**Paper II: Waves &
Oscillations(For Maths
Combinations)
II SEMESTER**

Work load: 60 hrs per semester   **4 hrs/week**

UNIT-I (12 hrs)
1. Simple Harmonic oscillations
   Simple harmonic oscillator and solution of the differential equation-Physical
   characteristics of SHM, torsion pendulum-measurements of rigidity modulus, compound
   pendulum- measurement of 'g', Principle of superposition,beats, combination of two
   mutually perpendicular simple harmonic vibrations of same frequency and different
   frequencies. Lissajous figures.

UNIT-II (12 hrs)
2. Damped and forced oscillations
   Damped harmonic oscillator, solution of the differential equation of damped oscillator.
   Energy considerations, comparison with un-damped harmonic oscillator, logarithmic
   decrement, relaxation time, quality factor, differential equation of forced oscillator and
   its solution, amplitude resonance and velocity resonance.

UNIT-III (10 hrs)
3. Complex vibrations
   Fourier theorem and evaluation of the Fourier coefficients, analysis of periodic wave
   functions-square wave, triangular wave, saw tooth wave, simple problems on evolution
   of Fourier coefficients.

UNIT-IV (17hrs)
4. Vibrating strings: 8 hrs
   Transverse wave propagation along a stretched string, general solution of wave equation
   andits significance, modes of vibration of stretched string clamped at ends, overtones and
   harmonics. Energy transport and transverse impedance.
5. Vibrations of bars: 9 hrs
   Longitudinal vibrations in bars-wave equation and its general solution. Special cases (i)
   bar fixed at both ends (ii) bar fixed at the midpoint (iii) bar fixed at one end. Tuning fork.

UNIT-V (9 hrs)
6. Ultrasonics: 9hrs
   Ultrasonics, properties of ultrasonic waves, production of ultrasonics by piezoelectric and
   magnetostriction methods, detection of ultrasonics, determination of wavelength of
   ultrasonic waves.Applications of ultrasonic waves.

REFERENCE BOOKS:
   1.   BSc Physics Vol.1, Telugu Academy, Hyderabad.

2. Waves and Oscillations. N. Subramanyam and Brijlal, Vikas Pulications.
3. Unified Physics Vol., Mechanics, Waves and Oscillations, Jai Prakash Nath&Co.Ltd.
4. Fundamentals of Physics. Halliday/Resnick/Walker ,Wiley India Edition 2007.
5. Waves & Oscillations. S.Badami, V. Balasubramanian and K.R. Reddy,Orient Longman.
6. College Physics-I. T. Bhimasankaram and G. Prasad. Himalaya Publishing House.
7. Science and Technology of Ultrasonics- Baldevraj, Narosa, New Delhi,2004
8. Introduction to Physics for Scientists and Engineers. F.J. Buche. McGraw Hill.

Practical Paper II: Waves & Oscillations

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

Minimum of 6 experiments to be done and recorded

1. Volume resonator experiment
2. Determination of 'g' by compound/bar pendulum
3. Simple pendulum normal distribution of errors-estimation of time period and the error ofthe mean by statistical analysis
4. Determination of the force constant of a spring by static and dynamic method.
5. Determination of the elastic constants of the material of a flat spiral spring.
6. Coupled oscillators
7. Verification of laws of vibrations of stretched string –sonometer
8. Determination of frequency of a bar –Melde's experiment.
9. Study of a damped oscillation using the torsional pendulum immersed in liquid- decayconstant and damping correction of the amplitude.
10. Formation of Lissajous figures using CRO.

Scheme of Valuation

Practicals	**50 marks**
Formula & Explanation	6
Tabular form +graph +circuit diagram	6
Observations	12
Calculation, graph, precautions & Result	6
Viva-Voce	10
Record	10

Suggested student activities

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

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Examples

Seminars — A topic from any of the Units is given to the student and asked to give abrief seminar presentation.

Group discussion — A topic from one of the units is given to a group of students and asked todiscuss and debate on it.

Assignment — Few problems may be given to the students from the different units andasked them to solve.

Field trip — Visit to Satish Dhawan Space Centre, Sriharikota / Thermal andhydroelectric power stations / Science Centres, any other such visit etc.

Study project — Web based study of different satellites and applications.

Domain skills:

Logical derivation, experimentation, problem solving, data collection and analysis, measurementskills

QUESTION BANK

UNIT I (Simple Harmonic oscillations)

Essay Questions (10M)

1. What is simple harmonic oscillator? Derive equation of motion of simple harmonic oscillator and find its solution?

2. Discuss the theory of combination of two SHMs of same frequency at right angles to each other?

3. Define compound pendulum. Derive the expression for acceleration due to gravity using compound pendulum.

4. Define torsion pendulum and how you determine rigidity modulus by using torsion pendulum. Explain.

Short Answers (5M)

1. What is SHM? What are the characteristics of SHM?

2. Write any five characteristics of SHM

3. Write briefly about Lissajou's figures.

UNIT II (Damped and forced oscillations)

Essay Questions (10M)

1. Describe the equation of motion of damped harmonic oscillator and find its solution under different conditions.

2. What are forced vibrations? Derive equation of motion of forced oscillator and its solution.

3. What are the forced oscillations? Obtain expressions for amplitude and phse of forced oscillator.

Short Answers (5M)

1. Derive the differential equation of damped harmonic oscillator.

2. Explain amplitude resonance.

3. Explain relaxation time and Q- factor.

4. What is logarithmic decrement. Derive expression for it.

UNIT III(Complex vibrations)

Essay Questions (10M)

1. State Fourier theorem and derive Fourier constants.

2. Discuss the analysis of square wave using Fourier theorem.

Short Answers (5M)

1. State and explain Fourier theorem.

2. State Fourier theorem and write the limitations of the theorem.

UNIT IV (Vibrating strings & Vibrations of Bars)

Essay Questions (10M)

1. Derive an expression for the velocity of a transverse wave in a stretched string.

2. Discuss the modes of vibrations of a stretched string fixed at both ends. Explain overtones.

3. Derive expression for the velocity of a longitudinal wave in a bar.

4. Discuss briefly the longitudinal modes of vibration of a bar clamped rigidly at both

the ends.

5. Derive the general solution for a longitudinal wave in a bar free at both the ends.

Short Answers (5M)

1. Explain the formation of harmonics and overtones in stretched strings.

2. Explain briefly about energy transport.

3. Obtain solution for longitudinal waves in bars.

UNIT V(Ultrasonics)

Essay Questions (10M)

1. What are ultrasonic waves. Describe the magnetostriction method for the production of ultrasonics.

2. Explain the method of production of ultrasonics using piezo electric method.

Short Answers (5M)

1. Write any five applications of ultrasonics.

2. Explain the detection of ultrasonics.