GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch :Sem 1: Civil/Environmental/Mining/Textile Manufacturing Technology/ Ceramic Technology/Printing Technology/Renewable Energy

Sem 2:Automobile/Chemical/Mechanical/Mechatronics/Textile Processing Technology/Fabrication Technology/Textile Design/Mechanical Engineering(CAD/CAM)

Course / Subject Code: DI01000121

Course / Subject Name: Applied Physics

w. e. f. Academic Year:	2024
Semester:	1 or **2**
Category of the Course:	BSC

Prerequisite:	10+
Rationale:	Physics is branch of science mainly deals with interaction of energy and matter and considered as the mother of all engineering disciplines. Diploma engineers (technologists) have to deal with various materials while using/ maintaining machines. More over the basic knowledge of principles of physics helps diploma students to lay foundations of core engineering courses. The laws and principles of physics, formulae and knowledge of physical phenomena and physical properties provides a means of estimating the behavior of things before we design and observe them. This course of modern physics has been designed as per program requirements to help students to study the relevant core engineering courses. The complicated derivations have been avoided. This course will help the diploma engineers to use/apply the basic concepts and principles of physics solve well designed engineering problems and comprehend different technology based applications.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Use relevant instruments with precision to measure the dimension of given physical quantities in various engineering situations.	R/U/A
02	Solve various engineering problems by the concept of linear momentum and circular motion.	R/U/A
03	Apply basic concepts of properties of matter in solving engineering problems efficiently.	R/U/A
04	Apply the basic concepts of heat transfer and thermometric properties to provide solutions for various engineering problems.	R/U/A
05	Use the concept of waves, ultrasonic and semiconductor for engineering applications	R/U/A

**Revised Bloom's Taxonomy (RBT)*

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Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content		No. of Hours	% of Weigh tage
1.	**Units and Measurements :** 1.a Explain physical quantities and their units. 1.b Convert unit of a given physical quantity in one system of units into another systems of units. 1.c Explain methods to measure the dimensions of given object by using relevant instruments. 1.d Estimate errors in the measurement. 1.e Apply the concept of least count, errors and significant figures to solve the given problems.	1.1 Measurement and units in engineering and science 1.2 Physical quantities: fundamental and derived quantities, 1.3 Systems of units: CGS, MKS and SI, Interconversion of units MKS to CGS and vice versa, requirements of standard units and unit systems, 1.4 Principle, construction, working, applications of Vernier calipers and Micrometer screw gauge with their errors. 1.5 Accuracy, precision , error, estimation of errors: absolute error, relative error ,percentage error, rounding off, significant digits	07	17
2.	**Circular Motion:**	2.1 Force, momentum, law of	08	14

	2.a Apply the concept of linear momentum and its conservation to explain recoil of gun. 2.b Apply the concept of centripetal and centrifugal forces to solve given engineering problems	conservation of linear momentum, its applications such as recoil of gun, impulse and its applications 2.2 Circular motion, angular displacement, angular velocity, angular acceleration and their interrelation 2.3 Centripetal and centrifugal forces examples: banking of roads and bending of cyclist		
3.	**General Properties of matter:** 3.a Explain the Hooke's law, stress-strain curve and moduli of elasticity. 3.b Explain surface tension, cohesive and adhesive forces. 3.c Apply Ascent formula to determine surface tension of the given liquid. 3.d Explain viscosity, coefficient of viscosity, terminal velocity and Stokes' law. 3.e Explain types of fluid motion and Reynolds number	**3.1 Elasticity** 3.1.1 Deforming and restoring Force 3.1.2 Stress-Strain with their types 3.1.3 Hooke's law 3.1.4 Moduli of elasticity, Young's modulus, Bulk modulus, Shear modulus 3.1.5 Stress-Strain curve **3.2 Surface Tension** 3.2.1 Surface tension; concept and units 3.2.2 Cohesive and adhesive forces 3.2.3 Molecular range and sphere of Influence 3.2.4 Laplace's molecular theory 3.2.5 Angle of contact, Ascent Formula (No derivation) 3.2.6 Relation between Surface tension and Surface energy 3.2.7 List the Applications of surface tension 3.2.8 Effect of temperature and impurity on surface tension **3.3 Viscosity** 3.3.1 Viscosity and its SI units	12	28

		3.3.2 Newton's law of Viscosity 3.3.3 Viscous force, velocity gradient and coefficient of viscosity and its SI units. 3.3.4 Types of fluid motion, stream line and turbulent flow, critical velocity, Reynold's number 3.3.5 Stokes' law : free fall of an object through viscous medium and terminal velocity*(No derivation) 3.3.6 Effect of temperature on viscosity.		
4.	**Heat and Thermometry:** 4.a Distinguish between heat and temperature. 4.b Explain modes of heat transmission. 4.c Explain various temperature scales and conversion between them. 4.d Explain heat capacity and specific heat. 4.e Explain types of thermometers and their uses. 4.f Apply the concept of coefficient of thermal conductivity to solve Engineering problems. 4.g Explain expansion in solids and coefficient of linear	4.1 Heat and temperature 4.2 Modes of Heat transfer: Conduction, Convection(natural and forced) and Radiation* 4.3 Temperature measurement scales: Kelvin, Celsius and Fahrenheit and interconversion between them 4.4 Heat capacity and specific heat 4.5 Types of thermometers: Mercury thermometer, Bimetallic thermometer: Principle, Construction, Working, Advantages and Disadvantages) and their uses. 4.6 Coefficient of thermal conductivity and its engineering applications. 4.7 Expansion of solids, coefficient of linear expansion	08	17

	expansions in solids.			
5.	**Waves , ultrasonic and Semiconductor :** 5.a Explain wave and wave motion with example. 5.b Distinguish between longitudinal and transverse waves. 5.c Explain frequency, periodic time, amplitude, wave length and wave velocity 5.d Explain principle of superposition of waves, interference. 5.e Explain reverberation, reverberation time, echo, noise and coefficient of absorption of sound. 5.f Apply Sabine's formula to calculate reverberation time. 5.g Explain ultrasonic waves and their properties. 5.h List engineering and medical applications of ultrasonic waves. 5.i Apply the concept of energy band gap to classify Conductor, Semiconductors and insulators	5.1 Waves, wave motion, and types of waves: longitudinal and transverse waves 5.2 Frequency, periodic time, amplitude, wave length and wave velocity and their relationship 5.3 Superposition of waves, Interference: constructive and destructive interference, conditions for stationary interference pattern. 5.4 Reverberation, reverberation time, echo, noise and coefficient of absorption of sound 5.5 Sabine's formula (derivation not required) for reverberation time, methods to control reverberation time and their applications 5.6 Ultrasonic waves and their properties, List the applications of ultrasonic waves in the field of engineering and medical 5.7 Conductors, Semiconductors and insulator in reference to Energy band gap* 5.8 Intrinsic Semiconductors 5.9 Extrinsic Semiconductors: P & N type, electric conduction in N-type and P-type semiconductor, temperature dependence of conductivity of semiconductor.	10	24

	5.j Apply the concept impurity doping to the semiconductors			
	Total		**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
26	**37**	**37**	**0**	**0**	**0**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Text Book of Physics for Class XI (Part-I, Part-II)	N.C.E.R.T., Delhi	N.C.E.R.T., Delhi, 2019 ISBN 81-7450-508-3(Part-I) & ISBN 81-7450-566-0 (Part-II)
2	Text Book of Physics for Class XII (Part-I, Part-II)	N.C.E.R.T., Delhi	N.C.E.R.T., Delhi, 2019 ISBN 81-7450-631-4 (Part-I) & ISBN 81-7450-671-3 (Part II)
3	Applied Physics, Vol. I and Vol. II	TTTI Publications	Tata McGraw Hill, Delhi, 2019
4	Concepts in Physics Vol. I and Vol. II	H C Verma	Bharti Bhawan Ltd. New Delhi, 2019 ISBN-13: 978-8177091878 ISBN-13: 978-8177092325
5	Engineering Physics	DK Bhattacharya & Poonam Tandon	Oxford University Press, New Delhi, ISBN:9781680158687

6	B. Sc. Practical Physics	C. L. Arora	S. Chand Publication, New Delhi, ISBN: 9788121909099
7	A Textbook of Engineering Physics	M.N. Avadhanulu, P.G. Kshirsagar, TVS Arun Murthy	S. Chand Publication, 11th edition ,New Delhi, 2018 ISBN-13: 978-9352833993
8	SEARS and ZEMANSKY'S University Physics with modern Physics	Hugh D. Young & Roger A. Freedman	Person Publication 14th Edition, USA, ISBN 10: 0-321-97361-5; ISBN 13: 978-0-321-97361-0 (Student edition)
9	Physics for Scientists and Engineers with Modern Physics	John W. Jewett & Raymond A. Serway	CENGAGE Learning, 10th edition, Boston, 2010, ISBN-10: 1337553298
10	University Physics (Volume I, II & III) (Open-source Material)	William Moebs, Samuel J. Ling & Jeff Sanny	OPENSTAX, Houston, Texas, 2016, ISBN-13: 1-947172-20-4
11	PHYSICS for SCIENTISTS & ENGINEERS with Modern Physics	Douglas C. Giancoli	Pearson, 7th edition, Delhi, 2015, ISBN-13: 978-1292057125
12	Principles of Physics	Jearl Ealker, David Halliday, Robert Resnick	Wiley India, Navi Mumbai 10th edition, 2015, ISBN-13: 978-8126552566
13	NCERT Physics	NCERT	NCERT Physics
14	Physics in Daily Life With illustrations	L.J.F. Hermans & Wiebke Drenckhan	EDP Sciences, France, 2012, ISBN: 978-2-7598-0705-5
15	Introductory Physics: Building Models to Describe Our World (Open-Source Material)	Ryan Martin, Emma Neary, Joshua Rinaldo & Olivia Woodman	Creative Commons license, 2019, GitHub

16	The Feynman Lectures on Physics - Vol. I, II & III,	Feynman Richard	Pearson Education, 2012, ISBN-10 : 9332580952, ISBN-13 : 978-9332580954
17	Conceptual Physics	Paul G. Hewitt,	Pearson Education, 12 edition, ISBN-10: 9352861779 ISBN-13: 978-9352861774.

(b) Open-source software and website:

1. https://ocw.mit.edu/courses/physics/
2. https://www.einstein-online.info/en/category/elementary/
3. https://academicearth.org/physics/
4. www.nptel.iitm.ac.in
5. http://phys23p.sl.psu.edu/phys_anim/Phys_anim.htm
6. http://www.atoptics.co.uk/
7. http://www.olabs.edu.in/
8. https://phet.colorado.edu/
9. https://www.iitm.ac.in/academics/learning-for-all/national-programme
10. https://www.khanacademy.org/
11. https://vlab.amrita.edu/
12. https://www.amrita.edu/project/online-labs/
13. https://www.vlab.co.in/
14. https://iitb.vlabs.co.in/
15. https://vlab.amrita.edu/
16. https://praxilabs.com/
17. https://www.compadre.org/osp/
18. https://www.instructables.com/
19. https://www.labster.com/simulation-courses
20. https://lab4u.co/en/home/
21. https://www.labxchange.org/
22. https://virtuallabs.merlot.org/vl_physics.html
23. https://www.ncbionetwork.org/iet/labsafety/
24. https://www.thephysicsaviary.com/Physics/Programs/Labs/find.php
25. https://sites.google.com/view/thephysicsaviary/all-labs?authuser=0
26. https://sciencelessonsthatrock.com/secondary-science-virtual-labs-html/
27. https://www.mheducation.com/highered/virtual-labs.html#virtuallabs
28. https://roqed.com/product-physics/

(c) Android/iOS Applications:

1. Physics Lab: https://play.google.com/store/apps/details?id=com.civitas.quantumphysics&pli=1
2. Lab4u: https://play.google.com/store/apps/details?id=com.lab4u.lab4physics
3. Phet: https://play.google.com/store/apps/details?id=edu.colorado.phet.androidApp
4. Micrometer screw: https://play.google.com/store/apps/details?id=com.priantos.micrometersimulator
5. Vernier Callipers: https://play.google.com/store/apps/details?id=com.vernier.tavifom

Suggested Course Practical List:

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs.
1	Use Vernier caliper to measure the dimensions of a given object.	I	02
2	Use micrometer screw gauge to measure diameter of a given wire and determine volume of a given metallic piece.	I	02
3	Use Hooke's law to determine force constant of a given spring.	III	02
4	Use Searle's method to determine Young's modulus of the given metallic wire.	III	02
5	Use capillary rise method and travelling microscope to determine the surface tension of a given liquid.	III	02
6	Use Stokes' law to determine the viscosity of a given liquid (e.g., glycerin).	III	02
7	Use different types of thermometers to measure temperature of a hot bath and convert it into different scales.	IV	02
8	Use Searle's method to measure the coefficient of thermal conductivity of a given metallic rod.	IV	02
9	Use Searle's method to determine the coefficient of linear expansion of the given metallic rod.	IV	02
10	Determine acceleration due to gravity 'g' by using simple pendulum.	V	02
11	Use sonometer to find the frequency of given tuning fork.	V	02
12	Use resonance tube to determine velocity of sound in air at room temperature.	V	02

13	Use ultrasonic interferometer to determine the velocity of ultrasonic waves in different liquids.	V	03
14	Use electrical vibrator to find the frequency of AC mains.	V	03
	Total		**30**

List of Laboratory/Learning Resources Required:

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	Vernier caliper analog - least count 0.02 mm	1, 4
2	Micrometer screw gauge analog (0-25 mm) – least count 0.01mm	2, 4
3	Rigid support, spring, 20 g hanger, six 20 g slotted weight, fine pointer, vertical wooden scale, hook	3
4	Young modulus apparatus (Searle's pattern): two aluminum graduated scales mounted on pillar supports, two pointers with clamps for attaching to specimen, brass and steel rod, cord and hook for carrying weight.	4
5	Travelling microscope - high magnification power, stainless steel scale with Vernier least count - 0.02 mm for taking the recordings, horizontal scale graduated up to 20 cm, vertical scale graduated up to 15 cm.	5
6	One meter high and 5 cm broad glass cylindrical jar with millimeter graduations along its height, steel balls	6
7	Hot water bath	7
8	Mercury filled glass thermometer 0-110 °C, Mercury filled glass thermometer 0-250 °C. Digital food thermometer, bimetallic thermometer.	7
9	Searle’s thermal conductivity apparatus - made up of pure copper and outer boxes are of wooden polished material, 04 thermometers, steam generator, measuring cylinder, constant water level tank, pinch cork, rubber tube	8
10	Linear expansion apparatus, steam generator, rubber tubing, metal rods of aluminum, iron, copper, brass, and steel.	9
11	A bob	10

12	A sonometer with set of tuning forks, two sharp edge wedges and a weight box.	11
13	Resonance tube apparatus, tuning forks of different frequencies, rubber pad, thermometer	12
14	Stop watch (least count = 1/100 s)	8, 10
15	Clamp with stand.	5
16	0.5 kg hanger, 0.5 kg slotted weight.	4
17	Hot plate (1800 W)	8, 9
18	Ultrasonic interferometer - gold plated quartz crystal, operating voltage - 220 Volt, display - analog, frequency - 2MHz with position control	13
19	Electrical Vibrator, uniform cord, weight pan, weight box, pulley, meter scale, sensitive balance	14

Suggested Project List:

1. Measurement: Measure physical quantities using smart phone applications.
2. Arduino: Physical quantities such as Voltage, Magnetic field, Temperature, Light, Sound and distance can be measured with the help of low-cost sensors and Arduino.
3. Prepare proto type Vernier calipers of given least count.
4. Unit Systems: Charts/Models of conversion from MKS to CGS and vice versa.
5. Density Tower: A stack of different immiscible liquid are staked in a glass cylinder to demonstrate the concept of density.
6. Centrifugal Force: Flexible steel strips mounted on a hand driven rotor can be used to visualize centrifugal force.
7. Bird lifts Elephant: A toy bird and toy elephant of different mass are attached to the two ends of string and passes through hollow pipe.
8. Cup does not spill: Water filled cup can sit on disc and tied with string and when rotated, water does not spill can be used to visualize centrifugal force.
9. Upside down ⊥: A ⊥ and two wooden discs can be used to demonstrate centrifugal force.
10. Centrifuge machine: It can be used to visualize concept more efficiently.
11. Beck's Centripetal Force apparatus: This apparatus used to measure the force needed to keep a mass rotating around in a circular path
12. Newton's cradle: This model can best demonstrate the law of conservation of momentum.

13. Wedge shaped glass vessel: For demonstration of capillary forces and surface tension for both wetting and non-wetting fluids.
14. Laminar flow fountain: A larger bore pipe, washing mesh, juice straw can be used to prepare laminar flow fountain.
15. Wood and Copper rod: A rod made up two completely different thermometric materials wrapped with paper and put it on flame.
16. Ball and Ring: This apparatus can be used to demonstrate heat conduction.
17. Heat Convection tube: A Glass rectangular glass tube filled with liquid and supplying heat better shows heat transfer in fluids.
18. Heat Convection Gas apparatus: A box, open pipe and lamp inside box can be used to demonstrate heat convection.
19. Hand Glass Boiler: A liquid filled glass tube with bulb shape can be held in hand and body heat can rise liquid into the boiler.
20. Metal bars: Different metal bars of same physical size and shape can be used to demonstrate heat conduction.
21. Heat Switch: A bimetallic strip can be used as a electrical switch via heat transfer.
22. Linear Expansion: A metal wire tightened at two ends and a metallic sphere hanged at the middle of wire. This wire is supplied by 12 Volt battery for some time. Sagging effect is observed.
23. Domino model: A model showing fundamental idea about wave and how it travels.
24. Shive Wave Machine: For demonstration of Frequency, Wavelength, wave velocity.
25. Wave Generator: model for generating transverse wave.
26. Powell's Wave machine: For demonstration of Frequency, Wavelength, wave velocity
27. Chand’s Plates: A model which provides a nice way to visualize the effects of vibrations on mechanical surfaces like flat sheet of metal mounted on a central stalk to a sturdy base. When the plate is made to vibrate, set up form complex but symmetrical patterns over its surface.
28. Slinky: A nice way to demonstrate transverse and longitudinal waves.
29. Singing Rijke Tube: A wired mesh is inserted in metal pipe and then air inside the pipe is heated, moving up and down the pipe, resonating sound is produced.

APPENDIX

a. Application level based numerical should be given at the time of instruction and assessment in each unit.
b. 'Definition' of units of fundamental physical quantities are only for information and not to be asked in examination in any form.
c. Students can be introduced to system of units other than SI, MKS, CGS unit systems but not to be asked in examinations.
d. Interrelation between different Moduli must not be introduced.
e. For terminal velocity, mathematical derivation not to be asked in examination in any form.
f. Heat Radiation, Wien's law for black body radiation must not be introduced.
g. Energy band Gap theory can be introduced only as tool to classify the conductors, semiconductors and insulators with the help of conduction and valance band. Energy band theory must not be asked in exams. Hybridization of orbitals must not be introduced.

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