NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF MECHANICAL ENGINEERING
MECHANICAL ENGINEERING PROGRAM

MB224 – PHYSICS II

I. GENERAL INFORMATION

CODE	**:**	MB224 Physics II
SEMESTER	**:**	2
CREDITS	**:**	5
HOURS PER WEEK	**:**	7 (Theory – Practice)
PREREQUISITES	**:**	MB223 Physics I
CONDITION	**:**	Compulsory

II. COURSE DESCRIPTION

The course prepares students in the understanding and explaining the physical phenomena related to periodic motion, oscillatory motion, fluid mechanics and thermodynamics. Student applies thermodynamic laws to analyze heat transfer and energy transformation in thermodynamic processes. Laboratories experiences are carried out to verify the validity and applicability of physics laws. Physics problems with engineering applications are analyzed and solved.

III. COURSE OUTCOMES

1. Describe the basic mechanical deformations of solids.
2. Analyze, describe and depict the oscillatory motion, according with kinematic, dynamic and energetic theory.
3. Describe and depict transverse, longitudinal and travelling waves.
4. Formulate, interpret and apply the basic principles and laws governing fluid statistics and dynamics.
5. Describe and apply the concepts of temperature and heat in order to understand the thermal properties of matter.
6. Distinguish, depict and apply microscopic and macroscopic models of gases and apply its laws into thermodynamics.
7. Formulate and interpret thermodynamic laws governing heat, work and energy transformations in thermal processes.

IV. COURSE CONTENTS

1. ELASTICITY

Elasticity of materials / Stress and deformation / Hooke's law / Elastic modulus / Elastic energy.

2. OSCILLATIONS

Simple harmonic motion (SHM) / Kinematics of SHM / Dynamics of SHM / Simple harmonic oscillator energy / Damped harmonic motion / Forced oscillations and resonance / Combinations of SHM.

3. MECHANICAL WAVES

Wave concept / Characteristics of waves / Types of wave / Mathematical description of one-dimensional waves propagation / Sinusoid or harmonic wave / Velocity of wave propagation / Oscillation velocity / One-dimensional wave equation / Wave power and intensity / Superposition principle / Harmonic wave interference / Standing and harmonic waves / Sound waves / Characteristics / Sound waves power and intensity / Vibrations and sound origin / Doppler effect.

4. FLUIDS

Fluids statistics / Density / Specific weight and pressure / Variation in a fluid with depth / Pascal and Archimedes principle / Fluids dynamics / Motion characteristics / Ideal fluid / Fluid lines / Fluid tube / Continuity and Bernoulli equation / Real fluids and viscosity / Poiseuille equation.

5. HEAT AND TEMPERATURE

Temperature / Macroscopic and microscopic description of a system / Temperature concept / Thermal equilibrium / Temperature measurement and temperature scales / Thermal expansion / Heat concept / Internal and Thermal energy / Heat capacity / Specific heat / Mechanical equivalent of heat / Changes of state / Heat transfer / conduction, convection and radiation.

6. GASES

Ideal gas / Macroscopic description / Equation of state / Microscopic description of an ideal gas / Kinetic theory / Molecular model of an ideal gas / Pressure Kinetic calculus / kinetic interpretation of temperature / Internal energy / Theorem of Energy Equipartition / Heat capacity of ideal gases / Real gases.

7. HEAT AND THE FIRST LAW OF THERMODYNAMICS

Heat and work / Internal energy / Heat capacity and specific heat / Internal energy of an ideal gas / Phase changes / Latent heat of melting and vaporization / First thermodynamics law / Heat and work in thermodynamic processes / Application of first law of thermodynamics / Heat transfer: conduction, convection and radiation.

8. THERMAL MACHINES, ENTROPY AND SECOND LAW OF THERMODYNAMICS

Thermal machines / Second thermodynamics law / Reversible and non-reversible processes / Carnot machine / Coolers and freezers / Entropy / Changes of entropy in non-reversible processes.

V. LABORATORY EXPERIENCES

Laboratory 1: Elasticity and Hooke law
Laboratory 2: Simple Harmonic motion
Laboratory 3: Vibrating waves
Laboratory 4: Density and surface tension
Laboratory 5: Linear dilation
Laboratory 6: Specific heat of solids

VI. METHODOLOGY

The course consists of theory, practice and laboratory sessions. The instructor presents the concepts and physical laws using applets, videos and formulating equations using differential and integral expressions. Problems related to engineering are solved with active student participation. Laboratory experiences are carried out using specialized equipment and software simulation. For every experience, students work in group and present a report summarizing main results, analysis and conclusions.

VII. GRADING SYSTEM

The Final Grade (FG) is calculated with the following formula:

FG = (EP + EF + PP) / 3

EP: Mid-term exam EF: Final exam PP: Average of quizzes and laboratories

VIII. BIBLIOGRAPHY

1. R. A. Serway
Physics, Vol I, Mc Graw-Hill Interamerica, 2005
2. Sears-Zemansky-Young-Freedman
University Physics Vol. 1, 2010, 12th Ed. Pearson Education.