# INSTITUTE OF AERONAUTICAL ENGINEERING

**(Autonomous)**
Dundigal, Hyderabad -500 043

## MECHANICAL ENGINEERING

## COURSE DESCRIPTOR

| | | | | | |
|---|---|---|---|---|---|
| **Course Title** | APPLIED PHYSICS | | | | |
| **Course Code** | AHS007 | | | | |
| **Programme** | B.Tech | | | | |
| **Semester** | I | AE \| ME \| CE | | | |
| **Course Type** | Foundation | | | | |
| **Regulation** | IARE - R16 | | | | |
| **Course Structure** | **Theory** | | | **Practical** | |
| | **Lectures** | **Tutorials** | **Credits** | **Laboratory** | **Credits** |
| | 3 | 1 | 4 | - | - |
| **Chief Coordinator** | Dr. Rizwana, Professor | | | | |
| **Course Faculty** | Mr. K Saibaba, Assistant Professor | | | | |

## I. COURSE OVERVIEW:

The course matter is divided into five units covering duly-recognized areas of theory and study. This course develops abstract and critical reasoning by studying mathematical and logical proofs and assumptions as applied in basic physics and to make connections between physics and other branches of sciences and technology. The topics covered include dielectric and magnetic properties, acoustics of buildings, ultrasonic and equilibrium of system of forces, friction and dynamics of rigid bodies. The course helps students to gain knowledge of basic principles and appreciate the diverse applications in technological fields in respective branches and also in their lives.

## II. COURSE PRE-REQUISITES:

| Level | Course Code | Semester | Prerequisites |
|---|---|---|---|
| - | - | - | Basic principles of Physics |

## III. MARKS DISTRIBUTION:

| Subject | SEE Examination | CIA Examination | Total Marks |
|---|---|---|---|
| Applied Physics | 70 Marks | 30 Marks | 100 |

## IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ✔ | Chalk & Talk | ✔ | Quiz | ✔ | Assignments | ✘ | MOOCs |
| ✔ | LCD / PPT | ✔ | Seminars | ✘ | Mini Project | ✔ | Videos |
| ✘ | Open Ended Experiments | | | | | | |

## V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

**Semester End Examination (SEE):** The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

| | |
|---|---|
| 50 % | To test the objectiveness of the concept. |
| 50 % | To test the analytical skill of the concept OR to test the application skill of the concept. |

### Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

| **Component** | **Theory** | | **Total Marks** |
|---|---|---|---|
| **Type of Assessment** | CIE Exam | Quiz / AAT | |
| **CIA Marks** | 25 | 05 | 30 |

### Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8$^{th}$ and 16$^{th}$ week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

### Quiz / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

## VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

| Program Outcomes (POs) | | Strength | Proficiency assessed by |
|---|---|---|---|
| PO 1 | **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. | 3 | Presentation on real-world problems |
| PO 2 | **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences | 2 | Seminar |
| PO 4 | **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. | 1 | Term Paper |

**3 = High; 2 = Medium; 1 = Low**

## VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

| Program Specific Outcomes (PSOs) | | Strength | Proficiency assessed by |
|---|---|---|---|
| PSO 1 | **Professional Skills:** To produce engineering professional capable of synthesizing and analyzing mechanical systems including allied engineering streams. | 2 | Seminar |
| PSO 2 | **Software Engineering Practices:** An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability | - | - |
| PSO 3 | **Successful Career and Entrepreneurship:** To build the nation, by imparting technological inputs and managerial skills to become Technocrats. | - | - |

**3 = High; 2 = Medium; 1 = Low**

## VIII. COURSE OBJECTIVES (COs):

| The course should enable the students to: | |
|---|---|
| I | Develop the strong fundamentals of system of forces and friction. |
| II | Strengthen the knowledge of theoretical and technological aspects of dynamics of rigid bodies. |
| III | Correlate principles with applications of the dielectric and magnetic materials. |
| IV | Enrich knowledge in acoustics and ultrasonic. |

## IX. COURSE LEARNING OUTCOMES (CLOs):

| CLO Code | CLO's | At the end of the course, the student will have the ability to: | PO's Mapped | Strength of Mapping |
|---|---|---|---|---|
| AHS007.01 | CLO 1 | Recall the basic principles of physics. | PO 1 , PO 2 | 3 |
| AHS007.02 | CLO 2 | Apply the concepts and principles in solving the problems of physics. | PO 1 , PO 4 | 2 |
| AHS007.03 | CLO 3 | Acquire knowledge of basic terms related to dielectric materials and different polarization mechanisms. | PO 1 , PO 4 | 2 |
| AHS007.04 | CLO 4 | Review properties of different magnetic | PO 1 , PO 2 | 2 |

| CLO Code | CLO's | At the end of the course, the student will have the ability to: | PO's Mapped | Strength of Mapping |
|---|---|---|---|---|
| | | materials and magnetization based on orientation of domains. | | |
| AHS007.05 | CLO 5 | Recollect basic principles of acoustics of buildings and modern architectural acoustic techniques. | PO 1 , PO 2 | 2 |
| AHS007.06 | CLO 6 | Explain production, properties and applications of ultrasonic waves | PO 1 , PO 2 | 2 |
| AHS007.07 | CLO 7 | Review the basic concepts of system of forces. | PO 1 , PO 4 | 1 |
| AHS007.08 | CLO 8 | Analyze different law of forces and condition of equilibrium. | PO 2 , PO 4 | 1 |
| AHS007.09 | CLO 9 | Discuss different types and laws of friction. | PO 2 , PO 4 | 1 |
| AHS007.10 | CLO 10 | Interpret applications of friction. | PO 1 , PO 2 | 2 |
| AHS007.11 | CLO 11 | Describe rotational motion of rigid bodies and moment of inertia of some of the regular shapes. | PO 1 , PO 4 | 2 |
| AHS007.12 | CLO 12 | Identify and apply theorems of moment of inertia. | PO 1 , PO 2 | 3 |
| AHS007.13 | CLO 13 | Correlate different concept of physics with day to day life applications. | PO 1 | 2 |
| AHS007.14 | CLO 14 | Understand the technical importance of moment of inertia of regular and irregular bodies. | PO 2 | 2 |
| AHS007.15 | CLO 15 | Identify the modern engineering devices based on basic principles of forces and friction. | PO 4 | 1 |

**3 = High; 2 = Medium; 1 = Low**

## X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

| CLOs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CLO 1 | 3 | 2 | | | | | | | | | | | 2 | | |
| CLO 2 | 2 | | | 2 | | | | | | | | | 1 | | |
| CLO 3 | 3 | | | 1 | | | | | | | | | 2 | | |
| CLO 4 | 1 | 3 | | | | | | | | | | | | | |
| CLO 5 | 3 | 2 | | | | | | | | | | | | | |
| CLO 6 | 3 | 2 | | | | | | | | | | | 2 | | |
| CLO 7 | 2 | | | 1 | | | | | | | | | 2 | | |
| CLO 8 | | 2 | | 1 | | | | | | | | | | | |
| CLO 9 | | 1 | | 1 | | | | | | | | | 2 | | |
| CLO 10 | 3 | 2 | | | | | | | | | | | 1 | | |
| CLO 11 | 2 | | | 1 | | | | | | | | | | | |
| CLO 12 | 3 | 2 | | | | | | | | | | | 2 | | |

| CLOs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CLO 13 | 2 | | | | | | | | | | | | | | |
| CLO 14 | | 2 | | | | | | | | | | | 1 | | |
| CLO 15 | | | | 1 | | | | | | | | | | | |

**3 = High; 2 = Medium; 1 = Low**

## XI. ASSESSMENT METHODOLOGIES – DIRECT

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CIE Exams | PO1,PO2 | SEE Exams | PO1,PO4 | Assignments | PO4 | Seminars | PO2 |
| Laboratory Practices | PO1,PO2 | Student Viva | - | Mini Project | - | Certification | - |
| Term Paper | PO 4 | | | | | | |

## XII. ASSESSMENT METHODOLOGIES - INDIRECT

| | | | |
|---|---|---|---|
| ✔ | Early Semester Feedback | ✔ | End Semester OBE Feedback |
| ✘ | Assessment of Mini Projects by Experts | | |

## XIII. SYLLABUS

| | |
|---|---|
| **Unit-I** | **DIELECTRIC AND MAGNETIC PROPERTIES** |
| Dielectric Properties: Basic definitions, electronic, ionic and orientation polarizations-qualitative; Internal field in solids. Magnetic Properties: Basic definitions, origin of magnetic moment, Bohr magneton, classification of dia, para and ferro magnetic materials on the basis of magnetic moment, domain theory of ferro magnetism on the basis of hysteresis curve. | |
| **Unit-II** | **ACOUSTICS AND ULTRASONICS** |
| Acoustics: Reverberation, reverberation time, Sabine's formula (qualitative), absorption coefficient, measurement of absorption coefficient, factors affecting acoustics of an auditorium and their remedies; Ultrasonics: Introduction; Generation of ultrasonic waves; Magnetostriction method, piezoelectric method, properties, applications. | |
| **Unit-III** | **EQUILIBRIUM OF SYSTEM OF FORCES** |
| Introduction, basic concepts, system of forces, coplanar concurrent forces, force systems in plane, parallel forces in plane; Force systems in space.<br><br>Couples, resultant, Lami's theorem, triangle law of forces, polygon law of forces, condition of equilibrium. | |
| **Unit-IV** | **FRICTION** |
| Friction: Types of friction, limiting friction, laws of friction, angle of repose, equilibrium of body laying on rough inclined plane, Application of friction: ladder friction, wedge friction, screw friction. | |
| **Unit-V** | **DYNAMICS OF RIGID BODIES - MOMENT OF INERTIA** |
| Rotational motion, torque, angular momentum, relation between torque and angular momentum, angular momentum of system of particles, moment of inertia, expression for moment of inertia, radius of gyration, theorems on moment of inertia, moment of inertia of thin rod, rectangular lamina, circular disc. | |

| Text Books: |
|---|
| 1. Dr. K. Vijaya Kumar, Dr. S. Chandralingam, “Modern Engineering Physics”, Chand & Co. New Delhi, 1st Edition, 2010.<br>2. R. C Hibbler, "Engineering mechanics", Prentice Hall, 12th Edition, 2009. |
| **Reference Books:** |
| 1. R. K. Gaur, S. L. Gupta, “Engineering Physics”, Dhanpat Rai Publications, 8th Edition, 2001.<br>2. Timoshenko, D. H. Young, "Engineering mechanics", Tata Mc Graw Hill, 5th Edition, 2013.<br>3. Hitendra K Malik, A. K. Singh, “Engineering Physics”, Mc Graw Hill Education, 1stEdition,2009.<br>4. S. S. Bhavikatti, "A text book of Engineering mechanics", New age international, 1st Edition, 2012. |

## XIV. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

| Lecture No | Topics to be covered | Course Learning Outcomes (CLOs) | Reference |
|---|---|---|---|
| 1 | Acquire knowledge of basic terms related to dielectric materials. | CLO 1 | T1:13.5<br>R1:1.3 |
| 2 | Discuss different polarization mechanisms in dielectrics | CLO 2 | T1:13.5<br>R1:1.3 |
| 3-4 | Derive expression for total electric field at a given point inside dielectrics. | CLO 32 | T1:13.5<br>R1:1.3 |
| 5 | Acquire knowledge of basic terms related to magnetic materials. | CLO 3 | T1:14.7<br>R1:3.4 |
| 6 | Describe magnetic moment in an atom in terms of Bohr Magneton | CLO 3 | T1:15.7<br>R1:4.10 |
| 7-8 | Classify different magnetic materials based on electron theory. | CLO 4 | T1:16.8<br>R1:4.15 |
| 9 | Examine the spontaneous magnetization in ferromagnets based on orientation of domains | CLO 4 | T1:16.9<br>R1:5.4 |
| 10 | Explain the basic terms related to acoustics of buildings | CLO 5 | T1:17.9<br>R1:5.8 |
| 11 | Analyze the Sabine’s formula of reverberation time | CLO 5 | T1:18.10<br>R1:6.8 |
| 12 | Calculate the absorption coefficient of a surface | CLO 6 | T1:19.10<br>R1:6.13 |
| 13 | Identify remedies for factors affecting architectural acoustics | CLO 6 | T1:19.9<br>R1:7.5 |
| 14-15 | Recall basics of ultrasonics | CLO 5 | T1:23.10<br>R1:7.5 |
| 16 | Explain the production of ultrasonics by Magnetostriction method | CLO 6 | T1:23.10<br>R1:8.1 |
| 17 | Explain the production of ultrasonics by Piezoelectric method | CLO 6 | T1:23.1<br>R1:9.2 |
| 18-19 | Review the properties of ultrasonics | CLO 6 | T1:23.1<br>R1:9.4 |
| 20 | Discuss the applications of ultrasonics | CLO 6 | T1:23.1<br>R1:9.9 |
| 21 | Identify the principle of forces | CLO 7 | T1:23.1<br>R1:9.10 |
| 22 | Recall different system of forces | CLO 7 | T2:27.5<br>R1:10.2 |
| 23 | Acquire knowledge of force systems in space | CLO 7 | T2:27.7<br>R1:11.3 |
| 24-25 | Analyze parallel forces in plane | CLO 8 | T2:27.8 |

| Lecture No | Topics to be covered | Course Learning Outcomes (CLOs) | Reference |
|---|---|---|---|
| | | | R1:11.6 |
| 26 | Correlate couples in systems | CLO 8 | T2:27.12<br>R1:11.7 |
| 27-28 | Apply Lami's theorem to problems | CLO 8 | T2:27.12<br>R1:11.8 |
| 29 | Analyze triangle law of forces | CLO 8 | T2:27.12<br>R1:11.9 |
| 30 | Analyze polygon law of forces | CLO 7 | T2:27.12<br>R1:11.10 |
| 31-32 | Recognize condition of equilibrium | CLO 9 | T2:27.14<br>R1:12.3 |
| 33 | Understand friction | CLO 9 | T2:27.1<br>R1:12.7 |
| 34-35 | Discuss limiting friction | CLO 9 | T2:27.17<br>R1:12.15 |
| 36 | Analyze laws of friction | CLO 10 | T2:27.18<br>R1:12.19 |
| 37-38 | Describe angle of repose | CLO 10 | T2:27.19<br>R2:14.4 |
| 39 | Identify equilibrium of body laying on rough inclined plane | CLO 10 | T2:27.20<br>R2:14.5 |
| 40-41 | Solve problems on friction | CLO 10 | T2:30.19<br>R2:14.5 |
| 42-43 | Understand ladder friction | CLO 10 | T2:30.20<br>R2:15.5 |
| 44-45 | Discuss wedge friction | CLO 10 | T2:32.19<br>R2:16.5 |
| 46-47 | Describe screw friction | CLO 10 | T2:32.20<br>R2:16.5 |
| 48-49 | Explain basic concept rotational motion | CLO 11 | T2:33.1<br>R2:16.6 |
| 50-51 | Derive relation between torque and angular momentum | CLO 11 | T2:34.1<br>R2:17.1 |
| 52-53 | Acquire the knowledge of moment of inertia | CLO 12 | T2:35.2<br>R2:17.2 |
| 54-55 | Examine radius of gyration | CLO 11 | T2:36.1<br>R2:18.1 |
| 56-57 | Understand theorems on moment of inertia | CLO 12 | T2:38.19<br>R2:16.5 |
| 58-59 | Calculate moment of inertia of thin rod, Rectangular lamina | CLO 12 | T2:39.19<br>R2:16.5 |
| 60 | Calculate moment of inertia of circular disc | CLO 12 | T2:40.19<br>R2:16.5 |

## XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

| S No | Description | Proposed Actions | Relevance With POs | Relevance With PSOs |
|---|---|---|---|---|
| 1 | To improve standards and analyze the concepts. | Seminars | PO 1 | PSO 1 |
| 2 | Conditional probability, Sampling distribution, correlation, regression analysis and testing of hypothesis | Seminars / NPTEL | PO 4 | PSO 1 |
| 3 | Encourage students to solve real time applications and prepare towards competitive examinations. | Guest Lecture | PO 2 | PSO 1 |

**Prepared by:**
Mr. K Saibaba, Assistant Professor

**HOD, FRESHMAN ENGINEERING**