Rayat Shikshan Sanstha's

Rajarshi Chhatarapati Shahu College, Kolhapur

Department of Physics

Question Bank

Paper **VI**- DSC-C2 **Waves and Optics - I**

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Unit I- Chapter I- Superposition of Harmonic Oscillations

- **Multiple Choice Questions (Correct answer is shown in red color)**

1.Following is the homogeneous differential equation

a) $\frac{d^2y}{dt^2} = A - \omega^2 y$ b) $\frac{d^2y}{dt^2} = \omega^2 y + x$

c) $\frac{d^2y}{dt^2} = C$ d) $\frac{d^2y}{dt^2} = -\omega^2 y$

2.Following is linear equation

a) $\frac{d^2y}{dt^2} = A - \omega^2 y$ b) $\frac{d^2y}{dt^2} = -\omega^2 y + Ay^2$

c) $\frac{d^2y}{dt^2} = -\omega^2 y + Ay^3$ d) $\frac{d^2y}{dt^2} = Ay^2$

3. Principle of superposition is obeyed by

a) homogeneous equations

b) linear equations

c) homogeneous and linear equations

d) non-linear equations

4. Resultant amplitude due to superposition of two vibrations $y_1 =$

$a_1 sin(\omega t + \alpha_1)$ and$y_1 = a_2 sin(\omega t + \alpha_2)$ is given by.....

a)$[a_1^2 + a_2^2 + 2a_1 a_2 \cos(\alpha_1 - \alpha_2]^{1/2}$

b) $[a_1^2 + a_2^2 + 2a_1 a_2 \sin(\alpha_1 - \alpha_2]^{1/2}$

c) $a_1 + a_2$

d) $a_1 - a_2$

5. Beats are produced due to superposition of two.....

a) harmonic oscillations

b) collinear oscillations

c) oscillations with slightly different frequencies

d) non harmonic oscillations

6. Beat frequency of two SHM's with frequencies n_1, and n_2 is given by.....

a)$n_1 + n_2$ b) $n_1 \sim n_2$ c)$\frac{1}{n_1 + n_2}$ d) $\frac{1}{n_1 \sim n_2}$

7. Lissajons figures are produced by superposition of two.....

a) SHM's

b) collinear SHM's

c) perpendicular SHM's

d) perpendicular SHM's with frequencies which can be expressed as simple integral ratios.

8. The resultant of two SHM's acting at right angles to each other and having equal frequencies and a phase difference of π is, ...

a) a straight line

b) an oblique ellipse

c) an ellipse

d) a circle

9. The resultant of two SHM's acting at right angles to each other and having same frequency but different amplitudes and a phase difference of π/2 is...

a) a straight line

b) an oblique ellipse

c) an ellipse

d) a circle

10. The resultant of two SHM's acting at right angles to each other and having same frequency, same amplitude but differing in phase by π/2 is...

a) a straight line

b) an oblique ellipse

c) an ellipse

d) a circle

11. The resultant of two SHM's acting at right angles to each other and having same frequency, different amplitudes and a phase difference of π/4 is...

a) a straight line

b) an ellipse

c) an oblique ellipse

d) a circle

12. The resultant Lissajous figure of two SHM's in-phase, acting at right angles to each other and having frequencies in the ratio 2:1 is a.....

a) a circle

b) figure like number 8

c) parabola

d) ellipse

13. Which of the following is an equation of ellipse?

a) $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

b) $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 0$

c) $x^2 + y^2 = 1$ d) $x^2 + y^2 = a^2$

14. Which of the following is an equation of circle?

a) $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ b) $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 0$

c) $x^2 + y^2 = 1$ d) $x^2 + y^2 = a^2$

15. Beat period of two SHM's with frequencies n_1, and n_2 is given by.....

a) $n_1 + n_2$ b) $n_1 \sim n_2$ c) $\frac{1}{n_1 + n_2}$ d) $\frac{1}{n_1 \sim n_2}$

- **Short answer questions**

1. What are Lissajous figures? Discuss briefly their importance in acoustical measurements.
2. Discuss uses of Lissajous figures?

- **Long answer questions**

1. Define superposition principle and show that it is valid only in case of homogeneous linear vibrations.
2. Discuss in detail, analytically, the resultant motion of two simple harmonic motions having same frequency and acting along the same line.
3. Discuss in detail, graphically, the resultant motion of two simple harmonic motions having same frequency and acting along the same line.
4. Discuss in detail, analytically the resultant vibration of SHM's having equal periods and acting at right angles to each other. Discuss different cases.
5. Explain, graphically, the composition of two SHM's of equal periods, zero phase difference and acting at right angles to each other.
6. Explain, graphically, the composition of two SHM's having same frequency, a phase

difference of $\frac{\pi}{2}$ and acting at right angles 2 to each other.

7. Explain, analytically, the resultant motion of two SHM's acting at right angles to each other and having frequencies in the ratio 2:1 and a phase difference (a). Discuss different cases of Lissajous figures.

8. Explain, graphically, the composition of two SHM's acting at right angles to each other and having frequencies in the ratio 2:1 and in-phase.

Unit I- Chapter II- Coupled Oscillations

- **Multiple Choice Questions (Correct answer is shown in red color)**

1. Simple harmonic oscillations are.....

a) periodic b) aperiodic c) sinusoidal d) nonsinusoidal

2. Normal modes of vibration of a coupled system are .....

a) periodic b) aperiodic c) sinusoidal d) nonsinusoidal

3. Slow frequency of normal mode of oscillation of two identical pendula is given by.....

a) $\sqrt{\frac{g}{l}}$ b) $\sqrt{\frac{g}{l}+\frac{2k}{m}}$ c) $\sqrt{\frac{l}{g}}$ d) $\sqrt{\frac{l}{g}+\frac{2k}{m}}$

4. Fast frequency of normal mode of oscillation of two identical pendula is given by.....

a) $\sqrt{\frac{g}{l}}$ b) $\sqrt{\frac{g}{l}+\frac{2k}{m}}$ c) $\sqrt{\frac{l}{g}}$ d) $\sqrt{\frac{l}{g}+\frac{2k}{m}}$

5. In normal modes of oscillation the oscillating parts have.....

a) same frequency b) different amplitude

c) different phase d) different frequency

6. Total energy of a coupled system of two pendula is.....

a) $2mA^2\left(\frac{\omega_1+\omega_2}{2}\right)^2 \sin^2\left(\frac{\omega_2-\omega_1}{2}\right)t$ b) $2mA^2\left(\frac{\omega_1+\omega_2}{2}\right)^2 \cos^2\left(\frac{\omega_2-\omega_1}{2}\right)t$

c) $2mA^2\left(\frac{\omega_1+\omega_2}{2}\right)^2$ d) $2mA^2\left(\frac{\omega_2-\omega_1}{2}\right)t$

7. In a coupled system the extent to which one system influences the motion of the other is called…….of the system

a) coupling b) coupling capacity c) limit of coupling d)binding

8. In the symmetric mode of oscillations , the particles are oscillating always---

a) in opposite phase b) in phase

c) with constant phase d) out of phase

9. Normal coordinates in coupled oscillatory system involve .....frequency.

a) one b) two c) three d) four

10. Anti symmetric mode of oscillations has .....frequency than symmetric mode.

a) half b)) one third c) two third d) higher

- **Short answer questions**

1. Write note on coupled oscillatory system.

- **Long answer questions**

1. For a coupled system of two identical pendula, coupled by a spring of spring constant k, explain what are normal coordinates and normal modes of vibrations and hence obtain expressions for the frequencies of normal modes of vibration.
2. Find an expression for the total energy of a coupled system of two identical pendula

coupled by a spring and thereby explain the energy transfer from one pendulum to other.

3. Discuss the nature of normal modes of oscillations of two identical pendula coupled by a spring of constant k..

Unit I- Chapter III- Ultrasonic Waves

- **Multiple Choice Questions (Correct answer is shown in red color)**

1. Expression for velocity of transverse wave travelling along a stretched string is…….

a) $v = \frac{T}{m}$ b) $v = \frac{m}{T}$ c) $v = \sqrt{\frac{T}{m}}$ d) $v = \sqrt{\frac{m}{T}}$

2. Expression for travelling wave in x-positive direction.....

a) $y = asin(\omega t - kx)$ b) $y = asin\frac{2\pi}{\lambda}(\omega t - kx)$

c) $y = asin(\omega t + kx)$ d) $y = asin\frac{2\pi}{\lambda}(\omega t + kx)$

3. Nodes in standing waves are the points where.....

a) displacement is zero b) amplitude is zero

c) displacement is maximum d) amplitude is maximum

4. Antinodes in standing waves are the points where…..

a) displacement is zero b) amplitude is zero

c) displacement is maximum d) amplitude is maximum

5. The distance between successive nodes (or antinodes) is....

a) $\frac{\lambda}{4}$ b) $\frac{\lambda}{2}$ c)λ d)2λ

6. Frequency, $n = \frac{p}{2l}\sqrt{\frac{T}{m}}$ is the frequency of .....

a) fundamental mode

b) p^{th} harmonic

c) p^{th} overtone

d) none of the above

7. Phase velocity of a wave is….

a) $v = \frac{\omega}{k}$

b) $v = \frac{k}{\omega}$

c) $v = \frac{d\omega}{dk}$

d) $v = \frac{dk}{d\omega}$

8. Group velocity of waves is….

a) $v = \frac{\omega}{k}$

b) $v = \frac{k}{\omega}$

c) $v = \frac{d\omega}{dk}$

d) $v = \frac{dk}{d\omega}$

9. Spherical waves are.....

a) originated from a point source

b) divergent

c) those in which energy goes on decreasing

d) all the above

10. Plane waves are.....

a) originated from a source at infinitely large distance

b) collimated

c) those in which energy (intensity) remains same

d) all the above

11. Piezoelectric generator uses.....

a) the principle of converse Piezo-electric effect

b) an electronic oscillator

c) the idea of resonance vibrations

d) all the above

12. Ultrasonics are.....

a) sound waves with frequency greater than 20,000 Hz.

b) sound waves with frequency less than 20,000 Hz.

c) waves travelling with velocity greater than that for sound waves.

d) waves travelling with velocity less than that for sound waves

- **Short answer questions**

1. Write a short note on spherical and plane wavefronts.
2. What is Piezo-electric effect?
3. How ultrasonic waves are detected?
4. Discuss the applications of ultrasonics in brief

- **Long answer questions**

1. Derive an expression for the velocity of transverse waves travelling along a stretched string under a tension.
2. Explain the travelling waves and standing waves in a stretched string and there by show that the distance between successive nodes (or antinodes) is equal to $\frac{\lambda}{2}$
3. What are normal modes of vibration of a stretched string? Obtain an expression for the frequency of p^{th} mode.
4. Explain phase velocity and group velocity and hence obtain expressions for the same.
5. Explain the principle, construction and working of Piezo-electric generator.

Unit II- Chapter I- Sound And Acoustics of Buildings

- **Multiple Choice Questions (Correct answer is shown in red color)**

1. The devices which converts non electrical signal into corresponding electrical signal or vice versa are called

a) microphones b) loudspeakers c) transducers d) amplifier

2. Microphones are

a) active transducer b) passive transducer

c) transducer d) amplifier

3. Unit of intensity level is....

a) decibel b) erg/cm^2/s c) joule/m^2/s d) erg/cm^2

4. The pleasant effect produced by notes produced one after another is called

a) chord b) dischord c) harmony d) melody

5. The interval between two notes is….. of their frequency

a) the ratio b)product c) sum d)difference

6. When sounding source in a closed space like hall is cut- off the intensity of sound…..

a) suddenly falls down to zero b) decreases linearly with time

c) decreases exponentially with time d) remains constant with time

7. Reverberation time is….

a) proportional to the volume of the hall

b) inversely proportional to the absorbing surface area in the hall

c) inversely proportional to the average coefficient of absorption

d) all the above

8. Standard unit of absorption of sound

a) one square foot

b) one square metre

c) one square metre of open window

d) one square foot of open window

9. Reverberation time should be…... for a good acoustic

a) optimum

b) very large

c) very small

d) zero

10. if (S) is actual surface area, (a) is absorption coefficient that effective absorbing area (A) is given by

a) $A = \frac{S}{a}$

b) $A = \frac{a}{S}$

c) $A = (aS)^2$

d) $A = aS$

11. Reverberation time in FPS system is ……

a) $T = 0.05\frac{V}{\bar{a}S}$

b) $T = 0.05\frac{V}{aS}$

c) $T = 0.165\frac{V}{\bar{a}S}$

d) $T = 0.165\frac{V}{aS}$

12. Reverberation time in MKS system

a) $T = 0.05\frac{V}{\bar{a}S}$

b) $T = 0.05\frac{V}{aS}$

c) $T = 0.165\frac{V}{\bar{a}S}$

d) $T = 0.165\frac{V}{aS}$

13. The interval….. is called as major tone

a) $\frac{9}{8}$

b) $\frac{10}{9}$

c) $\frac{9}{10}$

d) $\frac{8}{9}$

14. Loudness of sound is related to

a) intensity of sound

b) sensitivity of year of listener

c) density of medium

d) all the above

15. Maximum intensity that human ear can tolerate is.....

a) $10^{-2} watt/cm^2$ b) $10^{-4} watt/cm^2$

c) $10^{-2} watt/m^2$ d) $10^{-4} watt/cm^2$

16. Which of the following is zero intensity level?

a) $I_o = 10^{-10} watt/cm^2$ b) $I_o = 10^{-12} watt/cm^2$

c) $I_o = 10^{-14} watt/cm^2$ d) $I_o = 10^{-16} watt/cm^2$

17. intensity of sound waves is proportional to

a) square of the amplitude b) square of the frequency

c) density of the medium d) all (a), (b), (c)

- **Short answer questions**

1. What are transducers ? Discuss the characteristics of transducers.
2. What is the necessity of a baffle in the loudspeaker?
3. Define intensity of sound and explain what do you mean by loudness?
4. Define and explain intensity level of sound and its unit.
5. Write a note on musical notes.
6. What is musical scale? Elaborate the diatonic scale.
7. Define and explain reverberation and reverberation time?
8. Define and discuss the coefficient of absorption of sound energy.
9. Discuss 'acoustic aspects of an auditorium".

- **Long answer questions**

1. What is pressure microphone? Explain the principle, construction and working of pressure microphone.

2. Derive Sabine's formula for the reverberation time.

3. What is pressure microphone? Explain the principle, construction and working of moving coil loudspeaker.

Unit II- ChapterII- Viscosity

- **Multiple Choice Questions (Correct answer is shown in red color)**

1. The cgs unit of coefficient of viscosity is.....

a) erg b) dyne c) poise d) erg/cm

2. The viscosity of liquid ….with increase in temperature.....

a) increases b) decreases c) remains constant d) changes abnormally

3. Liquids used as lubricants are of …viscosity

a) low b) high c) zero d) infinite

4. The viscous drag in a liquid is given by the equation

a) $F = \eta A \frac{dv}{dz}$ b) $F = \frac{\eta}{A}\frac{dv}{dz}$ c) $F = \frac{\eta}{A\frac{dv}{dz}}$ d) $F = \frac{A}{\eta\frac{dv}{dz}}$

5. Which assumptions are made while deriving the Poiseuille's formula for coefficient of viscosity?

a)The flow of liquid is streamline.

b) There is no any radial flow.

c) The liquid in contact with the sides of the capillary tube.

d) All of the three above.

6. Following is the Poiseuille's equation for the coefficient of liquid.

a) $\eta = \frac{\pi V a^4}{8lP}$ b) $\eta = \frac{\pi P a^4}{8lV}$ c) $\eta = \frac{\pi VP}{8la^4}$ d) $\eta = \frac{8lV}{\pi P a^4}$

7. In Poiseuille's experiment to determine coefficient of viscosity of a liquid, the capillary is always kept...

a) horizontal b) vertical

c) slanted d) making an angle of 45° with the horizontal

8. For water, the coefficient of viscosity is.....at 80^{o} of its value at 10° C.

a) double c) one fourth b) triple d) one third

9. When temperature of liquid increases, the separation between molecules.....

a) increases b) decreases c) remains constant d) changes abnormally

10. When temperature of liquid increases, the cohesive forces between molecules.....

a) increases b) decreases c) remains constant d) changes abnormally

- **Short answer questions**

1. How viscosity of a liquid varies with temperature?
2. Write a note on lubrication.
3. What is mean by viscosity of fluid. Discuss streamline flow.
4. What is mean by viscosity of fluid. Discuss Turbulent flow.
5. Discuss characteristics of fluid flow.

- **Long answer questions**

1. Show that the profile of the advancing liquid in a horizontal capillary tube is a parabola.
2. Derive an expression for the rate of flow of liquid through a capillary tube.
3. Derive Poiseuille's formula for coefficient of viscosity of a liquid.
4. Describe the experimental determination of coefficient of viscosity of a liquid by Poiseuille's method.

Unit II- Chapter III- Physics of low pressure

- **Multiple Choice Questions (Correct answer is shown in red color)**

1. Rotary pump is also called.....

a) backing pump
b) fore pump
c) roughing pump
d) all the above

2. Rotary oil pump can produce a vacuum as low as .....

a) 10^{-3}torr b) 10^{-5}torr c) 10^{-7}torr d) 10^{-9}torr

3. Rotor in the rotary oil pump is

a) rotated fast
b) rotated inside the stator
c) rotated eccentrically
d) all the above

4. The principle of diffusion pump is.....

a) gases diffuse

b) gases diffuse from lower concentration to higher concentration

c) gases diffuse from higher concentration to lower

d) none of the above

5. Air-free mercury vapour is necessary for the action of pump.

a) rotary b) molecular c) diffusion d) vacuum

6. A cooling system is essential for the operation of ..... pump.

a) rotary b) diffusion c) molecular d) vacuum

7. Molecular pump can produce a vacuum as low as .....

a) 10^{-3}torr b) 10^{-5}torr c) 10^{-7}torr d) 10^{-9}torr

8.Knudsen gauge is

a) an absolute gauge

b) a secondary gauge

c) most rugged gauge

d) none of the above

9.Pirani gauge is

a) an absolute gauge

b) a secondary gauge

c) most sensitive gauge which can measure very low pressures

d) none of the above

10.Principle of Knudsen gauge is

a) diffusion of gas

b) dependence of thermal conductivity of the gas on the pressure

c) radiometric effect

d) molecular flow

11.Tolerable leak depends on

a) pumping speed

b) operating pressure

c) volume of the system

d) all the above

- **Short answer questions**

1. What are different classes of vacuum pumps? Discuss different characteristics of vacuum pumps.
2. Write a note on 'Leak Detection'.

- **Long answer questions**

1. Explain the principle, construction and working of rotary pump. What is the

significance of oil in the pump oil.

2. Discuss the principle, construction and working of a diffusion pump.
3. Why a backing pump is necessary for the operation of diffusion pump.
4. Explain the principle, construction and working of molecular pump.
5. Discuss the necessity of backing pump for the operation of molecular pump. 8. Explain the principle, construction and working of Knudsen gauge. Why it is called an absolute gauge?
6. Discuss the principle, construction and working of Pirani gauge.