Gyanmanjari Innovative University

Syllabus
Gyanmanjari Institute of Technology
Semester-2 (B. Tech.)

Subject: Physics for Engineers: Principles and Real-World Applications – BET1XX12204

Type of course: Basic Science Courses

Prerequisite: Basic mathematics, understanding of shapes, different states of matter.

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

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks		Total Marks
CI	T	P	C	SEE	CCE	
2	0	4	4	100	50	150

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; SEE - Semester End Evaluation; CCE-Continuous and Comprehensive Evaluation.

Course Content:

Sr. No.	Course Content	Hrs.	% Weightage
1	**Conductivity and Superconductivity** ***Theory Topics:*** Introduction of conductivity, Superconductivity, Properties of superconductor, Effect of magnetic field, Meissner effect, Pressure effect, Impurity effect, Isotopic mass effect, Mechanism of Superconductivity: BCS Theory, Penetration depth: Magnetic field, Josephson's junction and its application, Application of superconductors. ***Practical:*** 1. To determine the reduction factor of the given tangent galvanometer (K). 2. To find out the horizontal component of earth's magnetic field (B_H) by using tangent galvanometer. 3. To study the variation of magnetic field with distance along the axis of a circular coil carrying current. 4. To determine the magnetic dipole moment (m) of a bar magnet using a deflection magnetometer. 5. To determine the Horizontal intensity (B_H) of earth's magnetic field using a deflection magnetometer. 6. To determine the self-inductance of the coil (L) using Anderson's bridge. 7. To determine the volume magnetic susceptibility of Manganese sulphate solution at different concentrations.	18	20%

Evaluation Method

Sr. No.	Evolution Methods	SEE	CCE
1	**The Skill Simulation** By random draw System Student will get the problem statement from the above list of the experiment and achieve results as asked in problem statement by using virtual lab simulator.	20	00
2	**Active Learning Assignment: The Thermal Coefficient Challenge** Student will perform practical inspection of thermal coefficient for any semi-conductor and prepare report in form of micro research paper.	00	10
	Total	20	10

Examination Style:

The Skill Simulation (20)

By random draw System Student will get the problem statement from the above list of the experiment, student have to write Aim, apparatus formula (if any), observation and observation table than after they allowed to open amritavirtuallab simulator and start data collection complete the Calculations, Graph (if any) and Result in Given Supplementary and submit to expert.

The Thermal Coefficient Challenge (10)

Student will Measure the resistance of the (semiconductor) graphite lead at room temperature. Then, safely use a hair dryer to heat the pencil or place it in a freezer (sealed in a bag) to cool it. Record the resistance at three states: Cold, Room Temp, and Hot. Calculate the Temperature Coefficient of Resistance (α) using the formula: $R = R_0 [1 + \alpha (T - T_0)]$, create PDF of report showing aim, apparatus used, reading table, calculation and result and upload the report to GMIU Web Portal.

LASER

Theory Topics:

Properties of Laser Einstein's theory of matter radiation: A and B coefficients, Amplification of light by population inversion, Different types of lasers, gas lasers (He-Ne) solid-state lasers(ruby), Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles Applications of lasers in science, engineering and medicine.

Practical:

8. To determine the refractive index of a thin glass plate using Michelson Interferometer.
9. To determine the wavelength of a laser using the Michelson interferometer.
10. To measure the numerical aperture of optical fiber by using LASER.
11. To calculate the beam divergence and spot size of the given laser beam.
12. To set up and observe Newton's rings.

2 **Evolution Methods:** 18 20%

Sr. No.	Evolution Methods	SEE	CCE
1	**Applied Performance Assessment** By random draw System Student will get the problem statement from the above list of the experiment and achieve results as asked in problem statement by using amritavirtuallab simulator.	20	00
2	**Active Learning Assignment: The Refractive Index Probe** Measuring how much a material "slows down" light. This is a fundamental property in lens design and material science.	00	10
	Total	20	10

	Examination Style: **Applied Performance Assessment (20)** By random draw System Student will get the problem statement from the above list of the experiment, student have to write Aim, apparatus formula (if any), observation and observation table than after they allowed to open amritavirtuallab simulator and start data collection complete the Calculations, Graph (if any) and Result in Given Supplementary and submit to expert. **The Refractive Index Probe (10)** Use a clear rectangular container (like a Tupperware) filled with water (or transparent liquid) or a block of clear gelatin. Shine the laser at an angle into the side of the container. Place a piece of paper underneath to trace the path of the beam as it enters and exits. Use a protractor to measure the Angle of Incidence i and the Angle of Refraction R. Calculate the Refractive Index n using Snell's Law Determine the refractive index of your specific liquid/gel, Create PDF of full Report having calculation, result and upload the report on GMIU Web Portal.		
3	**Waves and ultrasonic sound.** ***Theory Topics*:** Types of waves, wave motion, Wave Equation, transverse and longitudinal vibration, Ultrasonic waves Properties of ultrasound, Production of ultrasonic waves: ***Practical:*** 13. To determine the wavelength of a monochromatic light source using Newton's rings method. 14. To determine the frequency of an electrically maintained tuning fork in Transverse mode of vibration by Melde's String Apparatus. 15. To determine the frequency of an electrically maintained tuning fork in Longitudinal mode of vibration by Melde's String Apparatus 16. To find the velocity of sound waves in a given rod with Kundt 's tube apparatus. 17. To find the Young's modulus of the material of the rod with Kundt 's tube apparatus.	18	20%

Evolution Methods:

Sr. No.	Evolution Methods	SEE	CCE
1	**The Technical Showcase** By random draw System Student will get the problem statement from the above list of the experiment and achieve results as asked in problem statement by using amritavirtuallab simulator.	20	00
2	**Active Learning Assignment: The "Dancing Droplets" Experiment** Student will Place a plastic wrap tightly over a large speaker, creating a "drum skin." Sprinkle light particles like salt, glitter, or tiny drops of water on top. Play a "Frequency Sweep" video from YouTube (20 Hz up to 20,000 Hz).	00	10
	Total	20	10

Examination Style:

The Technical Showcase

By random draw System Student will get the problem statement from the above list of the experiment, student have to write Aim, apparatus formula (if any), observation and observation table than after they allowed to open amritavirtuallab simulator and start data collection complete the Calculations, Graph (if any) and Result in Given Supplementary and submit to expert.

The "Dancing Droplets" Experiment

Student will Place a plastic wrap tightly over a large speaker, creating a "drum skin." Sprinkle light particles like salt, glitter, or tiny drops of water on top. Play a "Frequency Sweep" video from YouTube (starting from 20 Hz up to 20,000 Hz). At specific frequencies, the particles will form beautiful, geometric patterns. Identify the "Resonant Frequencies" where the patterns are most distinct. This explains why Ultrasonic waves are used in cleaning—they vibrate dirt particles at frequencies that "shake" them off surfaces. Make collage having minimum 3-3 own activity photos of Before and After resonance photos of the patterns at different frequencies and upload it to GMIU web portal.

Semiconductor

Theory Topics:

Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature, (equilibrium carrier statistics) Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction.

Practical:

18. To study the I-V Characteristics of PN diode.
19. To plot the characteristics of thermistor and hence find the temperature coefficient of resistance.
20. To study the I-V Characteristics of Zener diode.
21. To study the I-V Characteristics of LED.
22. To study Zener diode inline regulation as voltage regulator.
23. To study Zener diode in Load regulation as voltage regulator.
24. To determine the resistivity of semiconductors by Four Probe Method.

Evolution Methods:

Sr. No.	Evolution Methods	SEE	CCE
1	**Field Protocol Evaluation** By random draw System Student will get the problem statement from the above list of the experiment and achieve results as asked in problem statement by using amritavirtuallab simulator.	20	00
2	**The "Thermal Switch" Challenge** This activity demonstrates how temperature and "doping" (impurity) change the behavior of a semiconductor, specifically looking at the Fermi Level's dependence on heat.	00	10
	Total	20	10

4		18	20%

	Examination Style: **Field Protocol Evaluation (20)** By random draw System Student will get the problem statement from the above list of the experiment, student have to write Aim, apparatus formula (if any), observation and observation table than after they allowed to open amritavirtuallab simulator and start data collection complete the Calculations, Graph (if any) and Result in Given Supplementary and submit to expert. **The "Thermal Switch" Challenge (10)** Student need a 9V battery, an LED, and a Thermistor 1. Build a simple circuit: Battery → Thermistor → LED. 2. At room temperature, the LED will likely be dim or off because the "carrier concentration" is low. 3. Gently heat the thermistor with a hairdryer or by holding it between your fingers. As the temperature rises, the LED gets brighter. Document the Trigger Temperature where the LED fully lights up and explain the transition from Equilibrium to Excited carrier states create own clear video of showing temperature reading and LED fully glowing and upload it to GMIU web portal.		
5	**Elasticity and Surface tension** ***Theory Topics:*** Deforming and restoring Force, Stress-Strain with their types, Hooke's law, Modules of elasticity, Young's modulus, Bulk modulus, Shear modulus, Stress-Strain curve, Surface tension; concept and units, Cohesive and adhesive forces, Molecular range and sphere of Influence, Laplace's molecular theory, Angie of contact, Ascent Formula (No derivation), Surface energy, Applications of surface tension, Effect of temperature and impurity on surface tension. ***Practical:*** 25. To determine Young's modulus of a given wire. 26. To study various crystals structures. 27. To determine Young's modulus of given beam by Banding method. 28. Use capillary rise method and traveling microscope to determine the surface tension of a given liquid. 29. To determine the moment of inertia of the given disc using Torsion pendulum, with identical masses. 30. To determine g, the acceleration of gravity at a particular location.	18	20%

Evolution Methods:

Sr. No.	Evolution Methods	SEE	CCE
1	**The Proficiency Lab** By random draw System Student will get the problem statement from the above list of the experiment and achieve results as asked in problem statement by using amritavirtuallab simulator.	20	00
2	**Magic of Physics** Student have to perform one physics trick of own choice which looks like magic, make video with explanation and upload it to GMIU web Portal.	00	10
	Total	20	10

Examination Style:

The Proficiency Lab (20)
By random draw System Student will get the problem statement from the above list of the experiment, student have to write Aim, apparatus formula (if any), observation and observation table than after they allowed to open amritavirtuallab simulator and start data collection complete the Calculations, Graph (if any) and Result in Given Supplementary and submit to expert.

Magic of Physics (10)
Student have to choose and perform one physics trick which looks like magic, make own video of trick performance with explanation and upload it to GMIU web Portal.

Suggested Specification table with Marks (Theory):100

Distribution of Theory Marks **(Revised Bloom's Taxonomy)**						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage %	20%	20%	30%	10%	10%	10%

Course Outcome:

After learning the course the students should be able to:	
CO1	Design properties associated with semiconducting materials
CO2	Analyze the superconducting state and applications of Superconductivity.
CO3	Solve the problems based on principles and properties of Waves and wave motion.
CO4	Apply principles, properties and application of Lasers.
CO5	Use the concepts of Elasticity, Surface and Tension for various engineering applications

Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory.

The internal evaluation will be done on the basis of Active Learning Assignment.

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Reference Books:

[1] Semiconductor Optoelectronics: Physics and Technology by I. J. Singh, McGraw-Hill Inc. (1995).

[2] Fundamentals of Photonics, by B. E. A. Saleh and M. C. Teich, John Wiley & Sons, Inc., (2007).

[3] Semiconductor Devices: Physics and Technology, by S. M. Sze, Wiley (2008).

[4] Photonics: Optical Electronics in Modern Communications, by A. Yariv and P. Yeh, Oxford

[5] Fundamentals of Physics by Halliday, Resnick, and Walker

Suggested Assessment Guidelines:

Module-1: Conductivity and Superconductivity

The Skill Simulation (20)		
Criteria	**Description**	**Marks**
Virtual Setup & Calibration	Correct selection of apparatus, proper circuit connections, and "zeroing" instruments.	5
Procedural Accuracy	Systematic data collection. Did the student use appropriate increments in data collection.	5
Analytical Reporting	Correct use of formulas, unit conversions, and graph plotting. Does the final calculated value align with the simulation data ?	5
Conceptual Defense (Viva)	Oral or written explanation of the physics laws involved and the ability to troubleshoot virtual errors.	5
	Total	20

Module-2 LASER

Applied Performance Assessment (20)		
Criteria	**Description**	**Marks**
Virtual Setup & Calibration	Correct selection of apparatus, proper circuit connections, and "zeroing" instruments.	5
Procedural Accuracy	Systematic data collection. Did the student use appropriate increments in data collection.	5
Analytical Reporting	Correct use of formulas, unit conversions, and graph plotting. Does the final calculated value align with the simulation data ?	5
Conceptual Defense (Viva)	Oral or written explanation of the physics laws involved and the ability to troubleshoot virtual errors.	5
	Total	20

Module-3 Waves and ultrasonic sound.

The Technical Showcase (20)		
Criteria	**Description**	**Marks**
Virtual Setup & Calibration	Correct selection of apparatus, proper circuit connections, and "zeroing" instruments.	5
Procedural Accuracy	Systematic data collection. Did the student use appropriate increments in data collection.	5
Analytical Reporting	Correct use of formulas, unit conversions, and graph plotting. Does the final calculated value align with the simulation data ?	5
Conceptual Defense (Viva)	Oral or written explanation of the physics laws involved and the ability to troubleshoot virtual errors.	5
	Total	20

Module-4 Semiconductor

Field Protocol Evaluation (20)		
Criteria	**Description**	**Marks**
Virtual Setup & Calibration	Correct selection of apparatus, proper circuit connections, and "zeroing" instruments.	5
Procedural Accuracy	Systematic data collection. Did the student use appropriate increments in data collection.	5
Analytical Reporting	Correct use of formulas, unit conversions, and graph plotting. Does the final calculated value align with the simulation data ?	5
Conceptual Defense (Viva)	Oral or written explanation of the physics laws involved and the ability to troubleshoot virtual errors.	5
	Total	20

Module-5 Elasticity and Surface tension

The Proficiency Lab (20)		
Criteria	**Description**	**Marks**
Virtual Setup & Calibration	Correct selection of apparatus, proper circuit connections, and "zeroing" instruments.	5
Procedural Accuracy	Systematic data collection. Did the student use appropriate increments in data collection.	5
Analytical Reporting	Correct use of formulas, unit conversions, and graph plotting. Does the final calculated value align with the simulation data ?	5
Conceptual Defense (Viva)	Oral or written explanation of the physics laws involved and the ability to troubleshoot virtual errors.	5
	Total	20