G.PULLAIAH COLLEGE OF ENGINEERING AND TECHNOLOGY: KURNOOL

DEPARTMENT OF HUMANITIES AND SCIENCES

B. Tech I YEAR
COURSE DESCRIPTION

COURSE TITLE	ENGINEERING PHYSICS			
COURSE CODE	15A56101			
REGULATION	R15-JNTUA			
COURSE STRUCTURE	LECTURES	TUTORIALS	PRACTICALS	CREDITS
	3	1	-----	
COURSE COORDINATOR	B.SUNEETHA			
TEAM OF INSTRUCTORS	S.LOKA RAGHAVENDRA, B.LAVANYA			

I. Course Overview:

There has been an exponential growth of knowledge in the recent past opening up new areas and challenges in the understanding of basic laws of nature. This helped to the discovery of new phenomena in macro, micro and nano scale device technologies. The laws of physics play a key role in the development of science, engineering and technology. Sound knowledge of physical principles is of paramount importance in understanding new discoveries, recent trends and latest developments in the field of engineering. To keep in pace with the recent scientific advancements in the areas of emerging technologies, the syllabi of engineering physics has been thoroughly revised keeping in view of the basic needs of all engineering branches by including the topics like optics, crystallography, quantum mechanics, free electron theory. Also new phenomenon, properties and device applications of semiconducting, magnetic, superconducting and nano materials along with their modern device applications have been introduced.

II. Prerequisite(s):

Level	Credits	Periods / Week	Prerequisites
UG	3	3	Thorough knowledge of Basic sciences

III. Marks Distribution:

Sessional Marks	University End Exam Marks	Total Marks
There shall be 2 midterm examinations. Each midterm examination consists of subjective test and objective test. The subjective test is for 30 marks containing 5 questions of which student has to answer 3 questions of equal weightage 10 marks which is to be condensed to 20 marks, any fraction rounded off to the next higher mark. Objective test is set for 20 bits for 10 marks. First midterm examination shall be conducted for the first two units of syllabus and second midterm examination shall be conducted for the next three units. Final internal marks shall be arrived at by considering the marks secured by the students in both the mid examinations with 80% weightage to the better mid exam and 20% to the other.	70	100

IV. Evaluation Scheme:

S. No.	Component	Duration	Marks
1	I Mid Examination	1hr 50 min	30
2	II Mid Examination	1hr 50 min	30
3	External Examination	3	70

V. Course Objectives:

i) To evoke interest on applications of superposition effects like interference and diffraction, the mechanisms of emission of light, achieving amplification of electromagnetic radiation through stimulated emission, study of propagation of light through transparent dielectric waveguides along with engineering applications.

ii) To enlighten the periodic arrangement of atoms in crystals, direction of Bragg planes, crystal structure determination by X-rays and non-destructive evaluation using ultrasonic techniques.

iii) To get an insight into the microscopic meaning of conductivity , classical and quantum free electron model,the effect of periodic potential on electron motion, evolution of band theory to distinguish materials and to understand electron transport mechanism in solids.

iv) To open new avenues of knowledge and understanding semiconductor based electronic devices , basic concepts and applications of semiconductors and magnetic materials have been introduced which find potential in the emerging micro device applications.

v) To give an impetus on the subtle mechanism of superconductors in terms of conduction of electron pairs using BCS theory, different properties exhibited by them and their fascinating applications. Considering the significance of microminiaturization of electronic devices and significance of low dimensional materials, the basic concepts of nanomaterials, their synthesis, properties and applications in emerging technologies are elicited.

VI. Course Outcomes:

Upon successful completion of this course, the student will be able to:

CO-1: a)Understand the different realms of physics and their applications in both scientific and technological systems through the study of physical optics, lasers and fibre optics.

CO-2: b) Describe different types of x-ray diffraction techniques and analyze the crystal structure

CO-3: c) Understand the concept of piezoelectric effect in the production of ultrasonics and apply it in non-destructive testing of materials

CO-4: d) **E**stimate the energy of the particles using Schrödinger's wave equation and interpret the electrical properties of solids on the basis of origin of energy bands.

CO-5: e) Classify different types of semiconductors and magnetic materials.

CO-6: f) Elucidate the important properties of Superconducting materials and nano materials along with their engineering applications.

VII. How Course Outcomes are assessed:

Program Outcomes		Level	Proficiency assessed by
PO-I	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	H	Assignments, Exercises
PO-2	**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.	S	Exercises
PO-3	**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	Discussions
PO-4	**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.	N	---
PO-5	**Modern tool usage:** create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	N	----
PO-6	**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 practice.	N	---

PO-7	**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.	N	---
PO-8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	S	Exams Discussions
PO-9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	S	Seminars Discussions
PO-10	**Communications:** 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 receive clear instructions.	N	---
PO-11	**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	----
PO-12	**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.	S	Seminars Discussions

N = None **S = Supportive** **H = Highly Related**

VIII. Syllabus:

UNIT – I

PHYSICAL OPTICS, LASERS AND FIBRE OPTICS

Physical Optics: Interference (Review) – Interference in thin film by reflection –Newton's rings –Diffraction (Review) - Fraunhofer diffraction due to single slit, double slit and diffraction grating.

Lasers: Characteristics of laser – Spontaneous and stimulated emission of radiation – Einstein's coefficients –– Population inversion – Excitation mechanism and optical resonator – Nd:YAG laser - He-Ne laser – Semiconductor Diode laser - Applications of lasers

Fiber optics: Introduction - construction and working principle of optical fiber –Numerical aperture and acceptance angle – Types of optical fibers – Attenuation and losses in Optical fibers –Block diagram of Optical fiber communication system – Applications of optical fibers

UNIT – II

CRYSTALLOGRAPHY AND ULTRASONICS

Crystallography: Introduction – Space lattice –Unit cell – Lattice parameters –Bravias lattice – Crystal systems – Packing fractions of SC, BCC and FCC - Directions and planes in crystals – Miller indices – Interplanar spacing in cubic crystals – X-ray diffraction - Bragg's law – Powder method.

Ultrasonics: Introduction – Production of ultrasonics by piezoelectric method – Properties and detection – Applications in non-destructive testing.

UNIT – III

QUANTUM MECHANICS AND ELECTRON THEORY

*Quantum Mechanics: M*atter waves – de'Broglie hypothesis and properties - Schrodinger's time dependent and independent wave equations – Physical significance of wave function - Particle in one dimensional infinite potential well.*Electron theory:* Classical free electron theory – Equation for electrical conductivity - Quantum free electron theory – Fermi-Dirac distribution – Source of electrical resistance – Kronig-Penny model (qualitative treatment) – Origin of bands in solids – Classification of solids into conductors, semiconductors and insulators.

UNIT – IV

SEMICONDUCTORS AND MAGNETIC MATERIALS

Semiconductors: Intrinsic and extrinsic semiconductors (Qualitative treatment) – Drift & diffusion currents and Einstein's equation – Hall effect - Direct and indirect band gap semiconductors – Formation of p-n junction.

Magnetic materials: Introduction and basic definitions – Origin of magnetic moments – Bohr magnetron – Classification of magnetic materials into dia, para, ferro, antiferro and ferri magnetic materials (Qualitative treatment) – Hysteresis - Soft and hard magnetic materials, applications of magnetic materials.

UNIT – V

SUPERCONDUCTIVITY AND PHYSICS OF NANOMATERIALS

Superconductivity: Introduction - Effect of magnetic field - Meissner effect – Type I and Type II superconductors – Flux quantization – Penetration depth - BCS theory (qualitative treatment) — Josephson effects –Applications of superconductors.

Physics of Nanomaterials: Introduction - Significance of nanoscale and types of nanomaterials – Physical properties: optical, thermal, mechanical and magnetic properties – Synthesis of nanomaterials by Top down and bottom up approaches: ball mill, chemical vapour deposition, and sol gel – Applications of nanomaterials.

IX. List of Text Books / References / Websites / Journals / Others

Text Books:

1. Engineering Physics – K.Thyagarajan, 5th Edition, MacGraw Hill Publishers, NewDelhi, 2014.
2. Engineering Physics –P. K.Palaniswamy, , Second Edition, Scitech., Publications
3. Physics for Engineers - N.K Verma, 1st Edition, PHI Learning Private Limited, New Delhi,2014.

References:

1. Engineering Physics – Dr. M.N. Avadhanulu & Dr. P.G. Kshirsagar, 10th Edition, S.Chand and Company, New Delhi, 2014.
2. Engineering Physics – D K Pandey, S. Chaturvedi, 2nd Edition, Cengage Learning, New Delhi, 2013.
3. Engineering Physics – D.K Bhattacharya, Poonam Tandon, 1nd Edition, Oxford University Press, New Delhi, 2015.

X. Course Plan:

Lecture No.	Learning Objective	Topics to be covered	Reference
UNIT-I			
1-2	To understand the concept of interference	Introduction, Interference	**T1,T2**
3-4	To understand how colors are formed in thin films	Interference in thin films by reflection	**T1,T2**
5-6	To understand how to find out the radius of curvature of plano convex lens and fringe width	Newton's rings	**T1,T2**
7	To understand the concept of diffraction	Diffraction	**T1,T2**
8-9	To understand how the diffraction occurs due to single slit	Fraunhofer diffraction at a single slit	**T1,T2**
10	To understand how the diffraction occurs due to double slit	Fraunhofer diffraction at a double slit	**T1,T2**
11	Able to understand how to find out the wavelength by using diffraction grating	Diffraction grating	**T1,T2**
12	To study the nature of laser	Introduction – Characteristics of laser	**T2,R1**
13	To study the interaction of EM waves with matter	Spontaneous and stimulated emission of radiation	**T2**
14	To understand the relation between the co-efficients of absorption and emission	Einstein's coefficients	**T1**
15	To understand population inversion	Population inversion	**T2,R1**
16-17	To understand how to achieve the population inversion and working mechanism of Laser	Excitation mechanisms and optical resonator	**T2,R1**
18	To understand the construction and working of Ruby laser	Nd-YAG Laser	**T2,R1**
19	To understand the construction and working of He-Ne Laser	He-Ne Laser	**T2,R1**
20	To understand the applications of Lasers in Industry, Scientific and Medical fields.	Applications of Lasers	**T2,R1**
21	To understand the importance of an optical fiber	Introduction	**T2,R1**
22	To understand the basic principle of an optical fiber(Total internal reflection)	Construction and working Principle of optical fiber	**T2,R1**
23-24	To understand the light gathering capacity of an optical fiber and at which angle the light has to be launched in an optical fiber	Numerical aperture and acceptance angle	**T2,R1**

25-26	To understand the different types of optical fibers	Types of Optical fibers and refractive index profiles	**T2,R1**
27-28	To understand which type of losses occur when the light propagates through an optical fiber	Attenuation and losses in fibers	**T2,R6**
29	To understand how the communication reaches from one end to other end through an optical fiber	Optical fiber communication systems	**T2,R1**
30	To understand the applications of optical fibers in communication, sensors and medicine	Application of optical fibers in communication, sensors and medicine.	**T2,R1**
UNIT-II			
31	Able to understand the basics of crystal structures	Introduction	**T1,T2**
32	Able to understand the basics of crystal structures	Space lattice - Basis	**T1,T2**
33	Able to understand the basics of crystal structures	Unit cell - Lattice parameters	**T1,T2**
34-	Able to understand various crystal structures	Bravais lattices	**T1,T2**
35	Able to understand various crystal structures	Crystal systems	**T1,T2**
36-37	To understand the various structures of crystals	Structure of Simple cubic - Body Centered Cubic – Face Centered Cubic crystals	**T1,T2**
38	To understand the directions of various of planes in crystals	Miller indices of planes and directions in crystals	**T1,T2,R6**
39	To identify the location of planes in crystals and able to determine the inter planar spacing between the planes	Separation between successive (h k l) planes	**T1,T2**
40	To understand the basic principles of diffraction	X-ray diffraction by crystal planes - Bragg's law	**T1,T2**
41	To analyze the crystal structure	Powder methods.	**T1,T2**
42	To understand the production of ultrasonics	Introduction- production of ultrasonics by piezo electric method	**T1,T2**
43	To understand the properties of ultrasonics and detection of ultrasonics by various methods	properties and detection	**T1,T2**
44	To understand the applications of ultrasonics in non-destructive testing	applications in non-destructive testing	**T1,T2**
UNIT-III			
45	To introduce the concept of matter waves	Introduction to matter waves	**T1,T2**
46	To understand the dual nature of matter waves	de- Broglie's hypothesis and properties of matter waves	**T1,T2**

47-48	Introduction of Schrödinger's wave equation and its significance	Schroedinger's time independent and time dependent equation-significance of wave function	**T1,T2**
49	To understand the application of Schrödinger's equation	Particle in a one dimensional infinite potential well	**T1,T2**
50	To introduce the classical free electron theory	Classical free electron theory	**T1,T2**
51	Able to understand how the resistance arises in solids	Source of electrical resistance – equation for electrical conductivity	**T1,T2**
52	To introduce the concepts of quantum free electron theory	Quantum free electron theory	**T1,T2**
53	To understand the distribution of electrons in different energy levels	Fermi-Dirac distribution	**T1,T2**
54	To understand the motion of an electron in a periodic potential	Kronig-Penney model (qualitative treatment only)	**T1,T2**
55-56	To understand the formation of bands in solids and differences between them	Origin of Energy bands – conductors, semi conductors & insulators.	**T1,T2**
UNIT-IV			
57-58	To understand the basics of semiconductors	Introduction-Intrinsic and extrinsic semiconductors	**T1,T2**
59	To understand the concept of drift and diffusion	Drift & diffusion currents	**T1,T2**
60	To understand the relation between mobility and diffusion coefficient	Einstein's equation	**T1,T2**
61	To understand the Hall effect	Hall effect	**T1,T2**
62	To understand the band gap semiconductors	Direct & indirect band gap semiconductors	**T1,T2**
63	To understand the formation of p-n junction	Formation of p-n junction diode	**T1,T2**
64	To understand the basic concepts of magnetic materials	Introduction and basic definitions	**T1,T2**
65	To Study and analyze the nature of the magnetism	Origin of magnetic moments-Bohr magneton	**T1,T2**
66-68	To understand the differences between magnetic materials	Classification of magnetic materials - Dia, Para , Ferro, anti-Ferro and Ferri magnetic materials.(Qualitative treatment)	**T1,T2**
69	To understand the Hysteresis	Hysteresis	**T1,T2**
70	To understand the differences between magnetic materials based on the Hysteresis	Soft and hard magnetic materials-applications of magnetic materials.	**T1,T2**
UNIT-V			
71	To understand the concept of zero resistivity	Introduction of super conductors	**T1,T2**
72	To Study the effect of magnetic field	Meissner effect	**T1,T2**

	on superconductors.		
73	To understand the exponential decrease of magnetic field inside a super conductor	London Penetration depth	**T1,T2**
74	To understand the differences between the superconductors	Type I and Type II superconductors	**T1,T2**
75	To understand the quantization of flux in a super conductor	Flux quantization	**T1,T2**
76	To study the flow of current between the two super conductors	Ac and dc Josephson effects	**T1,T2**
77	To understand the cooper pair and the applications of super conductors	BCS theory and applications of superconductors	**T1,T2**
78	To study the basic principles of nanomaterials	Introduction-significance of nano scale-surface area and quantum confinement	**T2,R10**
79	To understand the properties of nano materials	Physical properties: optical, thermal, mechanical and magnetic properties	**T2,R10**
80	To understand the Top-down & Bottom-up fabrication methods	Ball milling – Chemical vapour deposition method & sol-gel methods and applications of nanomaterials	**T2,R10**

Prepared By : B.SUNEETHA
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