KAKARAPARTI BHAVANARAYANA COLLEGE

(AUTONOMOUS)

Kothapeta, Vijayawada – 520 001

SYLLABUS (R20)

DEPARTMENT OF PHYSICS & ELECTRONICS

(PHYSICS)

KAKARAPARTI BHAVANARAYANA COLLEGE
(Autonomous) Department Of Physics

Class:	Semester	Title of The Paper:	Paper Code:	W.E.F
I B.SC(MPC,MPCS)	1	Mechanics, Waves & Oscillations	R20PHY101	2020-21

Total No of Hours for Teaching - Learning	Instructional Hours for Week		Duration of Semester End Examination in Hours	Max Marks		Credits	
60 Hours	Theory 4	Practical 3	3 Hours	CIA 25	SEE 75	4	2

Objectives:

Students will be able to articulate and describe:

1 Relative motion. Inertial and non inertial reference frames.

2 Parameters defining the motion of mechanical systems and their degrees of freedom.

3 Study of the interaction of forces between solids in mechanical systems.

4 Centre of mass and inertia tensor of mechanical systems.

5 Application of the vector theorems of mechanics and interpretation of their results.

6 Newton's laws of motion and conservation principles.

7 Introduction to analytical mechanics as a systematic tool for problem solving.

8 Use of mechanical simulation software

9 Compare particle motion and wave motion in different types of waves

Course Outcomes:

On successful completion of this course, the students will be able to:

- *Understand Newton's laws of motion and motion of variable mass system and its application to rocket motion and the concepts of impact parameter, scattering cross section.*
- *Apply the rotational kinematic relations, the principle and working of gyroscope and its applications and the precessional motion of a freely rotating symmetric top.*
- *Comprehend the general characteristics of central forces and the application of Kepler's laws to describe the motion of planets and satellite in circular orbit through the study of law of Gravitation.*
- *Understand postulates of Special theory of relativity and its consequences such as length contraction, time dilation, relativistic mass and mass-energy equivalence.*
- *Examine phenomena of simple harmonic motion and the distinction between undamped, damped and forced oscillations and the concepts of resonance and quality factor with reference to damped harmonic oscillator.*
- *Appreciate the formulation of the problem of coupled oscillations and solve them to*

obtain normal modes of oscillation and their frequencies in simple mechanical systems.

- *Figure out the formation of harmonics and overtones in a stretched string and acquire the knowledge on Ultrasonic waves, their production and detection and their applications in different fields.*

UNIT-I:

1. Mechanics of Particles (5 hrs)

Review of Newton's Laws of Motion, Motion of variable mass system, Motion of a rocket, Multistage rocket, Concept of impact parameter, scattering cross-section, Rutherford scattering-Derivation.

2. Mechanics of Rigid bodies (7 hrs)

Rigid body, rotational kinematic relations, Equation of motion for a rotating body, Angular momentum and Moment of inertia tensor, Euler equations, Precession of a spinning top, Gyroscope, Precession of atom and nucleus in magnetic field, Precession of the equinoxes

Unit-II:

3. Motion in a Central Force Field (12hrs)

Central forces, definition and examples, characteristics of central forces, conservative nature of central forces, Equation of motion under a central force, Kepler's laws of planetary motion-Proofs, Motion of satellites, Basic idea of Global Positioning System (GPS), weightlessness, Physiological effects of astronauts

UNIT-III:

4. Relativistic Mechanics (12hrs)

Introduction to relativity, Frames of reference, Galilean transformations, absolute frames, Michelson-Morley experiment, negative result, Postulates of Special theory of relativity, Lorentz transformation, time dilation, length contraction, variation of mass with velocity, Einstein's mass-energy relation

Unit-IV:

5. Undamped, Damped and Forced oscillations: (07 hrs)

Simple harmonic oscillator and solution of the differential equation, Damped harmonic oscillator, Forced harmonic oscillator – Their differential equations and solutions, Resonance, Logarithmic decrement, Relaxation time and Quality factor.

6. Coupled oscillations: (05 hrs)

Coupled oscillators-Introduction, Two coupled oscillators, Normal coordinates and Normal modes- N-coupled oscillators and wave equation

Unit-V:

7. Vibrating Strings: (07 hrs)

Transverse wave propagation along a stretched string, General solution of wave equation and its significance, Modes of vibration of stretched string clamped at ends, Overtones and Harmonics, Melde's strings.

8. Ultrasonics: (05 hrs)

Ultrasonics, General Properties of ultrasonic waves, Production of ultrasonics by piezoelectric and magnetostriction methods, Detection of ultrasonics, Applications of ultrasonic waves, SONAR

REFERENCE BOOKS:

- B. Sc. Physics, Vol.1, Telugu Academy, Hyderabad
- Fundamentals of Physics Vol. I - Resnick, Halliday, Krane ,Wiley India 2007
- College Physics-I. T. Bhimasankaram and G. Prasad. Himalaya Publishing House.
- University Physics-FW Sears, MW Zemansky& HD Young,Narosa Publications, Delhi
- Mechanics, S.G.Venkatachalapathy, Margham Publication, 2003.
- Waves and Oscillations. N. Subramanyam and Brijlal, VikasPulications.
- Unified Physics - Waves and Oscillations, Jai PrakashNath&Co.Ltd.
- Waves & Oscillations. S.Badami, V. Balasubramanian and K.R. Reddy, Orient Longman.
- The Physics of Waves and Oscillations, N.K.Bajaj, Tata McGraw Hill
- Science and Technology of Ultrasonics- Baldevraj, Narosa, New Delhi,2004

Practical Course 1: Mechanics, Waves and Oscillations

Work load: 30 hrs per semester 2 hrs/week

Course outcomes (Practical):

On successful completion of this practical course, the student will be able to;

- Perform experiments on Properties of matter such as the determination of moduli of elasticity *viz.*, Young's modulus, Rigidity modulus of certain materials; Surface tension of water , Coefficient of viscosity of a liquid , Moment of inertia of some regular bodies by different methods and compare the experimental values with the standard values.
- Know how to determine the acceleration due to gravity at a place using Compound pendulum and Simple pendulum.
- Notice the difference between flat resonance and sharp resonance in case of volume resonator and sonometer experiments respectively.
- Verify the laws of transverse vibrations in a stretched string using sonometer and

comment on the relation between frequency, length and tension of a stretched string under vibration.

- Demonstrate the formation of stationary waves on a string in Melde's string experiment.
- Observe the motion of coupled oscillators and normal modes.

Minimum of 6 experiments to be done and recorded:

1. Young's modulus of the material of a bar (scale) by uniform bending
2. **Young's modulus of the material a bar (scale) by non- uniform bending**
3. Surface tension of a liquid by capillary rise method
4. Viscosity of liquid by the flow method (Poiseuille's method)
5. **Bifilar suspension –Moment of inertia of a regular rectangular body.(ch2)**
6. **Fly-wheel -Determination of moment of inertia (ch 2)**
7. Rigidity modulus of material of a wire-Dynamic method (Torsional pendulum)
8. Volume resonator experiment
9. Determination of 'g' by compound/bar pendulum
10. Simple pendulum- normal distribution of errors-estimation of time period and the error of the mean by statistical analysis
11. **Determination of the force constant of a spring by static and dynamic method. (Ch 5)**
12. **Determination of ultrasonic velocity of a liquid using ultrasonic interferometer (Ch 8)**
13. Coupled oscillators
14. **Verification of laws of vibrations of stretched string –Sonometer**
15. Determination of frequency of a bar –Melde's experiment.
16. Study of a damped oscillation using the torsional pendulum immersed in liquid-decay constant and damping correction of the amplitude.

MODEL PAPER

Class: I B.SC(MPC, MPCS) **Code: R20PHY101**
Paper: P a p e r I : : Mechanics, Waves & Oscillations **Semester: I**
Time: 3Hrs **Max.Marks:75**

W.E.F 2020-21

SECTION-A **5x10=50M**

Answer ALL Questions with internal choice from all units

1 (a). Derive an equation of motion of a system of variable mass.

(or)

(b).What is precessional motion? Find angular velocity of precession of a spinning top.

2 (a). What is central force? Give two examples. Show that central force is conservative in nature.

(or)

(b). Define Kepler's laws of planetary motion. Derive Kepler's first Law

3 (a). Describe Michelson-Morley experiment with a neat diagram and sufficient theory.

(or)

(b). What are the postulates of Special theory of relativity. Derive Lorentz transformation equations

4 (a). Establish the equation of motion of simple harmonic oscillator and give its solution **(or)**

(b). Formulate differential equation for 2- coupled oscillator and give its solution.

5 (a). Formulate the differential equation for a transverse wave on s stretched string and give general solution of wave equation.

. **(or)**

(b). Write the properties of ultrasonic waves. Describe magnetostriction method for the production of ultrasonics.

SECTION-B **3x5=15M**

Answer any 3 Questions out of 5 Questions.

6. Write a short note on impact parameter and scattering cross section.
7. Explain briefly about Global Positioning System (GPS)
8. Write a short note on relaxation time and logarithmic decrement
9. Derive Einstein mass energy equivalence relation.
10. Write the applications of ultrasonics.

SECTION-C **2x5=10M**

Answer any 2 Questions out of 5 Questions.

11.A ballet dancer spins about a vertical axis at the rate of 1 revolution per second with her arms out stretched. When her arms folded, her moment of inertia about the vertical axis decreases by 60%. Calculate the new rate of revolution.

12. If the mean distance of mars from the sun is 1.524 times that of the earth. Find the period of revolution of mars about the sun.

13. A rocket ship is 100m long on the ground. When it is in flight, its length is 99m to an observer on the ground. What is its speed?

14. The quality factor of a sonometer wire is $2X10^3$. On plucking it makes 240 vibrations per second. Calculate the time in which amplitude decreases to half the initial value.

15. A piezo electric crystal with vibrating length $3X10^{-3}m$ has density $3.5X10^{3}Kg/m^{3}$. If t is made of material of Young's modulus $8X10^{10}N/m^{2}$, what is its fundamental frequency?

Unit No	Essay	SAQ	Problems
I	2	1	1
II	2	1	1
III	2	1	1
IV	2	1	1
V	2	1	1

KAKARAPARTI BHAVANARAYANA COLLEGE
(Autonomous) Department Of Physics

Class:	Semester:	Title of the Paper	Paper Code:	W.
I B.SC(MPC, MPCS)	2	Wave Optics	R20PHY201	2020-21

Syllabus

Total No of Hours for Teaching - Learning	Instructional Hours for Week		Duration of Semester End Examination in	Max Marks		Credits	
60 Hours	Theory 4	Practical 3	3 Hours	CIA 25	SEE 75	4	2

Course outcomes:

On successful completion of this course, the student will be able to:

- *Understand the phenomenon of interference of light and its formation in (i) Lloyd's single mirror due to division of wave front and (ii) Thin films, Newton's rings and Michelson interferometer due to division of amplitude.*
- *Distinguish between Fresnel's diffraction and Fraunhoffer diffraction and observe the diffraction patterns in the case of single slit and the diffraction grating.*
- *Describe the construction and working of zone plate and make the comparison of zone plate with convex lens.*
- *Explain the various methods of production of plane, circularly and polarized light and their detection and the concept of optical activity..*
- *Comprehend the basic principle of laser, the working of He-Ne laser and Ruby lasers and their applications in different fields.*
- *Explain about the different aberrations in lenses and discuss the methods of minimizing them.*
- *Understand the basic principles of fibreoptic communication andexplore the field of Holography and Nonlinear optics and their applications.*

UNIT-I Interference of light: (12hrs) Introduction, Conditions for interference of light, Interference of light by division of wave front and amplitude, Phase change on reflection- Stokes' treatment, Lloyd's single mirror, Interference in thin films: Plane parallel and wedge- shaped films, colours in thin films, Newton's rings in reflected light-Theory and experiment, Determination of wavelength of monochromatic light, Michelson interferometer and determination of wavelength.

UNIT-II Diffraction of light:(12hrs)

Introduction, Types of diffraction: Fresnel and Fraunhoffer diffractions, Distinction between Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction at a single slit, Plane diffraction grating, Determination of wavelength of light using diffraction grating, Resolving power of

grating, Fresnel's half period zones, Explanation of rectilinear propagation of light, Zone plate, comparison of zone plate with convex lens.

UNIT-III Polarisation of light:(12hrs)

Polarized light: Methods of production of plane polarized light, Double refraction, Brewster's law, Malus law, Nicol prism, Nicol prism as polarizer and analyzer, Quarter wave plate, Half wave plate, Plane, Circularly and Elliptically polarized light-Production and detection, Optical activity, Laurent's half shade polarimeter: determination of specific rotation, Basic principle of LCDs

UNIT-IV Aberrations and Fibre Optics: (12hrs)

Monochromatic aberrations, Spherical aberration, Methods of minimizing spherical aberration, Coma, Astigmatism and Curvature of field, Distortion; Chromatic aberration-the achromatic doublet; Achromatism for two lenses (i) in contact and (ii) separated by a distance.

Fibre optics: Introduction to Fibers, different types of fibers, rays and modes in an optical fiber, Principles of fiber communication (qualitative treatment only), Advantages of fiber optic communication.

UNIT-V Lasers and Holography:(12hrs)

Lasers: Introduction, Spontaneous emission, stimulated emission, Population Inversion, Laser principle, Einstein coefficients, Types of lasers-He-Ne laser, Ruby laser, Applications of lasers; Holography: Basic principle of holography, Applications of holography

REFERENCE BOOKS:

- BSc Physics, Vol.2, Telugu Akademy, Hyderabad
- A Text Book of Optics-N Subramanyam, L Brijlal, S.Chand& Co.
- Optics-Murugeshan, S.Chand& Co.
- Unified Physics Vol.IIOptics, Jai PrakashNath&Co.Ltd., Meerut
- Optics,F.A. Jenkins and H.G.White, McGraw-Hill
- Optics, AjoyGhatak,TataMcGraw-Hill.
- Introduction of Lasers – Avadhanulu, S.Chand& Co.
- Principles of Optics- BK Mathur, Gopala Printing Press, 1995

Practical Course II: Wave Optics

Work load:30hrs **2 hrs/week**

Course outcomes (Practicals):

On successful completion of this practical course the student will be able to,

1. *Gain hands-on experience of using various optical instruments like spectrometer, polarimeter and making finer measurements of wavelength of light using Newton Rings experiment, diffraction grating etc.*

2. *Understand the principle of working of polarimeter and the measurement of specific rotatory power of sugar solution*
3. *Know the techniques involved in measuring the resolving power of telescope and dispersive power of the material of the prism.*
4. *Be familiar with the determination of refractive index of liquid by Boy's method and the determination of thickness of a thin wire by wedge method.*

Minimum of 6 experiments to be done and recorded

1. **Determination of radius of curvature of a given convex lens-Newton's rings. (Ch 1)**
2. Resolving power of grating. (ch 2)
3. Study of optical rotation –polarimeter. (Ch 3)
4. Dispersive power of a prism.
5. Determination of wavelength of light using diffraction grating-minimum deviation method.(ch2)
6. Determination of wavelength of light using diffraction grating-normal incidence method.
7. Resolving power of a telescope.
8. Refractive index of a liquid-hallow prism
9. Determination of thickness of a thin wire by wedge method (Ch 1)
10. Determination of refractive index of liquid-Boy's method.
11. Determination **of wavelength of Laser using diffraction grating**

KAKARAPARTI BHAVANARAYANA COLLEGE (Autonomous)

Department of Physics

MODEL PAPER

Class: I B.SC(MPC, MPCS) **Code: R20PHY201**

Paper: P a e r I I : : Wave Optics **Semester: II** **Time: 3Hrs**

Max.Marks:75

W.E.F 2020-21

SECTION-A **5x10=50M**

Answer ALL Questions with internal choice from all units

1. (a) How do you determine the wavelength of monochromatic light using Llyod mirror.

(OR)

(b) How do you determine the wavelength of the monochromatic light using Newton's rings with sufficient theory.

2. (a) Explain Fraunhoffer class of diffraction due to single slit.

(OR)

(b) What are Fresnel's half period zones? Give the construction and working of zone plate.

3 (a) Give the construction and working of Nicol prism as polariser and analyser.

(OR)

(b) Define specific rotator power? How it is determined by using Laurent's half shade polarimeter?

4(a) What is the achromatic doublet? How the chromatic aberration eliminated when a) two lenses in contact and b) two lenses separated by some distance.

(OR)

(b). Explain spherical aberration. How the spherical aberration eliminated when two lenses separated by some distance.

5(a) What is population inversion? Describe the construction and working of He – Ne Laser.

(OR)

(b) Describe the construction and working of Ruby Laser. What are the applications of Lasers?

SECTION-B

Answer any 3 Questions out of 5 Questions. **3x5=15M**

6. Explain the colours in thin films.
7. Give the differences between zone plate and convex lens.
8. State and explain Brewser's Law.
9. Advantages of fiber optic communication
10. Write a short note on holography

SECTION-C

Answer any 2 Questions out of 4 Questions. **2x5=10M**

11. In Michelson interferometer 200 fringes cross the field of view, when the movable mirror is displaced through 0.0589mm. Calculate the wavelength of monochromatic light used.

12. A grating has 15cm of the surface ruled with 6000 lines per cm. What is the resolving power of the grating in the first order?

13. Find the radius of the first zone in a zone plate of focal length 20cm for a light of wave length 50nm.

13. Calculate the thickness of the quarter – wave plate for light of wavelength of 5460AU. The refractive index of ordinary is 1.652 and extra ordinary ray is 1.488.

14. The focal lengths of thin convex lenses are 100cm and 96.8cm for red and blue colours respectively. Find the dispersive power of the material of the lens.

Unit No	Essay	SAQ	Problems
I	2	1	1
II	2	1	2
III	2	1	1
IV	2	1	1

V	2	1	---