# MOHAMMED SATHAK A J COLLEGE OF ENGINEERING

Siruseri IT park, OMR, Chennai - 603103

## LESSON PLAN

**Department of Physics**

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| Name of the Subject | Engineering Physics | Name of the handling Faculty | |
| Subject Code | PH3151 | Year / Sem | I Year / I Sem |
| Acad Year | | Batch | |

## Course Objective

To make the students effectively achieve an understanding of mechanics.

To enable the students to gain knowledge of electromagnetic waves and its applications.

To introduce the basics of oscillations, optics and lasers.

Equipping the students to successfully understand the importance of quantum physics.

To motivate the students towards the applications of quantum mechanics.

## Course Outcome

Upon completion of this course

CO1 - Understand the importance of mechanics.

CO2 - Express their knowledge in electromagnetic waves.

CO3 - Demonstrate a strong foundational knowledge in oscillations, optics and lasers.

CO4 - Understand the importance of quantum physics.

CO5 - Comprehend and apply quantum mechanical principles towards the formation of energy bands.

**Lesson Plan**

| Sl. No. | Topic(s) | T / R* Book | Periods Required | Mode of Teaching (BB / PPT / NPTEL / MOOC / etc ) | Blooms Level (L1-L6) | CO | PO |
|---|---|---|---|---|---|---|---|
| **UNIT I - MECHANICS** | | | | | | | |
| 1 | Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies | T1 / R3 | 1 | PPT | L1 | CO1 | PO1 |
| 2 | Motion of the CM – kinetic energy of the system of particles. Rotation of rigid bodies | T1 / R4 | 1 | PPT | L2 | CO1 | PO1 |
| 3 | Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I | T1 / R3 | 1 | BB | L5 | CO1 | PO12 |
| 4 | Moment of inertia of continuous bodies – M.I of a diatomic molecule | T1 / R4 | 1 | BB | L5 | CO1 | PO3 |
| 5 | Torque – rotational dynamics of rigid bodies – conservation of angular momentum | T1 / R3 | 1 | BB | L2 & L5 | CO1 | PO1 |
| 6 | Rotational energy state of a rigid diatomic molecule - gyroscope | T1 / R3 | 1 | BB | L5 | CO1 | PO5 |
| 7 | Torsional pendulum | T1 / R4 | 1 | BB | L5 | CO1 | PO3 |
| 8 | Double pendulum | T1 / R4 | 1 | PPT | L3 | CO1 | PO7 |

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| 9 | Introduction to nonlinear oscillations, Problems | T1 / R3 | 1 | BB | L5 | CO1 | PO2 |
| **Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any**<br>Assignment | | | | | | | |
| **Evaluation method**<br>Marks out of 10 | | | | | | | |
| **UNIT II - ELECTROMAGNETIC WAVES** | | | | | | | |
| **10** | The Maxwell's equations | T2 / R3 | 1 | BB | L2 | CO2 | PO1 |
| **11** | Wave equation | T2 / R4 | 1 | BB | L5 | CO2 | PO3 |
| **12** | Plane electromagnetic waves in vacuum, | T2 / R3 | 1 | BB | L5 | CO2 | PO1 |
| **13** | Conditions on the wave field | T2 / R3 | 1 | PPT | L3 | CO2 | PO12 |
| **14** | Properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter | T2 / R3 | 1 | PPT | L4 | CO2 | PO5 |
| **15** | Polarization - Producing electromagnetic waves | T1 / R4 | 1 | BB | L2 | CO2 | PO1 |
| **16** | Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure | T1 / R4 | 1 | PPT | L3 | CO2 | PO5 |
| **17** | Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium | T1 / R4 | 1 | PPT | L3 | CO2 | PO7 |
| **18** | Vacuum interface for normal incidence, Problems | T1 / R3 | 1 | BB | L5 | CO2 | PO2 |
| **Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any**<br>Assignment | | | | | | | |
| **Evaluation method**<br>Marks out of 10 | | | | | | | |
| **UNIT III - OSCILLATIONS, OPTICS AND LASERS** | | | | | | | |
| **19** | Simple harmonic motion - resonance | T2 / R3 | 1 | PPT | L2 | CO3 | PO1 |
| **20** | Waves on a string | T2 / R3 | 1 | PPT | L3 | CO3 | PO3 |
| **21** | Standing waves | T2 / R3 | 1 | PPT | L2 | CO3 | PO5 |
| **22** | Traveling waves, Energy transfer of a wave, sound waves - Doppler effect | T2 / R3 | 1 | PPT | L2 | CO3 | PO1 |
| **23** | Reflection and refraction of light waves - total internal reflection - interference, Michelson interferometer | T1 / R3 | 1 | BB | L3 | CO3 | PO3 |
| **24** | Theory of air wedge and experiment | T1 / R4 | 1 | BB | L5 | CO3 | PO3 |
| **25** | Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - | T1 / R4 | 1 | BB | L5 | CO3 | PO3 |
| **26** | Nd-YAG laser, CO2 laser | T2 / R3 | 1 | PPT | L4 | CO3 | PO7 |
| **27** | Semiconductor laser –Basic applications of lasers in industry | T2 / R3 | 1 | BB | L5 | CO3 | PO2 |

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| **Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any**<br>Assignment | | | | | | | |
| **Evaluation method**<br>Marks out of 10 | | | | | | | |
| **UNIT IV - BASIC QUANTUM MECHANICS** | | | | | | | |
| **28** | Photons and light waves - Electrons and matter waves | T1 / R3 | 1 | BB | L5 | CO4 | PO3 |
| **29** | Compton effect | T1 / R3 | 1 | BB | L5 | CO4 | PO3 |
| **30** | The Schrodinger equation - Time dependent form | T1 / R3 | 1 | PPT | L3 | CO4 | PO1 |
| **31** | Time independent form | T1 / R3 | 1 | PPT | L2 | CO4 | PO1 |
| **32** | Meaning of wave function - Normalization | T1 / R3 | 1 | BB | L5 | CO4 | PO3 |
| **33** | Free particle - particle in a infinite potential well: 1D | T1 / R3 | 1 | BB | L5 | CO4 | PO3 |
| **34** | Particle in a infinite potential well: 2D | T2 / R4 | 1 | BB | L2 | CO4 | PO1 |
| **35** | 3D Boxes- Normalization | T2 / R4 | 1 | PPT | L4 | CO4 | PO7 |
| **36** | Probabilities and the correspondence principle, Problems | T1 / R3 | 1 | BB | L5 | CO4 | PO2 |
| **Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any**<br>Assignment | | | | | | | |
| **Evaluation method**<br>Marks out of 10 | | | | | | | |
| **UNIT V - APPLIED QUANTUM MECHANICS** | | | | | | | |
| **37** | The harmonic oscillator | T3 / R3 | 1 | PPT | L1 | CO5 | PO1 |
| **38** | Barrier penetration | T3 / R3 | 1 | PPT | L2 | CO5 | PO1 |
| **39** | Quantum tunnelling | T3 / R3 | 1 | BB | L2 | CO5 | PO2 |
| **40** | Tunneling microscope | T3 / R3 | 1 | BB | L4 | CO5 | PO3 |
| **41** | Resonant diode | T3 / R3 | 1 | BB | L4 | CO5 | PO3 |
| **42** | Finite potential wells | T3 / R3 | 1 | BB | L4 | CO5 | PO7 |
| **43** | Bloch’s theorem for particles in a periodic potential | T1 / R4 | 1 | PPT | L3 | CO5 | PO12 |
| **44** | Basics of Kronig-Penney model | T1 / R4 | 1 | PPT | L3 | CO5 | PO5 |
| **45** | Origin of energy bands | T1 / R4 | 1 | PPT | L3 | CO5 | PO2 |
| **Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any**<br>Assignment | | | | | | | |
| **Evaluation method**<br>Marks out of 10 | | | | | | | |
| **Content Beyond the Syllabus Planned** | | | | | | | |

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| 1 | Particle in a 3-D box-Degeneracy and Hydrogen Atom |
| 2 | Medical application of LASER |

**Text Books**

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|---|---|
| 1 | D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017. |
| 2 | E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ.Press, 2013. |
| 3 | Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw- Hill (Indian Edition), 2017. |

**Reference Books**

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|---|---|
| 1 | R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009. |
| 2 | Paul A. Tipler, Physic – Volume 1 & 2, CBS, (Indian Edition), 2004. |
| 3 | K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019. |
| 4 | D.Halliday, R.Resnick and J.Walker. Principles of Physics, Wiley (Indian Edition), 2015. |
| 5 | N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer- Verlag, 2012. |

**Website / URL References**

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| 1 | Gyroscope: https://www.youtube.com/watch?v=cquvA_IpEsA |
| 2 | Cell Phone reception: https://youtu.be/kxLcwIMYmr0 |
| 3 | Nd-YAG laser: https://youtu.be/XI18Is5Lp9I |
| 4 | CO2 Laser: https://youtu.be/dhV_jGVeiG8 |

**Blooms Level**

| | | | | | |
|---|---|---|---|---|---|
| **Level 1 ( L1 ) : Remembering**<br>**Level 2 (L2) : Understanding**<br>**Level 3 (L3) : Applying** | Lower Order Thinking | Fixed Hour Exams | **Level 4 (L4) : Analysing**<br>**Level 5 (L5) : Evaluating**<br>**Level 6 (L6) : Creating** | Higher Order Thinking | Projects / Mini Projects |

**Mapping syllabus with Bloom's Taxonomy LOT and HOT**

| Unit No | Unit Name | L1 | L2 | L3 | L4 | L5 | L6 | LOT | HOT | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Unit 1 | MECHANICS | 1 | 2 | 1 | 0 | 6 | 0 | 4 | 6 | 10 |
| Unit 2 | ELECTROMAGNETIC WAVES | 0 | 2 | 3 | 1 | 3 | 0 | 5 | 4 | 9 |
| Unit 3 | OSCILLATIONS, OPTICS AND LASERS | 0 | 3 | 2 | 1 | 3 | 0 | 5 | 4 | 9 |
| Unit 4 | BASIC QUANTUM MECHANICS | 0 | 2 | 1 | 1 | 5 | 0 | 3 | 6 | 9 |
| Unit 5 | APPLIED QUANTUM MECHANICS | 1 | 2 | 3 | 3 | 0 | 0 | 6 | 3 | 9 |
| **Total** | | 2 | 11 | 10 | 6 | 17 | 0 | 23 | 23 | 46 |
| **Total Percentage** | | 4.35 | 23.91 | 21.74 | 13.04 | 36.96 | 0 | 50 | 50 | 100 |

**CO PO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | - | 2 | - | 1 | - | - | - | - | 1 | - | - |
| **CO2** | 3 | 3 | 2 | - | 2 | - | 1 | - | - | - | - | 1 | - | - |
| **CO3** | 3 | 2 | 2 | - | 1 | - | 1 | - | - | - | - | - | - | - |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO4** | 3 | 2 | 2 | - | 2 | - | 1 | - | - | - | - | 1 | - | - |
| **CO5** | 3 | 3 | 2 | - | 2 | - | 1 | - | - | - | - | 1 | - | - |
| **Avg** | 3 | 3 | 2 | - | 2 | - | 1 | - | - | - | - | 1 | - | - |

| **Justification for CO-PO mapping** | |
|---|---|
| **CO1** | Applying the knowledge of elastic nature of materials help to choose the suitable materials in the industries (PO1). This will help in problem solving (PO2) strongly, design and development of solution to some extent (PO3). This may help to know the modern tool usage to some extent(PO5). (PO7) gives the knowledge of engineering solutions in society and environment weakly and (PO12) recognizes the need for life-long learning weakly. |
| **CO2** | Concepts of waves, optical devices and its application to fibre optics attribute to strong Engineering knowledge (PO1). This will help in problem solving strongly (PO2), design and development of solution (PO3) and developing simple model helps in learning the techniques (PO5) to some extent. (PO7) weakly helps to understand the impact of optical devices and fibre optics to environment and (PO12) weakly helps in life-long learning process. |
| **CO3** | Thermal properties of the materials lead to identify the suitable industrial part strongly (PO1). This will help in problem solving (PO2), design and development of solution to some extent (PO3). This may weakly help to know the modern tools usage (PO5) and engineering solutions in society and environment (PO7). |
| **CO4** | While understanding the importance and application of Quantum Physics, strong engineering knowledge (PO1) is developed, this will help in problem solving (PO2), design and development of solution (PO3) and in applying appropriate techniques and tools with an understanding of the limitations (PO5) to some extent. Application of quantum mechanics may be of slight use to know the life-long technological changes (PO12) in devices like quantum tunneling microscope. |
| **CO5** | Understanding of various crystal structures and crystal growth techniques attributes to strong Engineering knowledge (PO1). This will help in problem solving (PO2) strongly, design and development of solution (PO3) moderately. Selecting suitable algorithm helps in learning the commercial software (PO5) to some extent. (PO7) gives the knowledge of engineering solutions in society and environment weakly. (PO12) recognizes the need for life-long learning weakly. |

| **3** | **High level** | **2** | **Moderate level** | **1** | Low level |
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Name & Sign of Faculty Incharge :

Name & Sign of Subject Expert :

Head of the Department :

Format No :231