

UNIT-I

ULTRASONICS

TWO MARK QUESTIONS AND ANSWERS

1. How are sound waves classified?

Sound waves are classified into three categories on the basis of frequency

- Audible sound (between 20Hz - 20,000 Hz)
- Ultrasound (above 20,000 Hz)
- Infra sound (below 20 Hz)

2. What is meant by ultrasonics ?

Ultrasonics are the sound waves of frequency above audible range (i.e) above 20,000 Hz (or) 20 KHZ. This sound wave cannot be heard by human ear, but it has many useful applications in engineering and medical fields.

3. Are the ultrasonic waves electro magnetic waves? Give proper reasons.

Ultrasonic waves are not electro magnetic waves because they are sound waves which does not consist of electric and magnetic vectors as in electro magnetic waves.

4. Why are ultrasonic waves not audible to humans?

The audible range of frequencies for human beings is between 20HZ to 20,000HZ. Since the frequency of ultrasonic wave is having above 20,000HZ, it is not audible to humans.

5. Name the methods by which ultrasonic waves are produced?

- Mechanical generators (Galton's whistle)
- Magnetostriction oscillator method
- Piezo- electric oscillator method

6. Why not ultrasonics be produced by passing high frequency alternating current through a loud speaker?

Ultrasonics cannot be produced by passing high frequency alternating current through loud speaker due to the following reasons.

1. Loud speaker cannot vibrate at such high frequency.
2. Inductance of the speaker coil becomes so high and practically no current flows through it.

7. Mention the properties of ultrasonic waves?

- They are highly energetic.
- They travel through longer distances.
- They are reflected, refracted and absorbed similar to ordinary sound waves.
- When ultrasonics are passed through liquid, it produces stationary wave pattern and makes the liquid to behave as an acoustical grating element.
- It produces heating effect.

8. What is the principle behind the magnetostriction oscillator or what is called as magnetostriction effect?

Magnetostriction effect is the principle of producing ultrasonic waves by using the magnetostriction oscillator. When an alternating magnetic field is applied to a rod of ferromagnetic material such as nickel, iron, cobalt, then the rod is thrown into longitudinal vibrations. When the frequency of the vibrating rod is equal to the natural frequency of vibration, resonance occurs. Thus produces ultrasonic waves under resonance condition.

9. What are the advantages of magnetostriction oscillator?

- ✓ It is mechanically versatile.
- ✓ Cost is low.
- ✓ It can produce large acoustical power with high efficiency.

10. What are the disadvantages of magnetostriction oscillator?

- ✓ It can produce frequencies upto 3MHz only.
- ✓ It is not possible to get a constant single frequency, because it depends on the temperature and the degree of magnetisation.
- ✓ The frequency is inversely proportional to the length of the vibrating rod, to increase the frequency, the length of the rod should be decreased which is practically impossible.

11. Why Ultrasonic frequencies greater than 3 MHz cannot be produced by magnetostriction method?

In magnetostriction method, the frequency is inversely proportional to the length of the rod. The frequency can be increased only by decreasing the length of the rod to a greater extent, which is practically impossible. Also it has to be noted that the ambient temperature alters the magnetization of the rod and in turn will affect the elastic properties. Hence, ultrasonic frequencies greater than 3MHz cannot be produced by magnetostriction method.

12. Can we use a copper rod in a magnetostriction generator? Why?

No, copper rod cannot be used to produce ultrasonics in magnetostriction generator because it is not a ferro magnetic material.

13. What are Piezo – Electric Crystals? Give Examples.

The crystals which produce piezo-electric effect and converse piezo-electric effect are termed as piezo-electric crystals.

Examples: Quartz, Tourmaline, Rochelle salts, etc.

14. What is meant by piezo-electric effect?

When pressure or mechanical force is applied along mechanical axis with respect to the optic axis of the crystals like quartz, tourmaline, Rochelle salt etc, then equal and opposite charges are produced along the electric axis of the crystal. This effect is called as piezo-electric effect.

15. What is meant by inverse piezo-electric effect ?

When potential difference or e.m.f is applied along electrical axis with respect to the optic axis of the c crystal then the crystal starts vibrating along the Mechanical axis of the crystal. This effect is called as inverse piezo-electric effect.

16. What are the differences between X-cut and Y-cut crystal?

X-cut crystals	Y-cut crystals
When the crystal is cut perpendicular to the x-axis then it is called as X-cut crystal.	When the crystal is cut perpendicular to the y-axis then it is called as Y-cut crystal.
X-cut crystals are used to produce longitudinal ultrasonic waves.	Y-cut crystals are used to produce transverse ultrasonic waves.

17. What are the merits or advantages of piezo-electric oscillator?

- It can produce frequency upto 500MHZ.
- It can produce longitudinal as well as transverse ultrasonic waves by properly shaping and cutting the crystal with respect to the optic axis.
- The production of ultrasonics is independent of temperature and hence produces high power ultrasonics at constant frequency.

18. What are the demerits of piezo-electric oscillator?

- Cutting and shaping the crystal is very difficult.
- It is too expensive.

19. What is the main difference in the quality of ultrasonic waves produced by piezo electric and magnetostriction method.

Magnetostriction Method	Piezo electric method
1. It generates low frequency ultrasonic waves(3MHz)	1.It generates very high frequency ultrasonic waves(500MHz)
We cannot obtain constant frequency of ultrasonic waves.	We can obtain constant frequency of ultrasonic waves.
The peak of resonance curve is broad.	The peak of resonance curve is narrow.
Frequency of oscillations depends on temperature.	Frequency of oscillation is independent of temperature.

20. What are the methods used for the detection of ultrasonics?

- Kundts tube method.
- Sensitive flame method.
- Thermal detector.
- Piezo-electric detector

18. What is meant by cavitation? What is its use?

Cavitation is the process of creation and collapse of bubbles, due to the principle of negative local pressure created inside the bubble.

Uses:

1. It is used to produce shock waves.
2. It is used to increase the temperature in liquids.

19. What is the principle used for finding the velocity of ultrasonic using acoustic grating ?

When ultrasonics are passed through a liquid like kerosene contained in a tank, due to variation in pressure the liquid act as acoustical grating. Now when monochromatic source of light is passed through the acoustical grating, it produces different orders of spectrum due to diffraction. Using diffraction condition we can find the velocity of ultra sonics. i.e. $v = \gamma_u \lambda_u$, where γ_u -frequency of ultrasonics and λ_u -wavelength of ultrasonics.

20. What are the applications of ultrasonic's in industry ?

- It is used to detect defect (or) flaws in metal structure. It is called non-destructive testing of materials.
- Ultrasonic waves are used for soldering, welding, drilling and cutting.
- They are used for producing alloy of uniform compositions.

21. What is NDT method?

NDT method is the method of testing the specimen without impairing or changing its usefulness for future service. It is used to examine the material and to detect the flaws present in the material without damaging it.

22. Give the importance of NDT.

By using NDT testing, the location, dimension flaws and material structure are determined. Due to the determination of these factors in the earlier stage, we can increase

- The quality of product
- Productivity and profit
- The serviceability

23. Compare destructive and non destructive testing

Destructive testing	Non destructive testing
1. Tested parts get damaged.	1. Tested parts are not damaged
2. It's applied only to a sample.	2. It's applied directly on production items.
3. Time consumption is high.	3. Time consumption is low.
4. Capital equipment and labour costs are high.	4. labour cost is low.

24. What is the principle of ultrasonic flaw detector?

The principle used in ultrasonic flaw detector is whenever there is a change in medium, the ultrasonic waves will be reflected. From the intensity of the reflected echoes the flaws are detected.

25. What are the advantages of NDT?

The advantages of NDT are

1. It can reveal internal defects.
2. This method is highly sensitive to most of the cracks and flaws.
3. It gives immediate results at very low cost and at a very high speed.
4. It indicates the size and location of the flaws exactly.
5. Since there is no radiation in this process, it is a safest method among the other methods.

26. What are the limitations of NDT?

1. It is difficult to find the defects of the specimen which has complex shapes.
2. Trained, motivated technicians alone can perform this testing.

27. What is meant by SONAR? Mention two applications of it.

SONAR is a device which stands for Sound Navigation and Ranging. The principle of SONAR is based on the echo sounding technique of ultrasonics. It is the acoustical technique used for locating the objects like submarines or icebergs in sea, by transmitting a high frequency sound pulse and receiving it after reflection from that object.

Applications:

1. To find the depth of sea.
2. To detect the submarines.

28. Name different scanning methods used in ultrasonics.

Depending on the type of display modes, ultrasonic scanning methods are classified into

1. A Scan (or) Amplitude modulated scan
2. B Scan (or) Brightness modulated scan
3. C-Scan (or) T-M scan or Time – motion scan

29. What is sonogram? Mention its application.

Sonogram is a technique which is used to record the sounds produced due to the pumping action of the heart using ultrasonics. It also provides the information on heart ratio, rhythmicity, blood pumping, valve action, etc.

30. What are the advantages of ultrasonics in medical field over other techniques?

1. There is no mutation (or) residual effects.
2. There is no ionization.
3. Side effects are almost zero.
4. By means of controlled focusing of ultrasonics into the normal tissues situated around the diseased tissues can be saved.
5. It doesn't affect the fetus of the mother during diagnosis.