INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE AND ENGINEERING

COURSE DESCRIPTION

Course Title	**ENGINEERING PHYSICS** (Common for CSE / IT/ ECE/ EEE)			
Course Code	**AHS007**			
Course Structure	**Lectures**	**Tutorials**	**Practicals**	**Credits**
	3	1	-	4
Course Coordinator	Dr. Rizwana, Professor			
Team of Instructors	Dr. A Jayanth Kumar, Dr. Rizwana, Dr. N Rajeshwar Rao Ms. S Charvani, Ms. K Sowmya, Mr. K Saibaba, Mr. V S K Prasad			

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 nanomaterials, lasers, dielectric and magnetic properties, principles of quantum mechanics and semiconductors physics. 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. PREREQUISITE(S)

Level	Credits	Periods	Prerequisite
UG	4	3	The basics of analytical and conceptual understanding of physics

III. MARKS DISTRIBUTION

Subject	SEE Examination	CIA Examination	Total Marks
Engineering Physics	70 Marks	30 Marks	100 Marks

Semester End Examination 70 Marks All the Units (1, 2, 3, 4 and 5)	70 Marks (3 Hours)	5 questions to be answered. Each question carries 14 Marks

<table>
<tr><td rowspan="8">Average of two CIA Examinations</td><td colspan="4">Continuous Internal Assessment - 1</td></tr>
<tr><td rowspan="3">30 Marks
(2 Hours)</td><td rowspan="3">Units
I, II and
III (half)</td><td rowspan="2">Continuous Internal Examination (CIE)
(2 hours)</td><td>Part - A
5 questions to be answered out of 5 questions, each carries 1 mark.</td></tr>
<tr><td>Part - B
4 questions to be answered out of 5 questions, each carries 5 marks.</td></tr>
<tr><td>Quiz-I /Alternate Assessment Tool (AAT- I)</td><td>5 marks for assignment.</td></tr>
<tr><td colspan="4">Continuous Internal Assessment - 2</td></tr>
<tr><td rowspan="3">30 Marks
(2 Hours)</td><td rowspan="3">Units
III (half)
IV and V</td><td rowspan="2">Continuous Internal Examination (CIE)
(2 hours)</td><td>Part – A
5 questions to be answered out of 5 questions, each carries 1 mark.</td></tr>
<tr><td>Part - B
4 questions to be answered out of 5 questions, each carries 5 marks.</td></tr>
<tr><td>Quiz-II /Alternate Assessment Tool (AAT- II)</td><td>5 marks for assignment.</td></tr>
</table>

IV. EVALUATION SCHEME

S. No	Component	Duration	Marks
1	CIE - I Examination	2 hour	25
2	Quiz - I / AAT - I	-	05
TOTAL			30
3	CIE - II Examination	2 hour	25
4	Quiz - II / AAT - II	-	05
TOTAL			30
CIA Examination marks to be considered as average of above two CIA’s			
5	EXTERNAL Examination	3 hours	70
GRAND TOTAL			100

V. COURSE OBJECTIVES

The course should enable the students to:

I. Develop the strong fundamentals of nanomaterials.

II. Meliorate the knowledge of theoretical and technological aspects of lasers.

III. Correlate principles with applications of the quantum mechanics, dielectric and magnetic materials.

IV. Enrich knowledge in modern engineering materials like semiconductors.

VI. COURSE OUTCOMES

After completing this course the student must demonstrate the knowledge and ability to:

1. **Recall** the basic principles of physics.
2. **Apply** the concepts and principles in solving the problems of physics.
3. **Explain** the basic principles, properties and applications of nanomaterials.
4. **Develop** knowledge about different techniques of producing nanomaterials.
5. **Describe** the principle involved in working of different types of laser systems.
6. **Acquire** knowledge of basic terms related to dielectric material and different polarization mechanisms.
7. **Review** the properties of different magnetic materials and magnetization based on orientation of domains.
8. **Interpret** and **verify** dual nature of matter wave concept using Davisson & Germer's experiment.
9. **Estimate** the energy of the particles using Schrödinger's wave equation and apply it to particle in potential box.
10. **Recollect** the conductivity mechanism involved in semiconductors.
11. **Calculate** carrier concentrations of intrinsic, p-type and n-type semiconductors.
12. **Discuss** about energy gap, direct, indirect band-gap semiconductors and Hall effect.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED

Program Outcomes		Level	Proficiency assessed by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	H	Assignments
PO2	**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.	H	Assignments
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	S	Assignments, Discussion
PO4	**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.	H	Exercise
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	S	Exercise
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering	S	Exercise

	practice.		
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	S	Discussion, Seminar
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	N	----------
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	S	Discussion
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	S	Discussion, Seminar
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	N	-----
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	H	Prototype, Discussion

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED

Program Specific Outcomes		**Level**	**Proficiency Assessed by**
PSO1	**Professional Skills:** The ability to research, understand and implement computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient analysis and design of computer-based systems of varying complexity.	N	-----
PSO2	**Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.	S	Tutorials
PSO3	**Successful Career and Entrepreneurship:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths, to be an entrepreneur, and a zest for higher studies.	S	Seminars and Projects

N - None **S - Supportive** **H – Highly Related**

IX. 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 LASERS

Lasers: Characteristics of lasers, spontaneous and stimulated emission of radiation, metastable state, population inversion, lasing action, Einstein's coefficients, ruby laser, He-Ne laser, semiconductor diode laser and applications of lasers.

UNIT – III NANOMATERIAL

Nanomaterial: Origin of nanomaterial, nano scale, surface to volume ratio, quantum confinement, properties of nanomaterials: physical, chemical, electrical, optical, magnetic and mechanical; bottom-up fabrication: sol-gel; top-down fabrication: chemical vapour deposition; applications of nanomaterials, characterization by XRD, TEM.

UNIT – IV QUANTUM MECHANICS

Quantum mechanics: Waves and particles, De Broglie hypothesis, matter waves, Heisenberg's uncertainty principle, Davisson and Germer experiment, Schrodinger's time independent wave equation, physical significance of the wave function, infinite potential well and its extension to three dimensions.

UNIT – V SEMICONDUCTOR PHYSICS

Semiconductor physics: Fermi Level in intrinsic and extrinsic semiconductors, calculation of carrier concentration in intrinsic and extrinsic semiconductors, energy gap, direct and indirect band gap semiconductors, Hall effect.

Textbooks:

1. Dr. K. Vijaya Kumar, Dr. S. Chandralingam, "Modern Engineering Physics", Chand & Co. New Delhi, 1st Edition, 2010.
2. P. K. Palanisamy, "Engineering Physics", Scitech Publishers, 4th Edition, 2014.

Reference books:

1. V. Rajendran, "Engineering Physics", Tata Mc Graw Hill Book Publishers, 1st Edition, 2010.
2. R. K. Gaur, S. L. Gupta, "Engineering Physics", Dhanpat Rai Publications, 8th Edition, 2001.
3. A. J. Dekker, "Solid State Physics", Macmillan India ltd, 1st Edition, 2000.
4. Hitendra K. Malik, A. K. Singh, "Engineering Physics", Mc Graw Hill Education, 1st Edition, 2009.

X. COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Unit No.	Lecture No.	Course Learning Outcomes	Topics to be covered	Reference
I	1	**Acquire** knowledge of basic terms related to dielectric materials.	Basic definitions of dielectric materials	T1, T2, R1, R2
	2	**Discuss** different polarization mechanisms in dielectrics	electronic, ionic and orientation polarizations	T1, T2, R1, R2
	3-4	**Derive** expression for total electric field at a given point inside dielectrics.	Internal field in solids	T1, T2, R1, R2
	5	**Acquire** knowledge of basic terms related to magnetic materials.	Basic definitions of magnetic materials	T1, T2, R1, R2
	6	**Describe** magnetic moment in an atom in terms of Bohr Magneton	origin of magnetic moment, Bohr magneton	T1, T2, R1, R2
	7-8	**Classify** different magnetic materials based on electron theory.	Classification of dia, para and ferro magnetic materials on the basis of magnetic moment	T1, T2, R1, R2
	9	**Examine** the spontaneous magnetization in ferro-magnets based on orientation of domains.	domain theory of ferro magnetism on the basis of hysteresis curve	T1, T2, R1, R2
II	10	**Explain** the principle involved in Lasers	Characteristics of lasers	T1, T2, R1, R2
	11	**Review** basic phenomena's of laser	spontaneous and stimulated emission of radiation	T1, T2, R1, R2
	12	**Acquire** knowledge of basic terms related to lasers	metastable state, population inversion	T1, T2, R1, R2
	13	**Discuss** functioning of laser system	lasing action	T1, T2, R1, R2
	14	**Derive** relation between Einstein's Coefficients	Einstein's coefficients	T1, T2, R1, R2
	15	**Explain** the principle and working of Ruby laser	ruby laser	T1, T2, R1, R2
	16	**Explain** the principle and working of Helium-Neon laser	He-Ne laser	T1, T2, R1, R2
	17	**Explain** the principle and working of semiconductor diode laser	semiconductor diode laser	T1, T2, R1, R2
	18	**Discuss** the uses of lasers	applications of lasers	T1, T2, R1, R2
	19	**Identify** the principle of nano technology	Introduction	T1, T2, R1, R4
	20	**Recall** origin of nanomaterials	Origin of nanomaterial, nano scale	T1, T2, R1, R4
	21	**Acquire** knowledge of basic principle of nanomaterials.	surface to volume ratio, quantum confinement	T1, T2, R1, R4
	22	**Analyze** nano material with their properties	properties of nanomaterials	T1, T2, R1, R4

III	23	**Develop** nanomaterials in sol gel method	bottom-up fabrication: sol-gel	T1, T2, R1, R4
	24	**Develop** nanomaterials chemical method	top-down fabrication: chemical vapour deposition	T1, T2, R1, R4
	25	**Discuss** applications of nanomaterials	applications of nanomaterials	T1, T2, R1, R4
	26	**Analyze** nanomaterials by XRD	characterization by XRD	T1, T2, R1, R4
	27	**Analyze** nanomaterials by TEM	TEM	T1, T2, R1, R4
IV	28	**Understand** dual nature of radiation	Waves and particles	T1, T2, R1, R2
	29	**Correlate** dual nature to material particle	De Broglie hypothesis	T1, T2, R1, R2
	30	**Analyze** matter wave concept mathematically	Problems of De Broglie wavelength	T1, T2, R1, R2
	31	**Describe** matter waves and Heisenberg's Uncertainty Principle	matter waves, Heisenberg's uncertainty principle	T1, T2, R1, R2
	32	**Identify** existence of matter wave experimentally	Davisson and Germer experiment	T1, T2, R1, R2
	33	**Derive** wave equation of matter wave	Schrodinger's time independent wave equation	T1, T2, R1, R2
	34	**Correlate** wavefunction to probability density.	physical significance of the wave function	T1, T2, R1, R2
	35	**Derive** the solution of wave equation in terms of Potential box	infinite potential well	T1, T2, R1, R2
	36	**Apply** to three dimensions	extension to three dimensions	T1, T2, R1, R2
V	37	**Explain** basic concepts of semiconductors	intrinsic and extrinsic semiconductors	T1, T2, R1, R2
	38-39	**Derive** carrier concentration in intrinsic Semiconductors	Intrinsic carrier concentration	T1, T2, R1, R2
	40-41	**Derive** carrier concentration in extrinsic semiconductors	Carrier concentration in p-type and n-type semiconductors	T1, T2, R1, R2
	42	**Identify** Fermi level in semiconductors	Fermi Level in intrinsic and extrinsic semiconductors	T1, T2, R1, R2
	43	**Determine** energy gap mathematically	energy gap	T1, T2, R1, R2
	44	**Compare** Direct &Indirect Band Gap semiconductors	direct and indirect band gap semiconductors	T1, T2, R1, R2
	45	**Understand** Hall Effect	Hall Effect, Problems	T1, T2, R1, R2

XI. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	H	H	S	H	S	H	S		S	S		H		S	S
II	H	H	S	H	S	S	S		S	S		H		H	S
III	H	H	S	H	S	H	S		S	H	S	H		S	S
IV	H	H	S	H	S	S	S	S	S	S		H		S	H

S = Supportive **H = Highly related**

XII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	H	H	S	H	S	H	S		S	S	S	H		S	S
2	H	H	S	H	S	S	S		S	S		H		S	S
3	H	H	S	H	S	S	H	S	S	S		H		H	S
4	H	H	S	H	S	S	S		S	H	S	H		S	S
5	H	H	S	H	S	S	S		S	S		H		S	S
6	H	H	S	H	S	H	S		S	S		H		S	H
7	H	H	S	H	S	S	S	S	S	S		H		H	S
8	H	H	S	H	H	S	S		S	S		H		S	S
9	H	H	S	H	S	S	S		S	S		H		S	S
10	H	H	S	H	S	H	S	S	H	S	S	H		S	H
11	H	H	S	H	S	S	H		S	S		H		S	S
12	H	H	H	H	H	S	S		S	H		H		S	H

S = Supportive **H = Highly related**

Prepared by: Dr. Rizwana, Professor

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