

AME 103 – ENGINEERING PHYSICS

Course Title	Engineering Physics	Course Code	AME 103
Year	I Semester	Course Group	Basic Science
Teaching Scheme in Periods (L:T:P)	60:15:0	Credits	3.0
Methodology	Lecture+ Tutorial	Total Contact Periods	75
CIE	60 Marks	Semester End Examination (SEE)	40 Marks

Pre requisites

This course requires the basic knowledge of Science and Mathematics.

Course Outcomes

Upon completion of the course, the student shall be able to

CO1	Apply the concepts of units, dimensions and vectors to solve basic engineering problems.
CO2	Apply the principles of projectile motion, elasticity, surface tension and viscosity to solve problems in basic engineering applications.
CO3	Utilize the principles of thermal expansion to solve basic engineering problems.
CO4	Extend the formulation of Simple Harmonic Motion to oscillating bodies and identify the noise controlling methods in practical engineering and environmental applications.
CO5	Apply the principles of electricity and magnetism to solve numerical problems in basic engineering applications.
CO6	Explain the concepts of Photoelectric effect, LASER, and Optical fibers and utilize them to engineering applications.

CO – PO Mapping Matrix

Course Outcome/ Programme Outcome	Basic and Discipline Specific Knowledge	Problem Analysis	Design/Development of Solutions	Engineering Tools, Experimentation and Testing	Engineering Practices for Society, Sustainability and Environment	Project Management	Lifelong Learning	Linked PO
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	
CO 1	3	1	-	-	-	-	2	1,2,7
CO 2	3	1	-	-	-	-	2	1,2,7
CO 3	3	-	-	1	-	-	2	1,4,7
CO 4	3	-	-	-	-	-	2	1,7
CO 5	3	1	-		-	-	2	1,2,7
CO 6	3	-	-	1	-	-	2	1,4,7
	3	1	-	1	-	-	2	1,2,4,7

Correlation Scale:

1 - Low

2 – Medium

3 - High

COURSE CONTENTS

Unit 1 Units, Dimensions and Vectors

Duration: 12 periods (L:10 – T:2)

Physical quantity, Fundamental and derived quantities, unit- definitions- SI units - Dimensions and dimensional formula, units and dimensional formulae for physical quantities, Principle of homogeneity –numerical problems, Applications of dimensional analysis, Limitations of dimensional analysis

Scalar and Vector quantities – definition and examples, Resolution of a vector-numerical problems, Parallelogram law of vectors – statement- expression for magnitude and direction of resultant vector –derivation, Representation of a vector in unit vectors $\hat{i}, \hat{j}$ and $\hat{k}$, Scalar product of two vectors- Numerical problems, Vector product of two vectors -numerical problems.

Unit 2 Dynamics and Properties of Matter

Duration: 13 periods (L:10 – T:3)

Projectile motion of body- examples, Oblique projection-expression for path of a projectile-derivation-Maximum height, Time of ascent, Time of descent, Time of flight, Horizontal range of a projectile in oblique projection - related numerical problems.

Friction – causes-types- Normal reaction, angle of repose and coefficient of friction- laws of static friction, expression for acceleration of a body on a rough horizontal surface- advantages and disadvantages - methods of minimizing friction.

Elasticity and elastic bodies-definition- examples, Stress and Strain-expressions-numerical problems, types of stress and strain, Elastic limit-definition, Hooke's law, Young's modulus of a wire –numerical problems, Surface tension- explanation and illustrations, capillarity and angle of contact-definitions, Viscosity-explanation- Newton's formula for viscous force-derivation- coefficient of viscosity-numerical problems- Poiseuille's equation for coefficient of viscosity- related numerical problems.

Unit 3 Energy Sources and Thermal Physics

Duration: 13 periods (L:11 – T:2)

Work, Power and Energy-explanation-numerical problems, Potential energy and Kinetic energy-explanation- examples, expressions for Potential energy and Kinetic energy and

related numerical problems, law of conservation of energy-statement-examples- Non-renewable and Renewable energy sources-explanation- sources.

Thermal expansion of solids and three coefficients of expansion of solids, thermal conductivity of a solid – expression, principle of bimetallic strip, bimetallic thermostat, Boyle's law in gases –explanation- its limitations-related numerical problems, concept of Absolute Zero, Absolute scale of temperature, Charles' laws in gases in terms of absolute temperature – related numerical problems, Ideal gas equation-derivation- related numerical problems - Isothermal and Adiabatic processes, expression for work done by the gas –derivation- related numerical problems, 1st law of thermodynamics-explanation-applications, 2nd law of thermodynamics –explanation- list of applications.

Unit 4 Simple Harmonic Motion and Waves

Duration: 12 periods (L:10 – T:2)

Simple Harmonic Motion (SHM) – examples of SHM, conditions of SHM, time period, frequency, amplitude and phase of a particle in SHM-definitions, expressions for Displacement, Velocity, Acceleration, Time period and Frequency of a particle executing in SHM – numerical problems, Ideal simple pendulum-definition, expression for time period of simple pendulum-derivation- numerical problems.

Wave-definition-characteristics, longitudinal and transverse waves –explanation-examples – Audible range, infrasonic and ultrasonic waves, expression relating wave velocity, frequency and wavelength-derivation- numerical problems, echo –explanation-time of echo from a distant obstacle-derivation- numerical problems-applications of echo, Reverberation, reverberation time and Sabine's formula, free and forced vibrations, and resonance –examples, noise pollution- causes, effects and methods to minimize noise pollution.

Unit 5 Electricity and Magnetism

Duration: 12 periods (L:10 – T:2)

Electric current and potential difference-summarize, Ohm's law-explanation-numerical problems, specific resistance-explanation-numerical problems, conductivity and conductance-definitions, combination of resistors in electric circuit –formula for series and parallel combination-related numerical problems, Kirchhoff's laws in electricity – explanation- numerical problems

Magnetic pole, pole strength, magnetic length of a bar magnet, Magnetic field, magnetic lines of force and magnetic induction, properties of magnetic lines of force, uniform and non uniform magnetic fields, magnetic flux, types of magnetic materials. Coulomb's

inverse square law of magnetism-explanation-numerical problems, expression for moment of couple on a bar magnet placed in a uniform magnetic field- derivation-numerical problems,

Unit 6 Modern Physics

Duration: 13 periods (L:11 – T:2)

Photo electric effect-explanation-Einstein's photo electric equation, work function and threshold frequency, laws of photo electric effect, working of photocell, applications of photocell, LASER-definition, concept of energy levels, Spontaneous emission, Stimulated emission, population inversion and optical pumping, principle and working-characteristics of LASER, applications of LASER, critical angle and total internal reflection of light, principle and working of Optical fiber, applications of optical fiber, Nano scale and properties of nano materials-types of nanomaterials - applications.

Reference Books

1. Principles of Physics by N. Subrahmanyam and Brijlal, S. Chand & Co, New Delhi, edition, 1982
2. Engineering. Physics by R.K. Gaur, S.L. Gupta, Dhanpatrai Publications, New Delhi.
3. Intermediate Physics, Vol. I & II, Telugu Academy, TS, Hyderabad.
4. Fundamentals of Physics by Halliday and Resnick.
5. Physics Part-I & II, NCERT

E-learning resources

Hyper Physics website: <http://hyperphysics.phy-astr.gsu.edu/>

Learning Outcomes

Upon completion of this course the student will be able to

CO1: Apply the concepts of units, dimensions and vectors to solve basic engineering problems.

- 1.1 Define Physical quantity, Fundamental quantity, derived physical quantity and Unit.
- 1.2 List SI units of fundamental quantities with their symbols.
- 1.3 Define Dimensions and Dimensional formula of a physical quantity.
- 1.4 List SI units and dimensional formulae of physical quantities (Area, Volume, Density, Velocity, Acceleration, Momentum, Impulse, Force, Work, Energy, Power, Pressure, Stress, Modulus of Elasticity, Angular velocity, Torque, Frequency, Surface Tension, Coefficient of viscosity, Universal Gravitational constant, Wavelength)
- 1.5 Explain principle of homogeneity of dimensions and solve related numerical problems (finding dimensions of terms in an equation).
- 1.6 List applications of dimensional analysis.
- 1.7 List the limitations of dimensional analysis.
- 1.8 Define Scalar and Vector quantities with examples.
- 1.9 Explain resolution of a Vector into two orthogonal components and solve related numerical problems.
- 1.10 Explain Parallelogram law of vectors and develop expressions for magnitude and direction of resultant of two vectors and solve related numerical problems.
- 1.11 Represent a vector in terms of unit vectors ($\hat{i}, \hat{j}, \hat{k}$) (no explanation).
- 1.12 Explain Scalar product of vectors and solve numerical problems.
- 1.13 Explain vector product of vectors and solve related numerical problems.

CO2: Apply the principles of projectile motion, elasticity, surface tension and viscosity to solve problems in basic engineering applications.

- 2.1 Explain projectile motion of a body with examples and develop the expression for path of a projectile in oblique projection.
- 2.2 Develop formulae for Maximum height, Time of ascent, Time of descent, Time of flight and Horizontal range of a projectile in oblique projection and solve related numerical problems.
- 2.3 Explain friction and causes of friction.
- 2.4 Classify types of friction.

- 2.5 Explain the concept of Normal reaction, Angle of repose and Coefficient of friction.
- 2.6 Outline the laws of Static friction.
- 2.7 Develop the expression for acceleration of a body on a rough horizontal surface and solve simple numerical problems on $a = \mu g$
- 2.8 Outline the advantages and disadvantages of friction.
- 2.9 Identify the methods of minimizing friction.
- 2.10 Define Elasticity and elastic bodies with examples.
- 2.11 Explain Stress and Strain with their expressions and solve related numerical problems.
- 2.12 Explain types of stress and strain (longitudinal, shear and bulk).
- 2.13 Define Elastic limit and explain Hooke's law.
- 2.14 Develop formula for Young's modulus of a wire having circular cross-sectional area and solve related numerical problems.
- 2.15 Explain Surface tension and illustrate Surface tension with examples.
- 2.16 Explain capillarity and angle of contact.
- 2.17 Explain Viscosity and develop Newton's formula for viscous force and explain coefficient of viscosity.
- 2.18 Outline Poiseuille's equation for coefficient of viscosity.

CO3: Utilize the principles of thermal expansion to solve basic engineering problems.

- 3.1 Explain the concept of Work, Power and Energy and solve related numerical problems.
- 3.2 Explain Potential energy and Kinetic energy with examples.
- 3.3 Develop expressions for Potential energy and Kinetic energy and solve related numerical problems.
- 3.4 Explain law of conservation of energy with examples.
- 3.5 Explain Non-renewable and Renewable energy sources and list the sources.
- 3.6 Explain thermal expansion of solids and outline three coefficients of expansion of solids.
- 3.7 Explain thermal conductivity of a solid and develop the expression for it $Q = [KA (\theta_1 - \theta_2) t]/L$.
- 3.8 Explain principle of bimetallic strip and construct bimetallic thermostat as an automatic temperature control device in electrical gadgets.
- 3.9 Explain Boyle's law in gases and its limitations and solve related numerical problems.
- 3.10 Explain concept of Absolute Zero and Absolute temperature scale.

- 3.11 Explain Charles' laws in gases in terms of absolute temperature and solve related numerical problems.
- 3.12 Develop Ideal gas equation and solve related numerical problems.
- 3.13 Explain Isothermal and Adiabatic processes.
- 3.14 Develop the expression for work done by the gas [$W=P(V_2-V_1)$] and solve related numerical problems.
- 3.15 Explain first law of thermodynamics and list applications of it and solve related numerical problems.
- 3.16 Explain second law of thermodynamics and list applications of it.

CO4: Extend the formulation of Simple Harmonic Motion to oscillating bodies and identify the noise controlling methods in practical engineering and environmental applications.

- 4.1 Explain Simple Harmonic Motion (SHM).
- 4.2 List the examples of SHM.
- 4.3 Define the terms time period, frequency, amplitude and phase of a particle in SHM.
- 4.4 Develop the expressions for Displacement, Velocity, Acceleration, Time period and Frequency of a particle executing in SHM and solve numerical problems.
- 4.5 Define Ideal simple pendulum and develop the expression for time period of a simple pendulum and solve numerical problems.
- 4.6 Define wave and outline its characteristics.
- 4.7 Explain longitudinal and transverse waves with examples.
- 4.8 Explain audible range, infrasonic and ultrasonic waves.
- 4.9 Develop the expression relating wave velocity, frequency and wavelength ($v = n\lambda$) and solve numerical problems
- 4.10 Explain echo and develop the formula for time of echo from a distant obstacle and solve numerical problems.
- 4.11 List the applications of echo.
- 4.12 Explain Reverberation, reverberation time and outline Sabine's formula.
- 4.13 Explain free vibrations, forced vibrations and resonance with examples.
- 4.14 Explain noise pollution and identify the causes, effects and methods to minimize noise pollution.

CO5: Apply the principles of electricity and magnetism to solve numerical problems in basic engineering applications.

- 5.1 Summarize electric current and potential difference.

- 5.2 Explain Ohm's law and solve numerical problems.
- 5.3 Explain specific resistance ($\rho = \frac{RA}{l}$) and solve related numerical problems.
- 5.4 Define conductivity and conductance.
- 5.5 Explain combination of resistors in electric circuit and develop formulae for equivalent resistance in series and parallel connection and solve related numerical problems.
- 5.6 Explain Kirchhoff's laws in electricity and solve numerical problems.
- 5.7 Explain magnetic pole, pole strength and magnetic length of a bar magnet.
- 5.8 Explain magnetic field, magnetic lines of force and magnetic induction.
- 5.9 List properties of magnetic lines of force.
- 5.10 Explain uniform and non uniform magnetic fields.
- 5.11 Define magnetic flux.
- 5.12 Explain types of magnetic materials (dia, para and ferro magnetic materials) based on magnetic properties.
- 5.13 Explain Coulomb's inverse square law of magnetism and solve numerical problems.
- 5.14 Develop expression for moment of couple on a bar magnet placed in a uniform magnetic field ($C = MB \sin\theta$) and solve numerical problems.

CO6: Explain the concepts of Photoelectric effect, LASER, and Optical fibers and utilize them to engineering applications.

- 6.1 Explain Photo electric effect.
- 6.2 Outline Einstein's photo electric equation; explain work function and threshold frequency and solve numerical problems.
- 6.3 Outline the laws of photo electric effect.
- 6.4 Construct photocell and explain its working.
- 6.5 Identify applications of photocell.
- 6.6 Concept of energy levels (Ground state, excited state and Meta stable state).
- 6.7 Explain Spontaneous emission, Stimulated emission, population inversion, optical pumping and the principle and working of LASER
- 6.8 List the characteristics of LASER.
- 6.9 Identify applications of LASER.
- 6.10 Explain critical angle and total internal reflection of light.
- 6.11 Make use of optical properties to explain working of Optical fiber.
- 6.12 Identify applications of optical fiber.
- 6.13 Explain Nano scale and identify properties at Nano scale.
- 6.14 Classify Nano materials (zero, one, two and three dimensional).
- 6.15 Identify applications of Nano materials.

Course Content and Blue Print of Marks for MID Examinations & Semester End Examination (SEE)

MID-I Examination					
S. No	Unit	Questions to be set for MID Exam			Remarks
		R	U	A	
1	UNIT-1 Units, Dimensions and Vectors	1, 2	5(a) 5(b)	7(a) 7(b)	
2	UNIT-2 Dynamics and Properties of Matter	3, 4	6(a) 6(b)	8(a) 8(b)	
Total Questions		4	4	4	
MID-II Examination					
S. No	Unit	Questions to be set for MID Exam			Remarks
		R	U	A	
1	UNIT-3 Energy Sources and Thermal Physics	1, 2	5(a) 5(b)	7(a) 7(b)	
2	UNIT-4 Simple Harmonic Motion and Waves	3, 4	6(a) 6(b)	8(a) 8(b)	
Total Questions		4	4	4	

Semester End Examination (SEE)

S. No	Unit	Questions to be set for SEE				Remarks	
		R		U	A		
1	UNIT-1 Units, Dimensions and Vectors	4	1		9(a)	13(a)	
2	UNIT-2 Dynamics and Properties of Matter						
3	UNIT-3 Energy Sources and Thermal Physics		2		10(a)	14(a)	
4	UNIT4 Simple Harmonic Motion and Waves						
5	UNIT-5 Electricity and Magnetism		3	5, 6	9(b)	13(b)	
					11(a)	15(a)	
				11(b)	15(b)		
6	UNIT- 6 Modern Physics		7,8	10(b)	14(b)		
				12(a)	16(a)		
				12(b)	16(b)		
Total Questions		8		8	8		

Legend:	Remembering (R)	1 Mark
	Understanding (U)	3 Marks
	Application (A)	5 Marks

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA

DIPLOMA EXAMINATION (C 26)
MID 1 EXAMINATION
AME 103 Engineering Physics
Model Question paper

Duration: 1hour

Max. Marks: 20

PART-A

Instructions: 1. Answer **ALL** questions.

2. Each question carries **ONE** mark.

4 X 1 = 4

1. Define fundamental physical quantity.
2. How does a vector differ from a scalar?
3. Define Normal reaction
4. Define angle of contact.

PART-B

Instructions: 1. Answer **ALL** questions.

2. Each question carries **THREE** marks.

2 X 3 = 6

- 5 (a). The displacement of a particle moving along x-axis with respect to time is $x=at+bt^2-ct^3$. Find the dimensional formulae of a, b and c.

(OR)

- 5 (b). At an airport, a horizontal wind is blowing at 15 ms^{-1} at an angle of 60° north of east. Calculate the components of the wind velocity in the north and east directions.

- 6 (a). A ball is kicked into air with velocity of 20 ms^{-1} at an angle 30° with the Earth's surface. Find maximum height reached by the ball. (Take $g = 10 \text{ ms}^{-2}$)

(OR)

- 6 (b). An object of weight 20 N is suspended vertically from a crane on a steel cable 4 m long and 2 mm in diameter produces an elongation of 0.24 mm. Calculate the stress and strain in the cable.

PART-C

Instructions: 1. Answer **ALL** questions.

2. Each question carries **FIVE** marks.

2 X 5 = 10

7(a). Develop expressions for magnitude and direction of resultant of two vectors using parallelogram law of vectors.

(OR)

7(b). Find the angle between two vectors $\vec{P} = 2\hat{i} - 2\hat{j} + \hat{k}$ and $\vec{Q} = \hat{i} - 2\hat{j} + \hat{k}$ by applying vector properties.

8(a). Develop the expression for path of a projectile in oblique projection.

(OR)

8(b). Develop Newton's formula for viscous force and explain coefficient of viscosity.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA

DIPLOMA EXAMINATION (C 26)

MID 2 EXAMINATION

AME 103 Engineering Physics

Model Question paper

Duration: 1hour

Max. Marks: 20

PART-A

- Instructions: 1. Answer **ALL** questions.
2. Each question carries **ONE** mark.

4 X 1 = 4

1. What is kinetic energy?
2. Define absolute zero.
3. Define amplitude of a wave.
4. Define reverberation.

PART-B

- Instructions: 1. Answer **ALL** questions.
2. Each question carries **THREE** marks.

2 X 3 = 6

- 5(a). Find the power of a machine gun if it fires 120 bullets per minute. The bullet travels with a velocity of 200 m/s and mass of each bullet is 20 grams.

(OR)

- 5(b). Explain principle of bimetallic strip.

- 6 (a). The acceleration of a particle in S.H.M. is 0.09 ms^{-2} when its displacement is 0.25 m. Find the period of oscillation.

(OR)

- 6(b). List three applications of echo

PART-C

Instructions: 1. Answer **ALL** questions.

2. Each question carries **FIVE** marks.

2 X 5 = 10

7(a). Explain Non-renewable and Renewable energy sources and list the sources.

(OR)

7(b). Develop the relation between Pressure, Volume and Temperature of an ideal gas.

8 (a). Develop the expression for acceleration of a particle in SHM.

(OR)

8(b). List five methods to minimize noise pollution.

.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA

DIPLOMA EXAMINATION (C 26)
SEMESTER END EXAMINATION
AME 103 Engineering Physics
Model Question paper

Duration: 2 hours

Max. Marks: 40

PART – A

- Instructions: 1. Answer **ALL** questions.
2. Each question carries **ONE** mark.

8 X 1 = 8

1. Name the dimensional formula of power.
2. What is the formula for maximum acceleration of a particle in S.H.M?
3. Define magnetic field.
4. Define elastic limit.
5. Define absolute zero.
6. Define conductivity.
7. What is photo electric effect?
8. What is total internal reflection?

PART – B

- Instructions: 1. Answer **ALL** questions.
2. Each question carries **THREE** marks.

4 X 3 = 12

- 9 (a). If $\vec{A} = \hat{i} + 2\hat{j} + n\hat{k}$ and $\vec{B} = 4\hat{i} + 3\hat{j} - 2\hat{k}$ are perpendicular vectors then find the value of n.

(OR)

- 9(b) Explain Coulomb's inverse square law of magnetism.

- 10 (a). 89.6 litre of a gas at a pressure of 760 mm of mercury is compressed isothermally to a volume of 33.6 litre. What is the final pressure?

(OR)

- 10 (b). List the applications of optical fibre.

11(a) Develop the formula for equivalent resistance of resistors connected in series in electric circuit.

(OR)

11(b) Two magnetic poles of strengths 40 A-m and 30 A-m are separated by a distance of 0.2 m in air. Calculate the force between them.

12(a) Outline Einstein's Photoelectric equation.

(OR)

12(b) List the characteristics of LASER

PART – C

Instructions: 1. Answer **ALL** questions.

2. Each question carries **FIVE** marks.

4 X 5 = 20

13(a). Develop expressions for magnitude and direction of resultant of two vectors using parallelogram law of vectors.

(OR)

13(b). Explain Kirchhoff's laws in electricity.

14(a). Develop the relation between Pressure, Volume and Temperature of an ideal gas.

(OR)

14(b). Explain the working of optical fibre.

15(a). List the properties of magnetic lines of force.

(OR)

15(b). Explain types of magnetic materials based on magnetic properties.

16(a). Explain principle and working of a LASER.

(OR)

16(b). Construct photocell and explain its working.