GUJARAT TECHNOLOGICAL UNIVERSITY

PHYSICS (Modified on 4th Feb 2014)
SUBJECT CODE: 2110011
B.E. 1st YEAR

Type of course: Engineering Science

Prerequisite: Engineering physics majors are expected to have a basic understanding of calculus, physics and chemistry or computer science

Rationale: The Engineering Physics program is to prepare students for careers in engineering where physics principles can be applied to the advancement of technology. This education at the intersection of engineering and physics will enable students to seek employment in engineering upon graduation while, at the same time, provide a firm foundation for the pursuit of graduate studies in engineering.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE Viva (V)	PA (I)	
3	0	2	5	70	30*	30#	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment

Content:

Sr No	Topic	Teaching Hrs.	Module Weightage
1	**DIELECTRICS:** • Definitions : Electric field intensity, Electric flux, Dielectric parameters • Types of Dielectric materials : Solid, Liquid and Gaseous • Classification of electrical insulating materials • Claussius-Mosotti equation • Uses of Dielectric Materials; **Capacitors: Single and multilayer, Polymeric Film, Electrolytic; Power and Distribution transformers, other applications**	5	15%
2	**MAGNETIC MATERIALS:** • Definitions : **Magnetic moment, Magnetic dipole, Magnetic Filed strength, Magnetic flux density, Intensity of magnetization, Magnetic dipole moment, Magnetic Field intensity, Magnetic permeability, magnetic susceptibility, Bohr magnetron** • Classification of Magnetic Materials on the basis of magnetic moment • Soft and Hard Magnetic Materials • Anti-ferromagnetic materials • Ferrites	5	15%

	• Magnetic Recording and Readout Storage of magnetic data		
3	**ACOUSTIC AND ULTRASONIC:** • Introduction, Classification and Characteristics of sound • Sabine's formula for reverberation (Without Derivations) • Introduction of Absorption co-efficient • Sound absorbing materials • Factors affecting the acoustics of building and their remedies • Sound Insulation • Noise Pollutions • Noise Control in machines • Properties of ultrasound • Generation of ultrasound by (1) piezoelectric method and (2) magnetostriction method • Methods for Ultrasound Velocity measurement • Applications of ultrasound: **Industry, Medicine** • NDT through Ultrasonic	5	15%
4	**SUPERCONDUCTIVITY:** • Superconductivity • General Properties of superconductors • Types of Superconductors • High Temperature superconductors • Applications: **Magnets, Josephson effect, SQUID, Maglev, other**	4	10%
5	**NON LINEAR OPTICS:** **LASER** • Introduction • Characteristics of laser radiation • Spontaneous and stimulated emission • Working of LASER with basic idea about Population Inversion, Pumping mechanism, Optical Resonators • Nd:YAG LASER • Applications of LASER: **Medical, Industrial, Communication and other** **FIBER OPTICS** • Introduction of Optical Fiber • Advantages of Optical Fiber • Total Internal Reflection • Numerical Aperture and Acceptance angle • Modes of Propagation • Types of Optical Fiber • Applications of optical fiber	7	15%
6	**NANOPHYSICS:** • Nanoscale • Surface to volume ratio • Surface effects on Nanomaterials	5	15%

	• Quantum size effects • Electron confinement • Nanomaterials and Nanotechnology • Unusal properties of Nanomaterials • Disadvantages of Nanomaterials • Synthesis of Nanomaterials • Carbon Nanotubes: **Introduction, Structure, Synthesis, Properties and applications** • Applications of Nanomaterials		
7	**ADVANCED ENGINEERING MATERIALS:** **SHAPE MEMORY ALLOYS** • Introduction, Synthesis, Properties and Applications **METALLIC GLASSES** • Introduction, Synthesis, Properties and Applications **BIO MATERIALS** • Introduction, Properties and Applications **ENERGY MATERIALS** • Solar cells • Fuel cells (H_2O_2, Lithium cell) • Ultra capacitors	5	15%

Reference Books:

1. Engineering Physics by V Rajendran, Tata McGraw Hill Education
2. Engineering Physics John Wiley Publication
3. Engineering Physics by Naidu, Pearson Education India
4. Non-Conventional Energy Resources", Mechanical Engineering Series, Khan B. H., Tata McGraw Hill Publishing Company Ltd., New Delhi, 2006
5. Engineering Physics by H Aruldhas, PHI India
6. Engineering Physics by B K Pandey , S. Chaturvedi, Cengage Learning
7. Resnick, Halliday and Krane, Physics part I and II, 5th Edition John Wiely (2002)
8. Physics for scientists and engineers with modern physics by Jewett &Serwey, Cengage publications
9. The Feynman Lectures on Physics Vol 2, Pearson Education India

Course Outcome:

1. The student will demonstrate the ability to think in core concept of their engineering application by studying various topics involved in branch specific applications.
2. The student will demonstrate the ability to use appropriate mathematical techniques and concepts to obtain quantitative solutions to problems in physics.
3. In courses involving laboratory, the student will demonstrate the ability to collect and analyze data and to prepare coherent reports of his or her findings.
4. In a design module project, the student will demonstrate the ability to perform a literature search, to make use of appropriate computational or laboratory skills, and to make an effective written or oral presentation of the results of the project.

List of Experiments:

Important Note

- ☞ Total 18 experiments are listed in the design module.
- ☞ Key goals of these experiments are :
  (1) To enhance the understanding of student towards the errors present in the real time measurement and the ways to take care of them.
  (2) To create visualization of various phenomena covered in the syllabus.
  (3) To induce the skill of student in handling different measuring instruments.
- ☞ Subject teacher is advised to setup any 8 experiments from the following list.
- ☞ In the session student should perform **minimum 4 set of experiments** and complete **one small project** based on engineering applications. This project along with any performed experiment should be **EVALUATED BY EXTERNAL EXAMINER.**

1. To understand some basic aspects of error analysis and graph drawing.
2. To measure the dielectric constant of a material
3. To measure the Hysteresis loss in a Ferromagnetic material.
4. To study the Hall-Effect.
5. To determine Young's Modulus of Elasticity of the given samples by bending.
6. Measurement of the Distance using Ultrasonic Sensors.
7. Study of Object Detection using Ultrasonic Sensors.
8. Determination of the Velocity of Ultrasonic Waves in a non-electrolytic Liquid by Ultrasonic Interferometer.
9. Determination of the Compressibility of a non-electrolytic Liquid by Ultrasonic Interferometer.
10. To study the I-V Characteristic of Silicon diode.
11. To study the I-V Characteristic of Zener diode.
12. To study the I-V Characteristic of LED.
13. To determine the efficiency of given solar cell.
14. To study basic wind power set up.
15. To measure the Resistivity & Band gap of Germanium Crystal (N-type) by Four Probe Method.
16. To measure the numerical aperture of optical fiber.
17. To Study of propagation & bending loss in optical fiber.
18. To determine the frequency of given laser source.

Open ended Projects in Science and technology study :-

Aims:
1. To provide experience in laboratory based experimentation, data recording and analysis and drawing of conclusions.
2. To develop report writing skills for scientific material
3. To develop the ability to undertake investigations where, as part of the exercise, the goals and methods have to be defined by the investigator.
4. To develop skills in literature searches and reviews.

In the beginning of the academic term, faculties will have to allot their students at least one (Students are free to select any area of science and technology)

- Open ended design based small project **or**
- Computer based simulation/ web based application/ analysis presentations of applied science field which may help them in their branches especially in their UDP/IDP projects.

1. These can be done in a group containing maximum three students in each.
2. Open ended design based small project OR UDP based study will be evaluated by external examiner with appropriate marks allotment given by GTU time to time.
3. Faculties should cultivate problem based project to enhance the basic mental and technical level of students.
4. Evaluation should be done on **approach of the student on his/her efforts** (not on completion) to study the design module of given task.

Open Ended Project fields:-

Students are free to select any area of science and technology may be based on their branches to define projects.

Some suggested projects are listed below:

1. Design: A working electric motor.
   Area: Electricity and Magnetism
   Using:1 meter of bendable, insulated wire, a size "D" battery, a disk magnet, two paper clips, sandpaper, wire strippers, masking tape.

2. Design: Computer based simulation/ small calculation with help basic programming language based on Physics
   Area: Computational physics
3. Design: A Hydraulic Jack works on the principle of Pascal's law that states Area: Fluid Dynamics
   Using : poker and scissors ,syringes, M-seal ,inlet pipes

Major Equipments:

Sr. No.	Name	Technical Specification
1	Universal training kit – electronics	
2	Rectifier Kit (Half wave, full wave, bridge)	Consisting of 0-30 V variable power supply, Diodes (IN 4007), Module of 10k resistors, Included Filter Circuit.
3	LDR, LED characteristic kit	0-30 V variable power supply
4	Diode - Zener Diode Characteristic Kit	0-30 V regulated tunnable power supply, milliammeter (0-50mA), Microammeter (0-100μA), Digital multimeter, Resistances module 10K, Facility of Silicon Diode (IN4001), Germanium Diode (DR 25) and Zener Diode with reverse bias voltage Max. up to 8-9 V
5	dB meter, Sound generator, speaker	dB meter with the range of 0-200 dB
6	Hall effect trainer	Power supply of (220 V, 50Hz), constant current source of (30 mA, DC) variable through port Digital Gauss Meter,

		Digital multimeter
7	Semiconductor energy gap set up	Four Probe experimental Set up (consisting constant current source, Dual range miliVoltmeter, power supply for oven and miliammeter Thermometer (Mercury) Temperature range up to 200-250 °C
8	Young's Modulus set up	Stand, weight box (up to 1kg), Samples (iron, Al, Cu etc), DC adapter, Spherometer stand with buzzer, weight holder
9	Resistivity and Band Gap measurement	
10	solar energy trainer	Fundamental of photovoltaic cell should be studied, application and Characteristics features should be measured by a kit
11	Plank's constant determination with using LED	Plank's constant apparatus, oven, LED Red, LED Yellow
12	Ultrasonic measurement kit	Quartz Crystal (Frequency: 2 MHz), Ultrasonic Transducer approx 25 cm to 1.2 m, Clock Generator 40 kHz, Amplifier 40 dB - 70dB
13	X ray powder pattern kit	Powder patterns slides, travelling microscope 10x, X ray diffraction pattern
14	Fiber Optic Kit	LED source 950 nm/660 nm compatible APV or Photo diode Detector with Numerical Aperture Measurement Facility
15	Laser Source	He- Ne Laser and 1350 nm I-R Laser
16	Introductory Nano Kit	
17	Hysteresis loop set up	Voltage Sensor range ± 0.5 V to ± 1V, current Sensor ±0.5 A to ±1 A, coil 250 to400 turns (pair), Resistance Module 10 ohm ,10 watt
18	Ruben's Tube (Sound)	
19	Optical Power meter	(-50 dB to 0dB) measurement range
20	CRO (20MHz)-(5MHz) dual channel	Dual channel,0-200 V, four probe, with power probe

21	Digital Multimeters	
22	Analog Voltmeters (mV, V)	
23	Analog Ammeter (micro, mA, A)	
24	Wires	
25	Tool Kit with tester	
26	Bread Board	
27	Screw Dirver Kit	
28	Regulated Power Supply (0-50V)	
29	Capacitors, Resistors	
30	Diodes	
31	LEDs, LDRs	
32	Rheostat	
33	Soldering kit with wire	
34	Function Generator (5MHz)	Generation of sine, Square, Saw tooth waves required, +/- pulses frequency range up to 20 MHz, Peak to peak voltage around 20 V
35	Multiple power supply	Variable of 0-30 volt , 30V/2A, 5V/2A , 15V/1A

List of Open Source Software/learning website:

- The Flying Circus of Physics 2nd edition by Jearl Walker, Wiley India
- Six Ideas that shaped physics by Thomas A Moore, McGraw Hill education
- http://www.howstuffworks.com/ -- Tech stuff
- How things works by Louis A Bloomfeild, Wiley Publications
- Physics of Everyday Phenomena by W. Thomas Griffith, Juliet Brosing, McGraw Hill Education
- Latest journals like BBC Knowledge, How things work-everyday technology explained by National Geographics.
- http://www.sciencefairadventure.com/

***PA (M):** 10 marks for Active Learning Assignments, 20 marks for other methods of PA

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus of Physics is covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should be sent to achievements@gtu.edu.in.

ESE Pr (V):10 marks for Open Ended Problems, 20 marks for VIVA.

Note: Passing marks for PA (M) will be 12 out of 30.
Passing marks for ESE Pract(V) will be 15 out of 30.