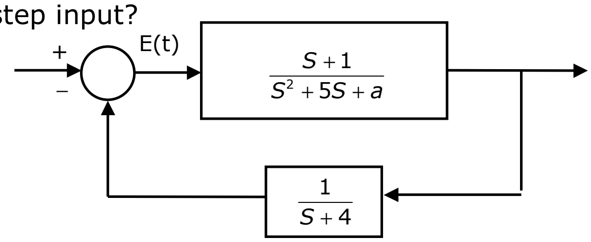
1.7 For what values of 'a' does the system shown in figure have a zero steady state error [i.e. $\lim_{t\to\infty} \in (t)$] for a step input?

(a) a = 0

(b) a ≠ 0

(c) a ≥ 4

(d) for no value of 'a'



1.8 In a Common Emitter amplifier, the unbypassed emitter resistance provides

(a) Voltage shunt feedback (b) Current series feedback

(c) Negative voltage feedback (d) Positive current feedback

1.9 An ideal OPAMP is used to make an inverting amplifier. The two input terminals of the OPAMP are at the same potential because

(a) the two input terminals are directly shorted internally

(b) the input impedance of the OPAMP is infinity

(c) the open loop gain of the OPAMP is infinity

(d) CMRR is infinity

1.10 In an RC-coupled Common Emitter amplifier, which of the following is true?

(a) Coupling capacitance affects the h_f response and bypass capacitance affects the I_f response.

(b) Both coupling and bypass capacitances affect the I_f response only

(c) Both coupling and bypass capacitances affect the h_f response only

(d) Coupling capacitance affects the I_f response and the bypass capacitance affects the h_f response.

1.11 If the HLT instruction of 8085 microprocessor is executed,

(a) the microprocessor is disconnected from the system bus till the Reset is pressed

(b) the microprocessor enters into a Halt state and the buses are tri-stated

(c) the microprocessor halts execution of the program and returns to monitor

(d) the microprocessor reloads the program from the locations 0024 and 0025 H.

1.12 An unshielded moving iron voltmeter is used to measure the voltage in an a.c. circuit. if a stray d.c. magnetic field having a component along the axis of the meter coil appears, the meter reading would be

(a) unaffected (b) decreased (c) increased

(d) either decreased or increased depending on the direction of the d.c. field

1.13 A resistance is measured by the voltmeter ammeter method employing d.c. excitation and a voltmeter of very high resistance connected directly across the unknown resistance. If the voltmeter and ammeter readings are subject to maximum possible errors of ±2.4% and ±1.0% respectively, then the magnitude of the maximum possible percentage error in the value of resistance deduced from the measurement is nearly

(a) 1.4% (b) 1.7% (c) 2.4% (d) 3.4%

1.14 The number of comparators needed in a parallel conversion type 8-bit A to D converter is:

(a) 8 (b) 16 (c) 255 (d) 256

1.15 In d.c. potentiometer measurements, a second reading is often taken after reversing the polarities of the d.c. supply and the unknown voltage, and the average of the two reading is taken. This is with a view to eliminate the effects of

(a) ripples in the d.c. supply (b) stray magnetic fields
(c) stray thermal emfs (d) erroneous standardization

1.16 Which of the following equations represents the Gauss' law in a homogenous isotropic medium?

(a) $\oint\!\!\oint \vec{D}.\vec{d}s = \iiint \rho dV$ (b) $\overline{V} \times \overline{H} = \overline{D}$ (c) $\overline{V}.\vec{J} + \rho = 0$ (d) $\overline{V}.\vec{E} = \frac{\rho}{\varepsilon}$

1.17 Two transformers of the same type, using the same grade of iron and conductor materials, are designed to work at the same flux and current densities; but the linear dimensions of one are two times those of the other in all respects. The ratio of kVA of the two transformers closely equals

(a) 16 (b) 8 (c) 4 (d) 2

1.18 The torque angle of a synchronous machine operating from a constant voltage bus, is usually defined as the space angle between

(a) Rotor *mmf* wave and stator *mmf* wave
(b) Rotor *mmf* wave and resultant flux density wave
(c) Stator mmf wave and resultant flux density wave
(d) Stator mmf wave and resultant mmf wave

1.19. Neglecting all losses, the develop torque (T) of a d.c. separately excited motor operating under constant terminal voltage, is related to its output power (P) as under

(a) $T \propto \sqrt{P}$ (b) $T \propto P$ (c) $T^2 \propto P^3$
(d) T independent of P

1.20. The developed electromagnetic force and/or torque in electro-mechanical energy conversion system act in a direction that tends

(a) to increase the stored energy at constant mmf
(b) to decrease the stored energy at constant flux
(c) to decrease the co-energy at constant mmf
(d) to decrease the stored energy at constant mmf

1.21. Two transformers of different kVA ratings working in parallel share the load in proportion to their ratings when their

(a) per unit leakage impedances on the same kVA base are the same
(b) per unit leakage impedances on their respective ratings are equal

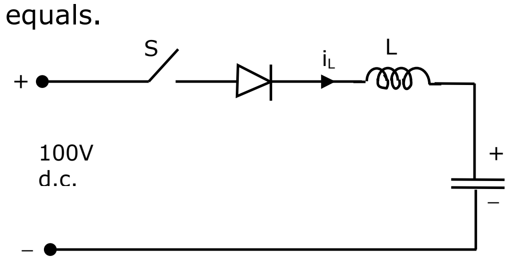
(c) ohmic voltages of the leakage impedances are inversely proportional to their ratings.
(d) ohmic values of the magnetizing reactances are the same

1.22. The inductance of a power transmission line increases with
(a) decreases in line length
(b) increase in diameter of conductor
(c) increase in spacing between the phase conductors
(d) increase in load current carried by the conductors

1.23. The selection of size of conductors for a distributor in a distribution system is governed by
(a) corona loss
(b) temperature rise
(c) radio interference
(d) voltage drop

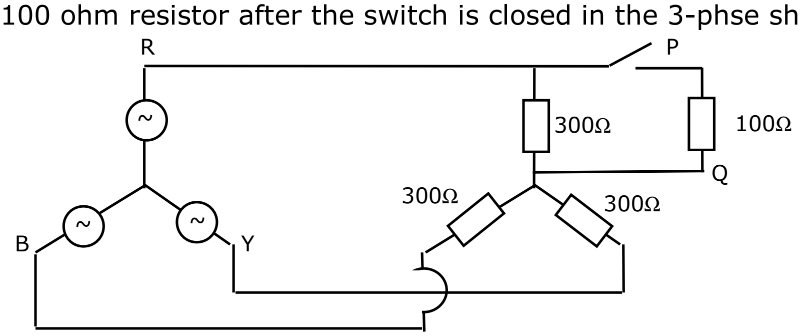
1.24. A Buchhholz relay is used for
(a) protection of a transformer against all internal faults
(b) protection of a transformer against external faults
(c) protection of a transformer against both internal and external faults
(d) protection of induction motors.

1.25 In the circuit of figure, the switch 'S' is closed at t = 0 with $i_L(0) = 0$ and $v_c(0) = 0$. In the steady state v_c equals.
(a) 200 V
(b) 100 V
(c) zero
(d) - 100 V



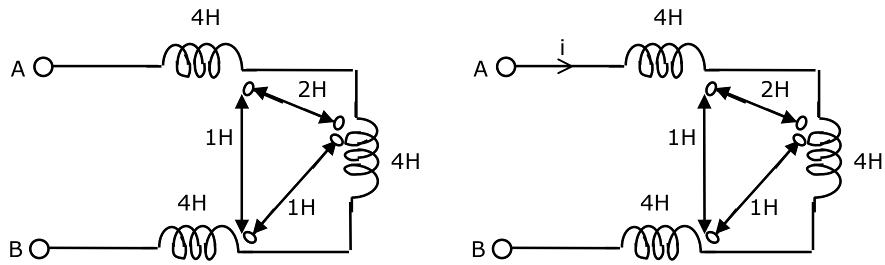
2.

2.1 Using Thevenin equivalent circuit, determine the rms value of the voltage across the 100 ohm resistor after the switch is closed in the 3-phse shown in figure.



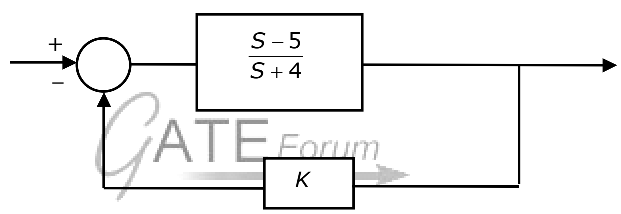
400V/3 Phase Balanced Source:

2.2. The equivalent inductance seen at terminals A – B in figure is ________ H.

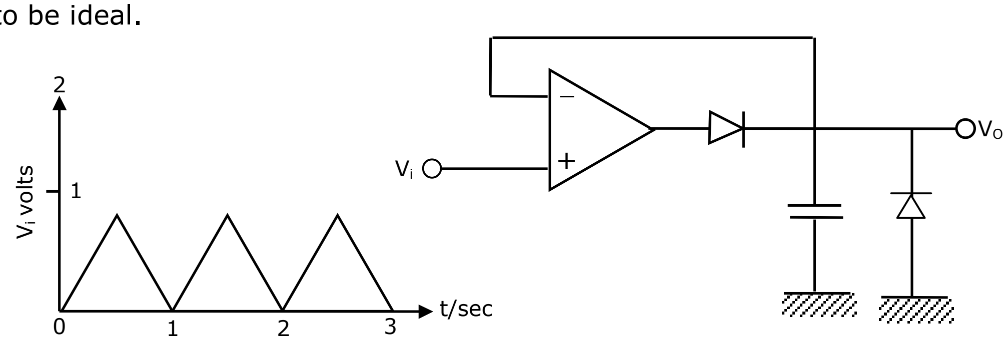


2.3. The impulse response of a network is $h(t) = 1$ for $0 \le t \le 1$ and zero otherwise. Sketch the impulse response of two such networks in cascade, neglecting loading effects.

2.4. For what range of K is the following system (figure) asymptotically stable? Assume K≥0.

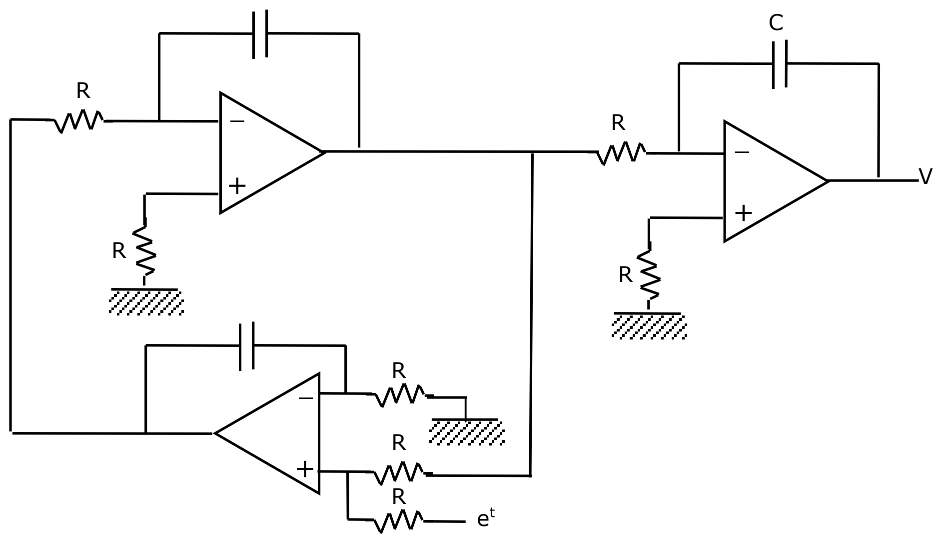


2.5. The circuit shown in figure is excited by the input v_i as shown. Sketch the waveform of the output v_o, indicating the salient values. Assume all components to be ideal.



2.6. In the following circuit (figure) the 5V zener diode requires a minimum current of 10 mA. For obtaining a regulated output of 5V, the maximum permissible load current, I_L, is ______ mA and the minimu power ratings of zener diode is _____W.

2.7. In the following circuit (figure), the output V follows an equation of the form
$$\frac{d^2v}{dt^2} + a\frac{dv}{dt} + bv = f_{(t)}.$$ Find a, b and $f_{(t)}$.



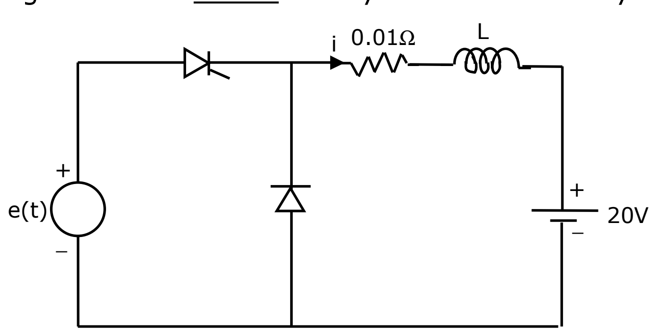
2.8. In a dual slope integrating type digital voltmeter the first integration is carried out for 10 periods of the supply frequency of 50 Hz. If the reference voltage used is 2V, the total conversion time for an input 1 V is __________ seconds.

2.9. An electrostatic potential is given by $\phi = 2x\sqrt{y}$ volts in the rectangular co-ordinate system. The magnitude of the electric field at x = 1m, y = 1m is _____ V/m.

2.10. A separately excited d.c. motor has an armature resistance of 0.5 ohm. It runs of a 250 V d.c. supply drawing an armature current of 20A at 1,500 rpm. The torque developed for an armature current of 10A will be _____ for the same field current.

2.11. In load flow studies of a power system, the quantities specified at a voltage controlled bus are _____ and _____.

2.12. In the circuit shown in figure, L is large and the average value of 'i' is 100A. the thyristor is gated in the _____ half cycle of 'e' at a delay angle α equal to _____.



3.1. Match the following transfer functions and impulse responses.

Transfer functions

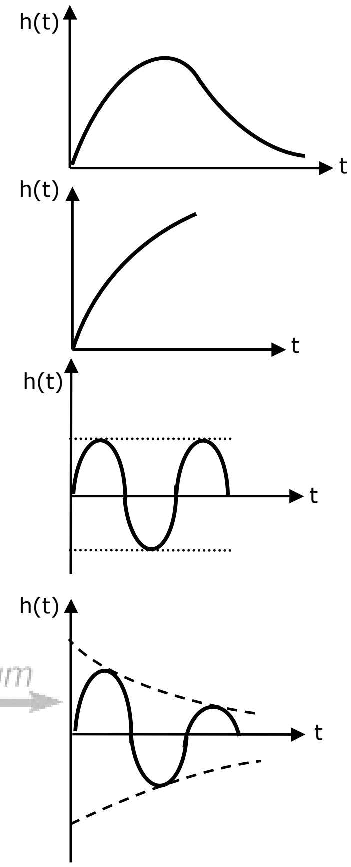
(a) $\frac{s}{s+1}$

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

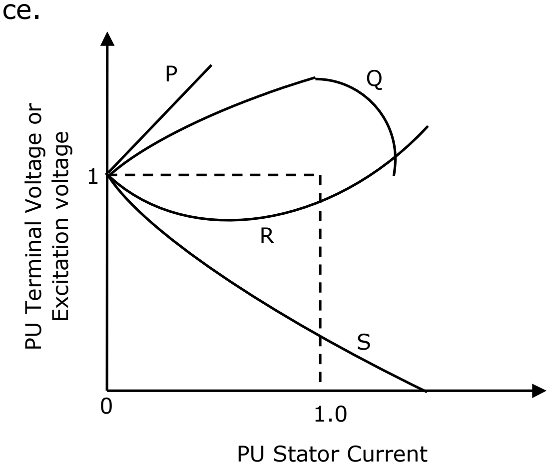
(c) $\frac{1}{s(s+1)+1}$

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

Impulse Responses



3.2. Figure depicts the load characteristics of an isolated three-phase alternator, running at constant speed. Match the following sets of operating conditions with the given characteristics. Disregard the effects of the saliency, saturation and stator resistance.



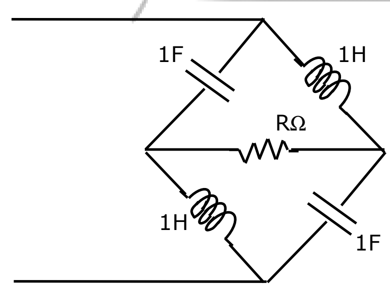
(a) Constant excitation and non-zero leading power-factor
(b) Constant excitation and zero power factor, leading
(c) Constant terminal voltage and zero power factor, leading
(d) Constant terminal voltage and non-zero leading power factor

3.3. Match the following:

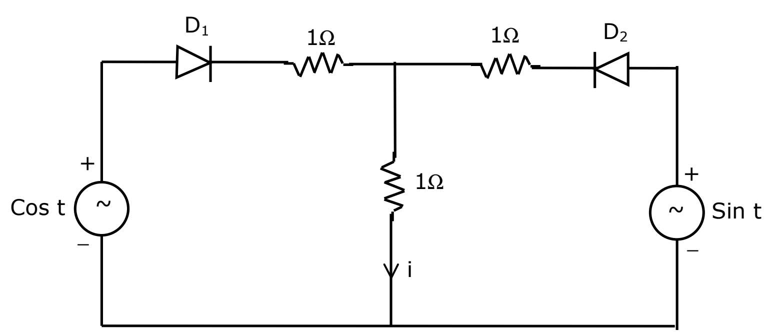
Equipment	Function
(A) Circuit breaker	(P) Voltage control
(B) Lighting arrester	(Q) Power control
(C) Governor	(R) Over voltage protection
(D) Exciter	(S) Over current protection

PART – B
NON-OBJECTIVE TYPE

4. For what value of R can one replace the circuit of figure by a pure resistance at all frequencies?



5. In the circuit shown in figure calculate and sketch the waveform of current *i* over one period of the input voltages. Assume the diodes to be ideal.



6. A control system is described by the differential equation, $\frac{d^3y(t)}{dt^3} = u(t)$ where $y(t)$ is the observed output and $u(t)$ is the input.

(a) Describe the system in the state variable for, i.e., $\dot{x} = Ax + Bu, y = Cx + Du$

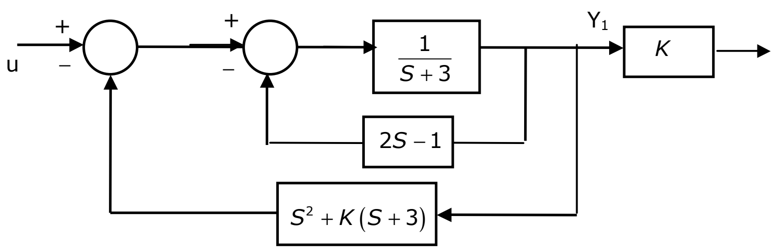
(b) Calculate the state transition matrix e^{At} of the system.

(c) Is the system controllable

7. (a) Find the overall transfer function of the system shown in figure.

(b) Sketch the root loci as K varies from zero to ∞

(c) Calculate the break away points.



8. (a) For the circuit shown in figure (a).

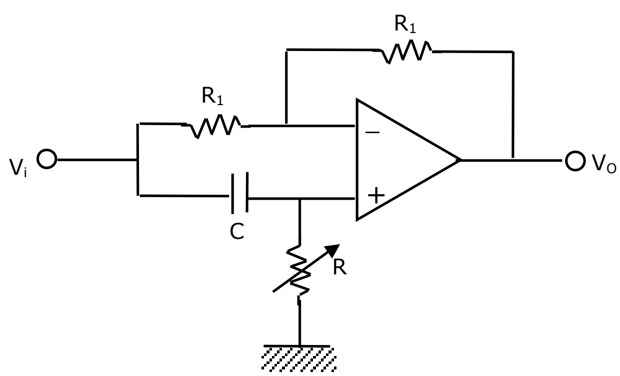
(i) Calculate the transfer function $\frac{V_o}{V_i}$.

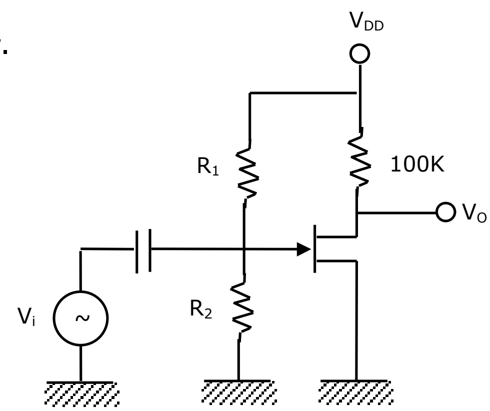
(ii) Plot the amplitude and phase response as a function of frequency for $R = R_1$.

(b) For the JFET amplifier shown in figure (b). μ=100 and $r_d = 50$ kΩ

(i) Draw the a.c. equivalent circuit.

(ii) Find the voltage gain of the amplifier.





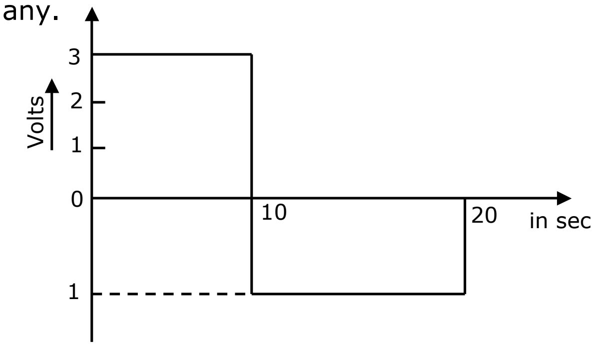
9. A digital system has four bits of a 4-bit word 'A B C D' as inputs. The output Y is equal to 1 when any two adjacent bits are 1, or any three or all four bits are

(a) Draw the Karnaugh map for Y.

(b) Find the minimal expression for Y in the 'Sum-of-product' form.

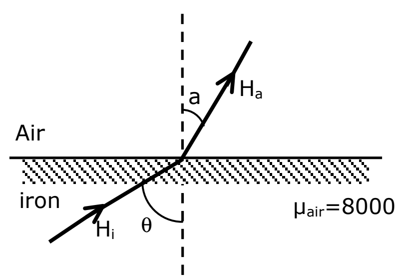
(c) Realize Y using 2-input and 3-input NAND gates only.

10. A periodic voltage whose waveform over one complete period is shown in figure is applied to the following types of commercial voltmeters.
(a) Permanent magnet moving coil (PMMC) meter with centre zero
(b) Moving iron type meter
(c) Full wave rectifier type a.c. voltmeter
(d) Peak response type electronic voltmeter
Find the reading(s) of each instrument, considering the effects of the reversal of connection, if any.



11. The power supplied by a 240 V single phase a.c. source to an inductive load is measured by a dynamoment wattmeter as 700 watts. The pressure coil branch of the wattmeter has a phase angle of 2°. When the wattmeter is replaced by a second wattmeter having a phase angle of 1° for the resistance of its press are coil branch, a reading of 620 watts is obtained. Calculate the actual power and current taken by the load, assuming that all errors of the watt meters except those due to pressure coil inductance are negligible.

12. A steady magnetic field of 100 amp/m is incident on an iron-air boundary as shown in figure. Relative permeability of iron is 8,000.



(a) Write the boundary conditions for the magnetic field in terms of the indicated variables and parameters, assuming surface currents to be absent.
(b) Plot α as θ for the range $0 \le \theta \le \frac{\pi}{2}$
(c) For $\theta = \frac{\pi}{4}$, find the magnitude and direction of magnetic flux density in air at the interface.

13. A 3-phase, 415 V, 6-pole, 50 Hz, star-connected synchronous motor has an emf of 520 V (L-L). The stator winding has a synchronous reactance of 2 ohms/phase, and the motor develops a torque of 220 N-m. The motor is operating off 415V, 50 Hz bus.

(a) Calculate the current drawn from the supply and its power factor.

(b) Draw the phasor diagram showing all the relevant quantities.

14. An induction motor runs at a slip frequency of 2 Hz when supplied from a three phase, 400 V, 50 Hz supply. For the same developed torque, find the slip frequency at which it will run when supplied from a three-phase 340V, 40 Hz system. Slip at which the machine develops maximum torque using 50 Hz supply is 0.1. Neglect the stator impedance and assume linear torque-slip characteristic between zero torque and maximum torque in the working region.

15. The maximum efficiency of a 3-phase 11,000/400 V, 500 kVA transformer is 98.8% and occurs at 80% full load, unity power-factor. Its percentage impedance is 4.5%. Load power-factor is now varied while the load current and the supply voltage are held constant at their rated values. Determine the load power factor at which the secondary terminal voltage is minimum and find the value of the later.

16. A 200 km, 3-phase, 50 Hz transmission line has the following data:

$A = D = 0.938\angle 1.2^\circ$

$B = 131.2\angle 72.3$ ohms/phase

$C = 0.001\angle 90^\circ$ siemens/phase

The sending end voltage is 230 kV. Determine

(a) the receiving end voltage when the load is disconnected

(b) the line charging current

(c) the maximum power that can be transmitted at a receiving end voltage of 220 kV and the corresponding load reactive power required at the receiving end.

17. A single line diagram of a power system is shown in figure, where the sequence reactances of generator (G), synchronous motor (M) and transformers (T_1, T_2) are given in per unit. The neutrals of the generator and transformers are solidly grounded. The motor neutral is grounded through a reactance $X_n = 0.05$ per unit. Draw the positive, negative and zero sequence networks with reactance values in per unit on a 100 MVA, 13.8 kV base in the zone of the generator. The pre-fault voltage is $1.05\angle 2^\circ$ per unit.

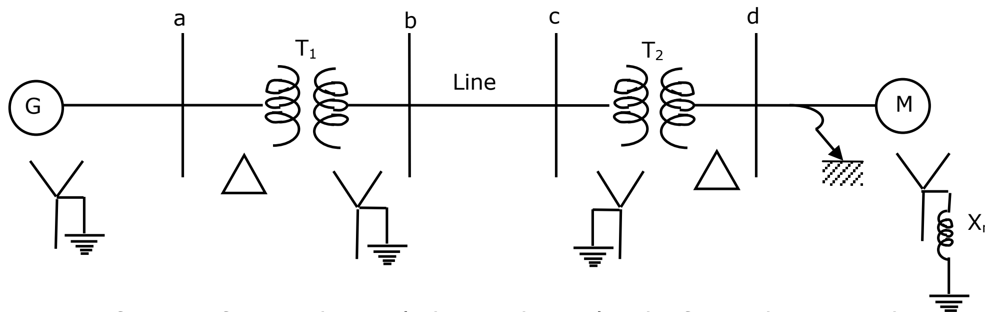
Calculate the per unit fault current for a three-phase to ground fault at bus 'd'. The system data are as follows :

G – 100 MVA; 13.8 kV; $X_1 = 0.15; X_2 = 0.17; X_0 = 0.05$

T_1, T_2 – 120 MVA; 13.8 kV/138 kV Δ/Y; X = 0.12

M – 100 MVA; 13.8 kV; $X_1 = 0.2, X_2 = 0.21, X_0 = 0.1; X_n = 0.05$

Line - $X_1 = X_2 = 20$ ohms; $X_0 = 60$ ohms



18. The power factor of an industrial three-phase load of 490 kW is to be improved from 0.7 lagging to 0.97 lagging by connecting loss free delta connected capacitors across the 6.6 kV, 50 Hz supply. The cost of suitable capacitors and control gear is Rs.200 per kVAR and the annual tariff charge is Rs.120 per kVA maximum demand. The annual interest and depreciation charges are 15 per cent. Calculate,
    (a) the total kVAR rating of capacitors required
    (b) the required value of capacitance per phase
    (c) the net annual saving.

19. A line commutated a.c. to d.c. converter is shown in figure. It operates from a three-phase, 50 Hz, 580 V (line-to-line) supply. It supplies a load current, I_o of 3464 A. Assume I_o to be ripple free and neglect source impedance.
    (a) Calculate the delay angle α of the converter if its average output voltage is 648 V.
    (b) Calculate the power delivered to the load R in kW.
    (c) Sketch the waveform of the supply current i_A vs time (m sec.)
    (d) Calculate fundamental reactive power drawn by converter from the supply in kVAR.