

First Midterm Examination

Subject:- Switchgear & Protection.

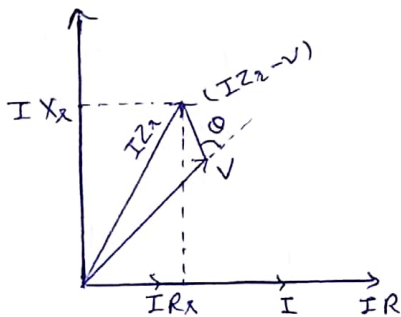
Code:- GEE3A

Q ①

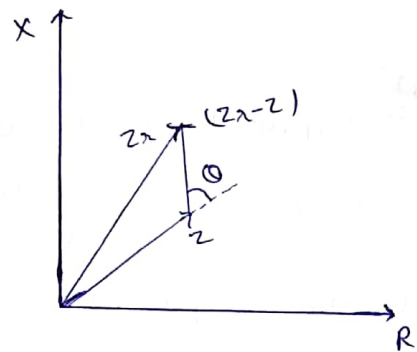
Ans: (a) Static MHO Relay Using a phase Comparator:-

Fig. (a) shows a vector diag. showing voltage, current and voltage drops. If we divide all vectors of the diag. by I , the resulting vector diag. will be as shown in fig. (b). The phase angle b/w V & $(IZ_x - V)$ is θ . Now draw a circle with Z_x as diameter, as shown in fig. (c). If the point P lies within the circle, θ is less than $\pm 90^\circ$. Therefore to realize a MHO char. the phase angle θ between $(IZ_x - V)$ & V is compared with $\pm 90^\circ$.

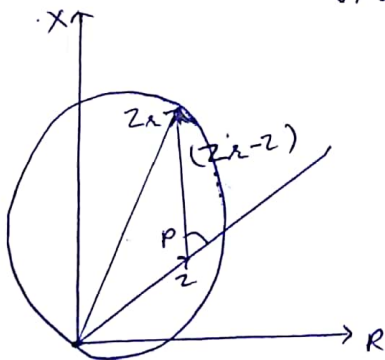
A rectifier bridge phase comparator as shown in fig. (d). can be employed to realize a MHO char. The inputs to the phase comparator are $(IZ_x - V)$ and V . A phase Comparator circuit using an operational amplifier has been shown in fig.



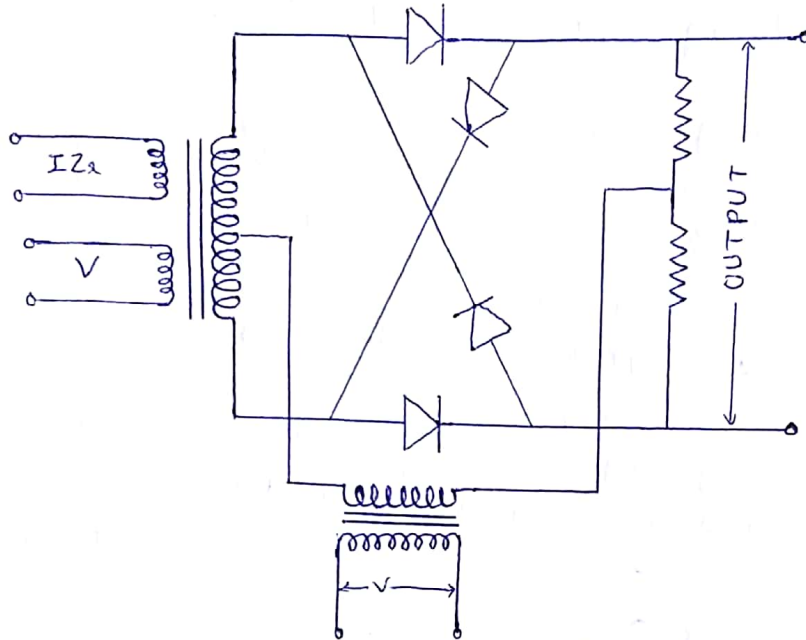
(a) Phase diag. showing V, I & Voltage drop.



(b) Impedance Diagram.



(c) MHO characteristic.



(d) Rectifier bridge phase comparator.

Ans: - (B)

Coincidence Circuit Type Phase Comparators: -

If Two signals have a phase difference, of similar polarities, of coincidence of such signals is $\psi \doteq (180 - \alpha)$. If the operation is desired for a phase angle less than say $\pm 90^\circ$ then coincidence period should be greater than 90° .

Thus the criterion for operation becomes

$$-90^\circ \leq \alpha \leq +90^\circ$$

Different techniques have been used for measured the period of coincidence. These are -

- (i) Direct or block spike phase comparison.
- (ii) phase splitting techniques.
- (iii) Integrating type phase comparator
- (iv) Rectifier phase comparator.
- (v) Time bias type comparator.

or block spike phase comparison :-

In this method the input is converted into a square wave & the other into a pulse of short duration at the instant of zero crossing peak value or any other (θ) instant. The spike and the block signals are then fed through an AND gate.

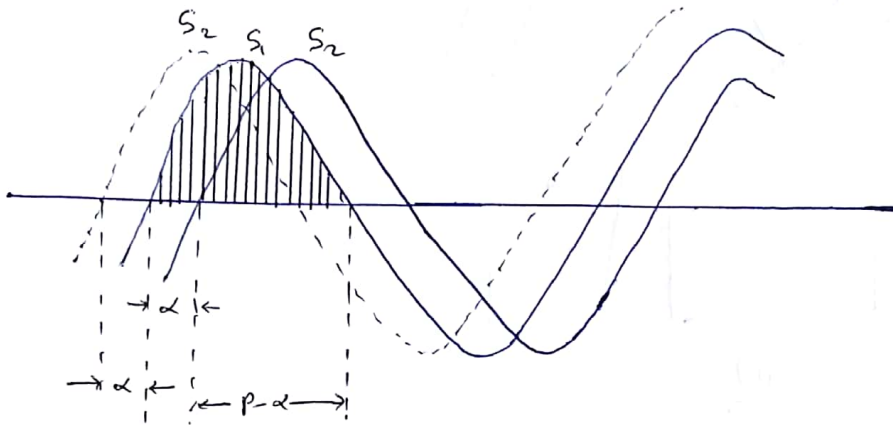
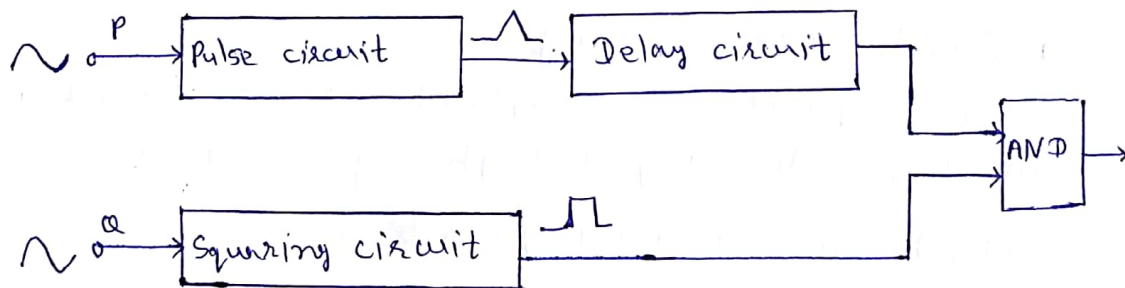


Fig:- Coincidence of two sinusoidal input.

Output will be available from AND Gate for different phase difference as follows:-

- (i) With spike derived at peak value output for $-90^\circ \leq \alpha \leq +90^\circ$
- (ii) With spike derived at zero value output for $0 \leq \alpha \leq 180^\circ$
- (iii) With spike derived at any other instant output for $\theta \leq \alpha \leq (180 - \theta)$



(a)

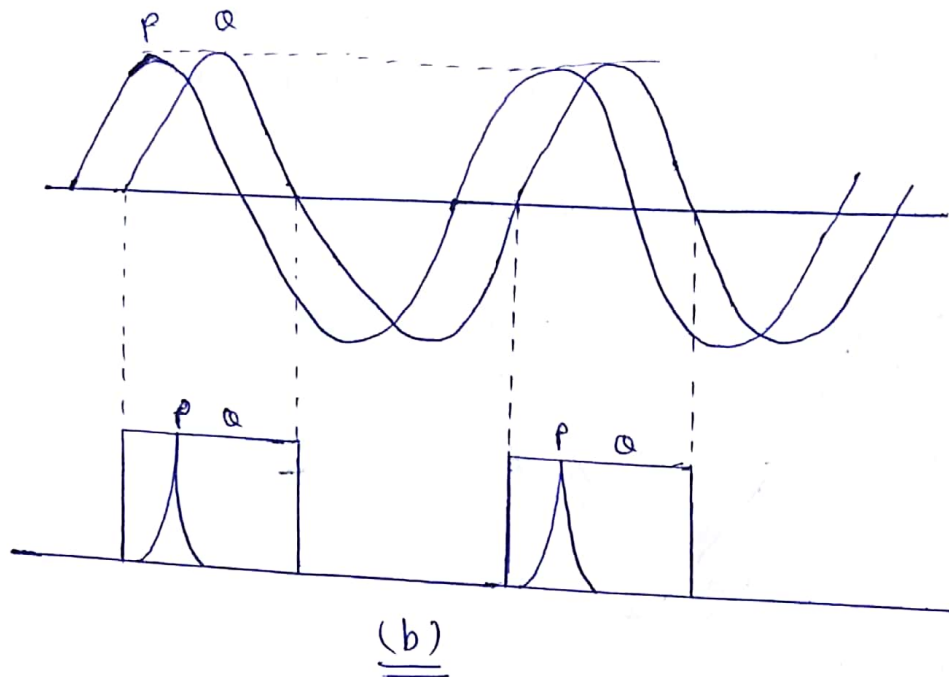


Fig:- Direct Phase Comparison Technique.

The spike is always produced at the zero value as this is the simplest method and then shifting it in phase as required in (1), (2), (3) above. Spikes may be produced by different methods when actual circuits will be illustrated under different applications.

Q. ②

Ans:- (a) Merits & Demerits of Static relay over analog relay:-

Merits:-

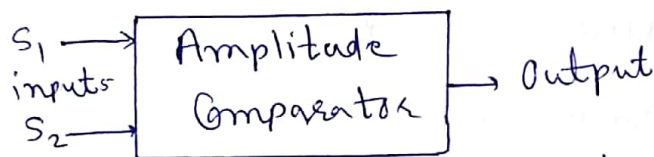
- (i) Quick response, long life.
- (ii) Shock proof, fewer problems of maintenance.
- (iii) High reliability & high degree of accuracy.
- (iv) Absence of moving contacts.
- (v) Quick reset Action.
- (vi) No effect of gravity.
- (vii) Characteristics are easy & accurate.
- (viii) Static relay very compact.

Merits:-

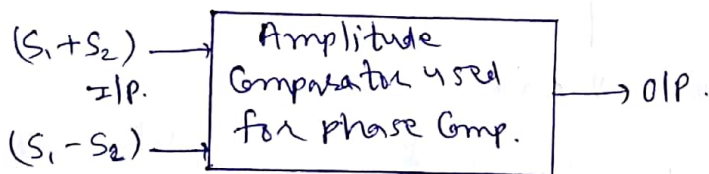
- (i) Auxiliary DC supply is required.
- (ii) Static relay are sensitive to voltage spikes.
- (iii) Reliability depends upon large no. of components
- (iv) The static relay have low short time overload capacity.
- (v) Static relay are costlier.
- (vi) Highly trained personal are required for their servicing.

Ans:- (b) Duality between phase & amplitude comparator:-

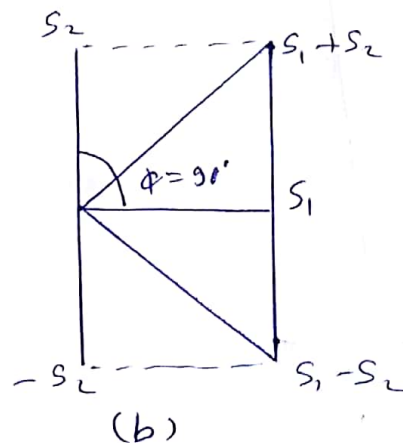
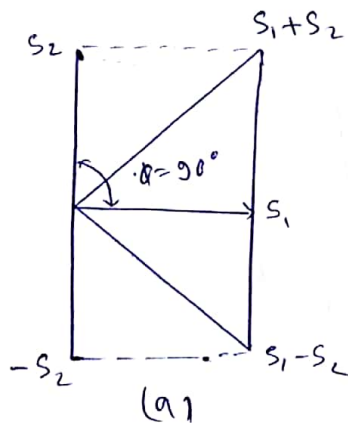
Consider the operation of an amplitude comparator with input signals $S_1 + S_2$ such that it operates when $|S_1| > |S_2|$.
If the input are changed to $|S_1 + S_2|$ and $|S_1 - S_2|$ so that it operates when $|S_1 + S_2| > |S_1 - S_2|$.

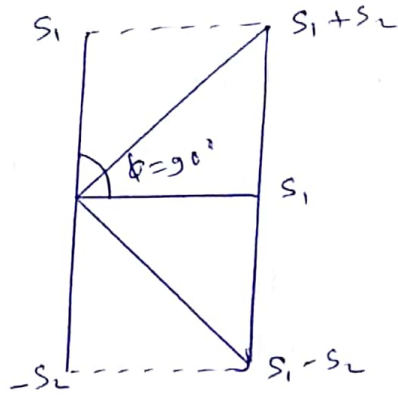


(a) Amplitude comparator with input S_1, S_2 .



(b) Amplitude Comparator used for phase comparison





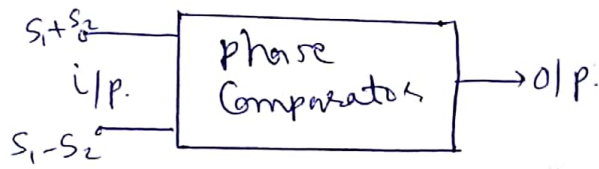
(c)

Fig:- Phase Comparison using an Amplitude Comparator



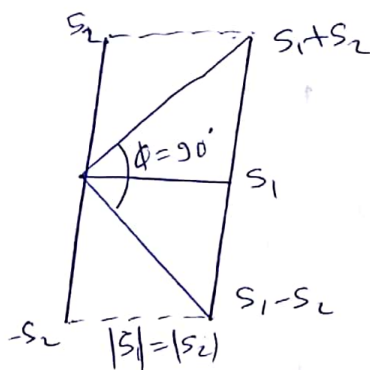
operates when $\phi < 90^\circ$

Fig:- phase Comparator.

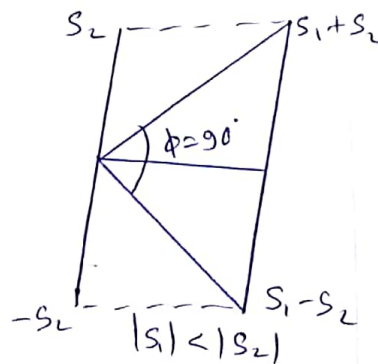


when $\phi \neq 90^\circ$

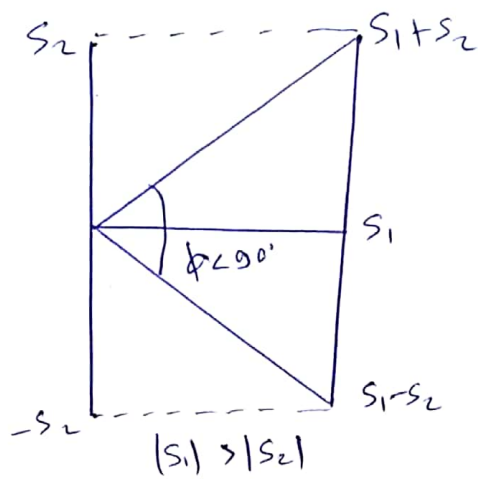
Fig:- phase Comparator used for amplitude comparison



(a)



(b)



(c)

fig:- Amplitude comparison using a phase Comparator