ENGINEERING PHYSICS

(Common to CHEMICAL, CIVIL, MECHANICAL and MECHANICAL (ROBOTICS))

Course Code: 22BP1103

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Course Outcomes: At the end of the Course the student shall be able to

CO1: Apply laws of mechanics to solve engineering problems (L3)
CO2: Apply the principles of acoustics for noise reduction (L3)
CO3: Develop the relationship between elastic constants (L3)
CO4: Classify various modes of heat transfer and find thermal conductivityof a material (L4)
CO5: Identify the sensors for various engineering applications and explain the preparation and uses of nanomaterials (L3)

UNIT-I: MECHANICS — 12 Lectures

Basic laws of vectors and scalars, conservative forces- F = -grad V, torque and angular momentum - Newton's laws in inertial and linearly accelerating non-inertial frames of reference-rotating frame of reference with constant angular velocity-concept of pseudo forces (Centrifugal and Coriolis forces)- qualitative explanation of Foucault's pendulum-rigid body-angular velocity vector-moment of inertia tensor, ex: rod executing conical motion with fixed centre of mass- gravitation and Kepler's laws.

Text Book 1: Sec: 1.5 to 1.7, 5.11 (note 5.2), 7.5, 4.4, 2.10, Chapter 9 (example-9.11), 8.6, 8.6.1, Chapter-7 (example 7.9), Chapter 2 (example 2.10), 10.1;
Text Book 2: Sec: 15.2, 15.3, 15.3.1, 15.3.2.

Learning Outcomes: The students will be able to

1. Identify forces and moments in mechanical systems using scalar and vector techniques (L3)
2. Apply Newton's second law for inertial and non-inertial frames of reference (L3)
3. Explain the effect of the Earth's rotation on the formation and movement of winds (L2)

UNIT-II: ACOUSTICS AND ULTRASONICS — 10 Lectures

Classification of sound-Weber-Fechner law-decibel-Reverberation and reverberation time Sabine's formula-Derivation using growth and decay method-Absorption coefficient-

definition and its determination-factors affecting acoustics of buildings and their remedies (Shape of the auditorium, Reverberation time and seating arrangement).
Introduction of ultrasonics-Production of ultrasonics by magnetostriction and piezoelectric methods- Acoustic grating- Applications-Non Destructive Testing using ultrasonics-Sonogram.

Text Book 3: Sec:13.3, 13.4.4, 13.5, 13.9.1.1, 13.16, 13.17, 13.18, 13.13, 13.14, 13.20 (iv, vi, vii), 14.1, 14.4.2.1, 14.4.3.1, 14.8.2, 14.12.1

Learning Outcomes: The students will be able to

1. Explain the sound propagation in buildings (L2)
2. Interpret the properties of materials for building acoustics (L2)
3. Demonstrate the production of ultrasonics for various applications (L2)

UNIT-III: ELASTICITY **09 Lectures**

Stress, Strain, Hooke's Law- Stress-Strain diagram, Generalized Hooke's law- different types of moduli of elasticity and their relations- bending of beams- Bending Moment of a Beam- Depression of cantilever- Young's modulus by uniform bending.

Text Book 3: Sec: 2.3, 2.3.1, 2.3.2, 2.4, 2.5, 2.5. 1-3, 2.6, 2.7, 2.10, 2.10.1-3, 2.12, 2.12.1, 2.12.2, 2.12.5

Learning Outcomes: The students will be able to

1. Interpret the stress and strain curve (L2)
2. Develop the relationship between elastic constants (L2)
3. Identify various methods to determine Young's Modulus of a material (L3)

UNIT-IV: HEAT TRANSFER **08 Lectures**

Transfer of heat-Thermal conduction, convection and radiation and their Fundamental Laws (Newton's Law of Cooling, Stefan-Boltzmann law and Wien's law)- Thermal expansion of solids and liquids-Heat Conduction in solids-Thermal Conductivity-Lee's method (bad conductor)-Heat conduction through compound media
Text Book 3: Sec: 16.1, 16.2, 16.3, 16.4.2, 16.5.2, 16.7

Learning Outcomes: The students will be able to

1. Identify the different modes of heat transfer (L3)
2. Explain various laws of thermal radiation (L2)
3. Demonstrate the coefficient of thermal conductivity of a bad conductor. (L3)

UNIT-V: SENSORS AND NANOMATERIALS **11 Lectures**

Sensors:(qualitative description only): Classification of sensors, Strain and Pressure sensors-Piezoelectric, magnetostrictive sensors, Fibre optic methods of pressure sensing; Temperature sensor- Thermocouple, bimetallic strip, pyroelectric detectors, Hall-effect sensor, smoke and fire detectors.
Basics of Nanomaterials-Top-down and bottom-up approaches-Preparation- ball milling and Sol-gel, Carbon nanotubes-Applications of Nanomaterials (better insulating materials, elimination of pollutants, high energy density batteries, nanomachines and nanodevices).

Text Book 4: Sec: 1.1, 1.2, 1.3, 4.2,4.4, 4.8, 7.11
Text Book 3: Sec: 49.3, 49.5.1(iii), 49.5.2 (iv), 49.9, 49.17(ii, v, viii xiv)

Learning Outcomes: The students will be able to

1. Explain the physics behind the working of a sensor (L2)
2. Illustrate the basic preparation methods of nanomaterials (L2)
3. Identify the applications of nanomaterials in various fields (L3)

Text Books:
1. D. Kleppner and R. Kolenkow, *An Introduction to Mechanics*, 2nd Edition, Cambridge University Press, 2014.
2. M. K. Harbola, *Engineering Mechanics*, Fourth Edition, Cengage Learning India Pvt. Ltd, 2011.
3. M. N. Avadhanulu, P. G. Khirsagar, and T. V. S. Arun Murthy, *A textbook of Engineering Physics*, Revised edition (11e), S. Chand and Company Ltd., 2019.
4. I. R. Sinclair, *Sensor and Transducers*, 3rd Edition, Elsevier (Newnes), 2001.

Reference Books:
1. S. P. Timoshenko and J. N. Goodier, *Theory of Elasticity*, Third Edition, Tata Mc Graw Hill, 2010.
2. R. K. Gaur and S. L. Gupta, *Engineering Physics*, Fourth Revised Edition, Dhanpat Rai Publications, 2014.
3. Jacob Fraden, *Handbook of Modern Sensors*, 3rd Edition, Springer Verlag Newyork Inc., 2004.

Web References:

https://www.youtube.com/watch?v=JAzg4mPVEe4
https://nptel.ac.in/courses/115/107/115107122/

https://nptel.ac.in/courses/115/104/115104094/
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https://www.youtube.com/watch?v=ebO38bbq0_4