PHY 301.1

Reg No.....

CREDIT BASED THIRD SEMESTER B.Sc. DEGREE EXAMINATION OCTOBER 2012

PHYSICS

PAPER III: ACOUSTICS AND OPTICS

Duration: 3 Hours **Max Marks: 80**

PART –A

1. (a) **Answer any TEN of the following.** **1X10=10**

i) A body is in SHM. At which point is its acceleration minimum?

ii) What is damping?

iii) What is the relation between phase velocity and group velocity of waves?

iv) What are shock waves?

v) What is the path difference corresponding to phase difference π ?

vi) Mention two methods to obtain interference pattern by division of wave front.

vii) Why do we observe colours on soap bubbles?

viii) Why Newton's rings are circular in shape?

ix) What is meant by half period zone?

x) Define resolving power.

xi) Distinguish between unpolarized and polarized light.

xii) Define specific rotation.

(b) **Answer any FIVE questions of the following.** **2X5=10**

i) Define force constant and damping constant.

ii) What are the applications of ultra-sonics?

iii) Mention the condition for constructive and destructive interference in terms of phase difference.

iv) Explain why the central fringe in a Lloyds mirror is dark.

v) Give any two differences between a Fresnel's and Fraunhoffer's diffraction.

vi) Write two differences between positive and negative crystal.

PART-B

UNIT-I

Answer any TWO from the following: **10X2=20**

2. (a) What is simple harmonic motion? Derive an expression for acceleration of a simple harmonic oscillator.

(b) The equation of a transverse wave is given by $y = 8\sin(0.4\pi x - 100\pi t)$. Find the velocity and angular velocity of the wave. **(6+4)**

3. (a) Derive an expression for velocity of longitudinal waves in a fluid.

(b) Calculate the velocity of sound in dry hydrogen at 363K, assuming the density of hydrogen at STP is 0.088 kgm^{-3} and γ of hydrogen is 1.41. **(6+4)**

4. (a) Using the expression for the velocity of transverse waves in a string, get the expression for the fundamental frequency of vibration of the string and discuss the formation of different harmonics in a stretched string.

(b) Two identical strings are vibrating in unison. One of them stretched by a load of 2 kg is 0.5m long. The length of the other string is 1m. Calculate the load suspended from the other. (6+4)

UNIT-II

Answer any TWO of the following.

5. (a) Describe with suitable theory, the method to determine wavelength of sodium light using biprism.

   (b) In a Young's double slit experiment the slits are separated by 0.24 mm. The screen is 1.2m away from the slits. The fringe width is 0.3cm. Calculate the wavelength of light used in the experiment. (6+4)

6. (a) Explain with a ray diagram, the phenomenon of interference at a film due to transmitted light. Discuss the cases.

   (b) A soap film of refractive index 4/3 and of thickness 1.5×10^{-6} m is illuminated by white light incident at an angle of 60°. The light reflected by it is examined by a spectroscope in which dark band is found corresponding to a wavelength of 500 nm. Calculate the order of interference of the dark band. (6+4)

7. (a) Describe the construction of Michelson interferometer and explain its working.

   (b) In a Newton's ring experiment the diameter of the 15th ring was found to be 5.9 mm and 5th ring was 3.36 mm. If the radius of the plano-convex lens is 1m, calculate the wavelength of the light. (6+4)

UNIT-III

Answer any TWO of the following.

8. (a) What is a zone plate? Derive an expression for its focal length.

   (b) Find with respect to a point 0.5m distance, for a wavelength 600 nm, number of half period elements contained in a circular hole of radius (i) 1mm (ii) 1 cm. (6+4)

9. (a) Explain diffraction at a plane transmission grating, when light is incident normally on its surface.

   (b) A diffraction grating containing 6×10^5 lines per meter is used at normal incidence. Calculate the dispersive power of the grating in the second order spectrum of wavelength region $5 \times 10^{-7} m$. (6+4)

10. (a) What are retarders? Deduce expressions for the thickness required for a quarter wave plate and half-wave plate for light of given wavelength.

    (b) Sugar solution of concentration $100\ kg\ m^{-3}$ is kept in a polarimeter tube of length 0.22m. If the specific rotation of sugar is 0.75 deg kg^{-1} m^2, calculate the rotation of plane of polarization. (6+4)

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PHY 301.1 **Reg No.....**

CREDIT BASED THIRD SEMESTER B.Sc. DEGREE EXAMINATION OCTOBER 2014

PHYSICS

PAPER III: ACOUSTICS AND OPTICS

Duration: 3 Hours **Max Marks: 80**

PART –A

1. (a) Answer any TEN of the following. **1X10=10**

i) Define SHM.

ii) Give the expression for the velocity of sound in air.

iii) Write the differential equation of wave motion.

iv) What are nodes and antinodes?

v) State the condition for destructive interference in terms of phase difference between two waves.

vi) What are coherent sources?

vii) Why do we observe colours on soap bubbles?

viii) What is an interferometer?

ix) What is diffraction of light?

x) What is grating element?

xi) Define plane of vibration.

xii) What are laevo-rotatory substances?

(b) Answer any FIVE questions of the following. **2X5=10**

i) What is meant by critical damping in an oscillatory system?

ii) What are the important characteristics of stationary waves?

iii) Explain the formation of coherent sources in the case of a biprism.

iv) Explain the use of compensating glass plate in Michelson interferometer.

v) Give any two differences between a zone plate and a convex lens.

vi) State two differences between 0-ray and E-ray.

PART-B

UNIT-I

Answer any TWO from the following: **10X2=20**

2. (a) What are forced oscillations? Derive an expression for the amplitude of forced vibration of a body.

(b) The equation $y = 4\sin\pi\left(\frac{t}{0.01} - \frac{x}{200}\right)$ represents a wave. Calculate linear velocity and angular velocity of the wave. **(6+4)**

3. (a) Derive an expression for velocity of sound in air using Helmholtz resonator.

(b) An addition of 20 Kg to the tension of a string of a sonometer wire changed its frequency to three times the original frequency. What is the original frequency? Given: linear density of the wire $= 1.68 \times 10^{-3} Kgm^{-1}$. length of the sonometer wire $0.27m$. **(6+4)**

4. (a) Discuss the effect of pressure, temperature and humidity of the medium on the speed of sound waves in air.

   (b) At what temperature will be velocity of sound in air be double of the velocity in air at $22^{o}C$? **(6+4)**

UNIT-II

Answer any <u>TWO</u> of the following. **10x2=20**

5. (a) What is interference of light? Describe Young's double slit experiment to demonstrate the phenomenon of interference of light.

   (b) In Young's double slit experiment while using a source of light of wavelength 500 nm the fringe width obtained is 0.6 cm. If the distance between the slits and the screen is reduced to half, calculate the new fringe width. **(6+4)**

6. (a) Explain the interference due to wedge shaped film and obtain expression for fringe width.

   (b) A soap film is illuminated by white light incident at an angle of 30°. The reflected light is examined by a spectroscope in which a dark band corresponding to wavelength of 5000 Å is found. Calculate the smallest thickness of the film. Refractive index of film is 1.33. **(6+4)**

7. (a) Deduce an expression for diameter for dark and bright ring using Newton's rings and hence find the spacing between consecutive dark rings and bright rings with respect to their order.

   (b) In Newton's ring experiment the diameter of the 4th and 12th dark ring are 4 mm and 7mm respectively. Find the diameter of the 20th ring. **(6+4)**

UNIT-III

Answer any <u>TWO</u> of the following. **10x2=20**

8. (a) Calculate the area of half period zones in case of a plane wavefront and show that it is practically constant.

   (b) A plane wavefront of light of wavelength $5\times10^{-7}m$ falls on an aperture and the diffraction pattern is observed in an eyepiece at a distance of 1m from the aperture. Find the radius of the 100th half period element and the area of a half period zone. **(6+4)**

9. (a) Explain the diffraction pattern due to Fraunhoffer diffraction at a double slit.

   (b) Calculate the highest order spectrum for normal incidence which may be seen with monochromatic light of wavelength $6000\times10^{-10}m$ by means of a diffraction grating having 6×10^{5} lines per metre. **(6+4)**

10. (a) Give the theory of production of polarized light. How would you detect plane polarized light?

    (b) Calculate the rotation of the plane of polarization in a substance of unit thickness for a light of wavelength 5890 Å. The difference between the refractive indices for right and left circularly polarized light in the substance is 7.62×10^{-7}. **(6+4)**

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PHY 301.1 Reg No.....

CREDIT BASED THIRD SEMESTER B.Sc. DEGREE EXAMINATION OCTOBER 2015

PHYSICS

PAPER III: ACOUSTICS AND OPTICS

Duration: 3 Hours **Max Marks: 80**

PART –A

1. (a) Answer any TEN of the following. **1X10=10**

i) What are free oscillations?

ii) Write the relation between energy and amplitude of Simple Harmonic oscillation.

iii) Define group velocity of a wave.

iv) What are nodes and antinodes?

v) What are coherent sources?

vi) Can white light produce interference? What is its nature?

vii) What types of fringes are observed in case of interference at a wedge?

viii) Why the central Newton's ring is dark?

ix) What is a zone plate?

x) What type of wave-front is involved in Fresnel's diffraction?

xi) What is grating?

xii) What is the effect of increasing the number of lines on a grating?

(b) Answer any FIVE of the following. **2X5=10**

i) What are damped oscillations? Give examples.

ii) Derive the differential equation of wave motion.

iii) How can you determine the refractive index of a liquid by means of Newton's rings?

iv) Explain the formation of coherent sources in the case of a biprism.

v) Define resolving power of on optical instrument? Give the expression for it in case of a transmission grating.

vi) Give any two differences between a prism spectrum and a diffraction grating spectrum.

PART-B

UNIT-I

Answer any TWO from the following: **10X2=20**

2. (a) What are forced oscillations? Derive an expression for the amplitude of forced vibration of a body.

(b) A plane wave travelling through a medium is given by $y = 0.02\, e^{(2\pi t - 0.04\pi x)}$ meter. Find the wavelength and frequency. **(6+4)**

3. (a) Assuming the expression for velocity of longitudinal waves in a fluid, deduce Newton's formula for the velocity of sound in air and apply Laplace's correction.

(b) Calculate the velocity of sound in cartoon dioxide at N.T.P. Given Density of carbon dioxide at N.T.P. is $1.977 kg\, m^{-3}$ and the ratio of specific heat capacities of the gas is 1.306. **(6+4)**

4. (a) Write a neat diagram of Kundt's tube and derive the expression for the velocity of sound in a Kundt's rod.

(b) At what temperature will be velocity of sound in air be double of the velocity in air at 22°C? **(6+4)**

UNIT-II

Answer any TWO of the following. **10x2=20**

5. (a) Give the theory of interference and deduce the conditions for constructive and destructive interference.

(b) In a bi-prism experiment fringes of width 0.02 m are observed at 1 m from the slit. On introducing a convex lens 0.3 m away from the slit two enlarged images of the slit are seen 0.7 cm apart. Calculate the wavelength of sodium light. **(6+4)**

6. (a) Explain the interference due to wedge shaped film and obtain expression for fringe width.

(b) A parallel beam of light of $\lambda = 6\times10^{-7} m$ is incident on thin transparent film of refractive index 1.5 such that the angle of refraction is 45° in the film. Calculate the smallest thickness of the film which will appear dark by reflection. **(6+4)**

7. (a) Draw a neat diagram of Michelson's interferometer. Describe how it is used to determine wavelength of monochromatic light.

(b) In an experiment with Michelson's interferometer the distance travelled by the mirror for two successive positives of maximum distinctness was 0.2945 mm. If the mean wavelength for the two components of sodium D line is 589.3 nm, Calculate the difference between them. **(6+4)**

UNIT-III

Answer any TWO of the following. **10x2=20**

8. (a) Calculate the area of half period zones in case of a plane wave-front and show that it is practically constant.

(b) The diameter of the central zone of a zone plate is 2.3 mm. If a point source of light $(\lambda = 589.3\, nm)$ is placed at a distance of 6 m from it, calculate the position of the first image. **(6+4)**

9. (a) Discuss the theory of plane diffraction grating for oblique incidence.

(b) Calculate the number of lines/m in a grating of width 4 cm which will just resolve the sodium lines in the second order.

Given: The wavelength of sodium lines to be 589 nm and 589.6 nm. **(6+4)**

10. (a) Give Fresnel's theory of optical roation.

(b) The rotation of plane of polarization in a certain substance is 10° per cm. Calculate the difference between the refractive indices for the right and left circularly polarized lights in the substance.

Given $(\lambda = 589.3\, nm)$ **(6+4)**

PHY 301.1 Reg No.....

CREDIT BASED THIRD SEMESTER B.Sc. DEGREE EXAMINATION - OCTOBER 2016

PHYSICS

PAPER III: ACOUSTICS AND OPTICS

Duration: 3 Hours **Max Marks: 80**

PART –A

1. (a) Answer any TEN of the following. **10X1=10**

i) A body is in simple harmonic motion. At which point is its acceleration minimum?

ii) What is meant by critical damping in an oscillatory system?

iii) What are nodes and antinodes?

iv) Define mach number

v) Define bi-prism.

vi) Give two practical examples of interference at thin films.

vii) Why is the central Newton's ring dark?

viii) Define air wedge.

ix) Name the types of diffraction gratings.

x) What is meant by half-period elements?

xi) Define optic axis of a doubly refracting crystal.

xii) What is a Nicol prism?

(b) Answer any FIVE of the following. **5X2=10**

i) Define force constant and damping constant.

ii) Explain why the velocity of sound is greater in solids than in gases.

iii) Why should the two slits be narrow in Young's double slit experiment?

iv) Explain the use of a compensating glass plate in Michelson interferometer.

v) What is the special advantage of a zone plate over a lens?

vi) What is a polarimeter?

PART-B

UNIT-I

Answer any TWO from the following: **2X10=20**

2. (a) What are damped oscillations? Set up the equation for damped oscillation of a vibrating body.

(b) The equation of a plane progressive wave is given by $y = 0.4 \sin e^{2\pi(t-0.08x)}$ where x & y are in metres and t in seconds. Find the amplitude, wavelength and frequency of the wave. **(6+4)**

3. (a) Derive an expression for velocity of longitudinal waves in a fluid.

(b) Stationary waves are produced in a Kundt's tube filled with air by vibrating a steel rod of length one metre fixed at its centre. If the frequency of the steel rod is 2475 Hz and the distance between the heaps of powder is 0.07 m in the tube, find the speed of sound in (i) the steel rod (ii) in air. **(6+4)**

4. (a) Derive the effect of pressure, temperature, density of the medium and humidity on the speed of sound waves in gases.

(b) The fundamental frequency of vibration of a stretched string is 500 *Hz*. Keeping the tension a constant, when the length is decreased by 5 *cm* the fundamental frequency increases by 39 *Hz*. Find the original length of the string. **(6+4)**

UNIT-II

Answer any <u>TWO</u> of the following. **10x2=20**

5. (a) Define fringe width and obtain an expression for the same.

(b) Newton's rings are observed in reflected light of wavelength 590 *nm*. The diameter of the 10th dark ring is 0.005 *m*. Find the radius of curvature of the lens and the thickness of the air film. **(6+4)**

6. (a) Draw a neat diagram of Michelson's interferometer and label its parts. Describe how Michelson interferometer is used to obtain circular fringes, straight fringes and white light fringes.

(b) A bi-prism is placed 0.05 *m* from a slit illuminated by light of wavelength 650 *nm*. The width of the fringes on a screen 0.75 *m* from the bi-prism is $9.8\times10^{-4}m$. Find the distance between the coherent sources. **(6+4)**

7. (a) What are Newton's rings? Prove that in reflected light (i) diameter of dark rings are proportional to square root of natural numbers (ii) the diameters of bright rings are proportional to square root of odd natural numbers.

(b) In a young's double slit experiment using light of wavelength 520 *nm* the width of ten bright fringes was found to be 13 *mm*. If the distance between the slits is 0.3 *mm*, find the distance between the slits and the screen. **(6+4)**

UNIT-III

Answer any <u>TWO</u> of the following. **10x2=20**

8. (a) What is a zone plate? Derive an expression for its focal length.

(b) If the diameter of the central zone is 2.5 *mm* and a point source of light of wavelength 750 *nm* is placed 5 *m* away from the zone plate, find the position of the primary and the secondary image. **(6+4)**

9. (a) Distinguish between resolving power and dispersive power of an optical instrument. Deduce an expression for the dispersive power of a plane transmission granting.

(b) Calculate the angles at which the first dark band and the next bright band are formed in the Fraunhoper diffraction pattern at a slit 0.3 *mm* wide using light of wavelength 589 *nm*. **(6+4)**

10. (a) Explain the method of production and detection of plane, circularly, elliptically polarized light.

(b) Plane polarized light is incident on a piece of quartz cut parallel to the axis. Find the least thickness for which the ordinary and extra-ordinary rays combine to form plane polarized light. Given: $\mu_0 = 1.5442$ $\mu_E = 1.5533$ $\lambda = 5\times10^{-7}m$ **(6+4)**

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