HOLOGRAPHY

2ND SEM

PHOTOGRAPH

- It represents a **two-dimensional recording of a three-dimensional scene**.

- **What is recorded????????**

The intensity distribution that prevailed at the plane of the photograph when it was exposed.

- The light-sensitive medium is sensitive only to the intensity variations; hence while recording a photograph, **the phase distribution** which prevailed at the plane of the photograph **is lost**.

- Since **only the intensity pattern has been recorded,** the three-dimensional character (e.g.,parallax) of the object scene is lost. Thus one cannot change the perspective of the image in the photograph by viewing it from a different angle, or one cannot refocus any unfocused part of the image in the photograph

HOLOGRAPHY

- **one records not only the amplitude but also the phase of the light wave**; this is done by using interferometric techniques.

- Because of this, the image, produced by **the technique of holography has a true three-dimensional form**.

- Thus, as with the object, one can change one's position and view a different perspective of the image, or one can focus at different distances.

- It can produce images as true as the object itself is responsible for the wide popularity gained by holography.

BASIC TECHNIQUE IN HOLOGRAPHY/ BASIC PRINCIPLE OF HOLOGRAPHY

Two step process

1. RECORDING OF THE HOLOGRAM,

2. VIEWING THE IMAGE OR RECONSTRUCTION

RECORDING OF THE HOLOGRAM,

Superimpose → object wave and reference wave

resulting interference pattern/fringes
is recorded on the photographic plate

Developed negative of these interference pattern/fringes is a hologram

Hologram is formed (information about the object is coded)

Does not contain a distinct image of the object but contains information about not only the amplitude but also the phase of the object wave

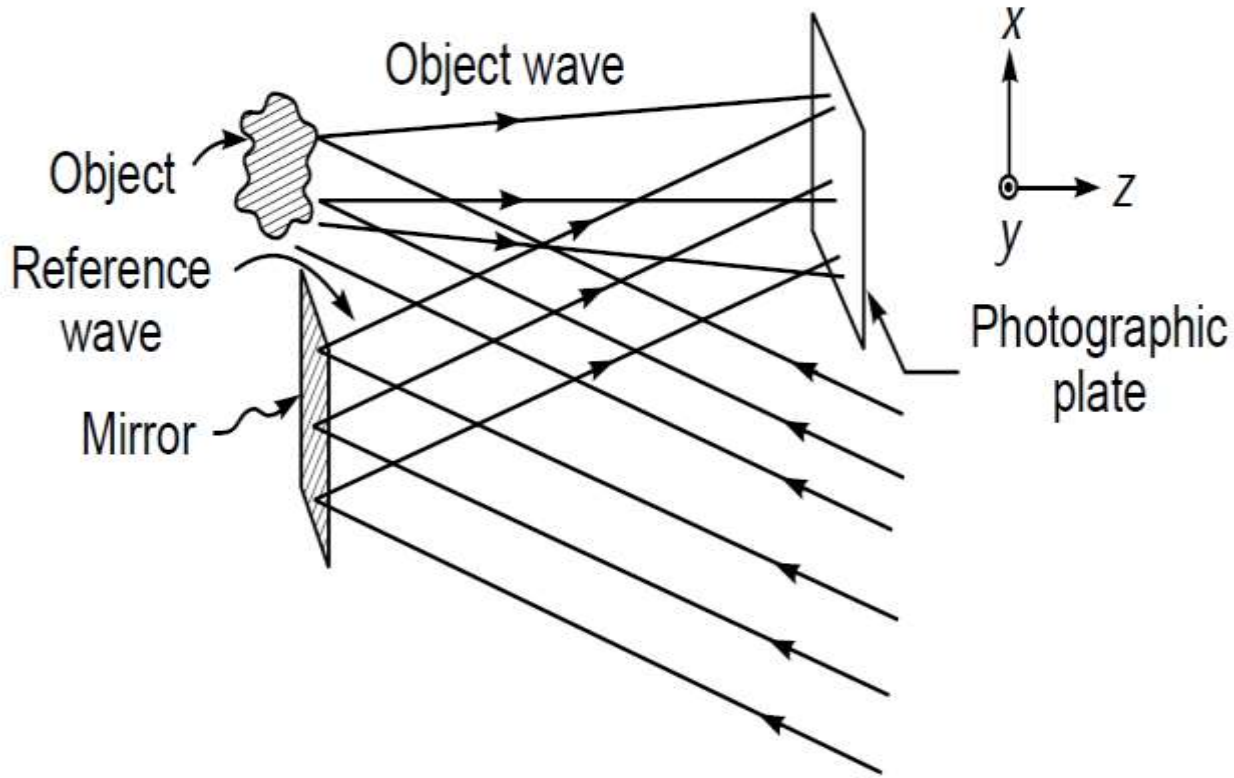

Fig. 21.1 Recording of a hologram.

Fringes on the hologram acts as a diffraction grating- diffracted rays form---real and virtual images.

Is formed at the position previously occupied by the object-> true image

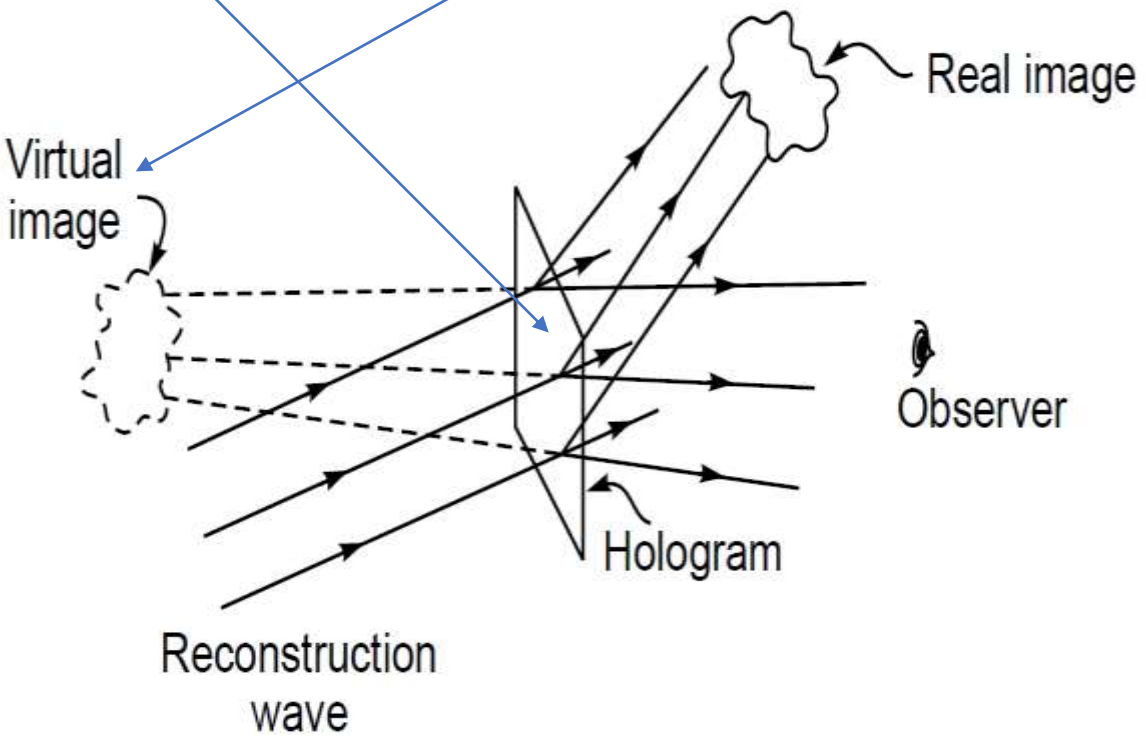

Fig. 21.2 Reconstruction process.

VIEWING THE IMAGE
OR
RECONSTRUCTION

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Reconstruction process

Illuminate the hologram with another wave, called the reconstruction wave (identical to the reference wave)

virtual and a real image of the object scene

has all the characteristics of the object, such as parallax. Thus one can move the position of the eye and look behind the objects, or one can focus at different distances.

can be photographed without the aid of lenses just by placing a light-sensitive medium at the position where the real image is formed

Holography → interference phenomenon

REQUIREMENTS

- certain coherence requirements have to be met.
- For stable interference fringes are to be formed (so that they are recordable), the maximum path difference between the object wave and the reference wave should not exceed the coherence length.
- the spatial coherence is important so that the waves scattered from different regions of the object could interfere with the reference beam.
- During reconstruction, the reconstructed image depends on both the wavelength and the position of the reconstructing source. Hence if the resolution in the reconstructed image has to be good, the source must not be broad and must be emitting a narrow band of wavelengths.
- If the reconstruction source is of the same wavelength and is situated at the same relative position with respect to the hologram as the reference source, then the reconstructed image does not suffer from any aberrations.
- Another critical requirement in making holograms is stability of the recording arrangement. Thus, the film, the object, and any mirrors used in producing the reference beam must be motionless with respect to one another during exposure

A very *interesting property possessed by holograms is that even if the hologram is broken up into different fragments, each separate fragment is capable of producing a complete virtual image of the object.*This property can be understood from the fact that for a diffusely reflecting object, each point of the object illuminates the complete hologram and consequently each point in the hologram receive waves from the complete object. But the resolution in the image decreases as the size of the fragment decreases. For non diffusely reflecting objects or for transparencies, one makes use of an additional diffusing screen through which the object is illuminated.