

**NTK/KW/15/5825**

**Bachelor of Science (B.Sc.) Semester—III**  
**Examination**  
**301 : PHYSICS**  
**(Sound Waves, Applied Acoustic, Ultrasonic & Power**  
**Supply)**  
**Paper—I**

Time—Three Hours] [Maximum Marks—50

- N.B. :—** (1) All questions are compulsory.  
(2) Draw neat diagram wherever necessary.

**EITHER**

1. (A) Obtain the expression for resultant displacement and fundamental frequency of transverse vibrations of standing waves on a stretched string. What are the harmonics and overtones in case of standing waves on a stretched string ? 5
- (B) (i) Find the relation between group velocity and phase velocity for a monochromatic plane harmonic wave travelling along positive X-direction in a dispersive medium.

(E) Mention the types of filters and give the working of any one filter with circuit diagram.  $2\frac{1}{2}$

(F) Explain Zener diode as a voltage regulator.  $2\frac{1}{2}$

5. Solve any **TEN** of the following questions :

(i) The intensity of sound is  $10^{-5} \text{ W/m}^2$ . Find the loudness level in dB. ( $I_0 = 10^{-12} \text{ W/m}^2$ )

(ii) Write any two characteristics of musical sound.

(iii) State the frequency range of human audibility and define the threshold of human hearing.

(iv) Draw the well labelled diagram of moving coil loudspeaker.

(v) Write any two necessary conditions of good auditorium.

(vi) What is an Echelon effect ?

(vii) What is an Active Transducer ?

(viii) Write any two uses of ultrasonic waves in Medical Science.

(ix) The length of the Nickel rod to produce ultrasonic wave of frequency 50 kHz is 4.9 cm. What is the length of the Nickel rod required to produce frequency 100 kHz ?

(B) (i) Derive the Sabine's formula for reverberation time using Jaeger's statistical method. 3

(ii) Calculate the time of reverberation of the empty hall of volume 80,000 cu.ft. and total absorption without audience is 775 Sabine only. 2

**OR**

(C) Define the transducer and state its characteristics.  $2\frac{1}{2}$

(D) Give the construction and working of crystal microphone in brief.  $2\frac{1}{2}$

(E) Explain the sound absorption and define sound absorption coefficient. Mention the factors on which the values of sound absorption coefficient depends.  $2\frac{1}{2}$

(F) A hall of volume 56,000 cu.ft. is found to have reverberation time of 2 sec. If the area of sound absorbing surface be 7000 sq. ft., calculate the average absorption coefficient.  $2\frac{1}{2}$

**EITHER**

3. (A) What is acoustic grating in a liquid ? Explain the determination of wavelength and velocity of ultrasonic waves using liquid acoustic grating. 5

- (B) (i) Explain, with the help of neat diagram, a method for generation of ultrasonic waves by magnetostriction effect. 3
- (ii) A nickel rod of 10 cm length with a density  $8.1 \times 10^3 \text{ kg/m}^3$  and a Young's modulus of  $82 \times 10^{10} \text{ N/m}^2$  is used in a magnetostriction oscillator. Determine the fundamental frequency of the ultrasonic wave generated. 2

**OR**

- (C) What do you mean by ultrasonic waves ? What are their properties ? 2½
- (D) State the principle and working of 'SONAR' system. 2½
- (E) What are the various methods for detection of ultrasonic waves ? Explain any one method in short. 2½
- (F) The ultrasonic waves with velocity 1800 m/s sent from sea water surface returns after 2 s. Find the depth of sea and wavelength of ultrasonic waves of a frequency 50 kHz. 2½

**EITHER**

4. (A) Give the construction and working of full wave rectifier with graphical representation and circuit diagram. 5
- (B) (i) Obtain an expression for average value  $I_{dc}$  and root mean square value  $I_{rms}$  in case of full wave rectification. 3
- (ii) A full-wave rectifier uses two diodes, each of internal resistance  $20 \Omega$ . The transformer r.m.s. secondary voltage from the centre tap to each end of secondary is 50 V and load resistance  $R_L = 980 \Omega$ . Find :
- (i) The average value of current  $I_{dc}$  and
- (ii) r.m.s. value of current  $I_{rms}$ . 2

**OR**

- (C) Explain the working of forward biased p-n junction and its V-I characteristic curve. 2½
- (D) In a centre tapped full wave rectifier, the peak value of current is 0.1041 A. Calculate the dc current, r.m.s. current and ripple factor. 2½

- (ii) Two sine waves  $Y_1 = 0.07 \cos (3t - 4x)m$  and  $Y_2 = 0.07 \cos (t - 2x)m$  are super-imposed in a dispersive medium. Calculate the group velocity.

3+2

**OR**

- (C) Derive an expression for the speed of transverse wave on a stretched string.

2½

- (D) A closed pipe 1.5 m long and emitting its second overtone is in unison with an open pipe emitting its third overtone. What is the length of the latter ?

2½

- (E) What are the defects of Diatonic scale ? What do you mean by temperament and equal temperament in case of musical scale ?

2½

- (F) Explain the construction and working of harmonium.

2½

**EITHER**

2. (A) Give the construction of audible compact disc. Explain the recording and reproduction of sound on/from CD with labelled diagrams.

5

- (x) Mention the advantages of bridge rectifier over a full wave rectifier.

- (xi) State the essential characteristics of an ideal power supply.

- (xii) If the maximum a.c. voltage  $E_0 = 70.7 \text{ V}$ , find peak inverse voltage in full wave rectifier.  $1 \times 10 = 10$