INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**MODERN PHYSICS**				
Course Code	AHS008				
Programme	B.Tech				
Semester	II	AE | ME | CE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Mr. A Chandra Prakash, Assistant Professor				
Course Faculty	Dr. Rizwana, Professor Ms. S Charvani, Associate Professor Mr. K Saibaba, Assistant Professor				

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 crystallography, X-ray diffraction, defects in crystals, lasers, sensors, fiber optics, interference and diffraction. 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. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	Basic principles of physics

III. MARKS DISTRIBUTION:

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

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):
Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Presentation on real-world problems
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	2	Seminar
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.	1	Term Paper

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	1	Seminar
PSO 2	**Broadness and diversity:** Graduates will have a broad understanding of economical, environmental, societal, health and safety factors involved in infrastructural development, and shall demonstrate ability to function within multidisciplinary teams with competence in modern tool usage.	-	-
PSO 3	**Self-learning and service:** Graduates will be motivated for continuous self-learning in engineering practice and/ or pursue research in advanced areas of civil engineering in order to offer engineering services to the society, ethically and responsibly.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Develop strong fundamentals of crystal structures and properties.
II	Meliorate the knowledge of theoretical and technological aspects of lasers.
III	Correlate principles with applications of the x-ray diffraction and defects in crystals.
IV	Enrich knowledge in modern engineering principles of interference and diffraction.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS008.01	CLO 1	Recall the basic principles of physics and apply these concepts of physics in solving the real-time problems.	PO 1 , PO 2	3
AHS008.02	CLO 2	Acquire knowledge of basic terms related to crystals, crystal systems, Bravais lattices and Miller Indices.	PO 1 , PO 4	3
AHS008.03	CLO 3	Discuss in detail different crystal structures and calculate their packing factors.	PO 1 , PO 4	3
AHS008.04	CLO 4	Describe different X-ray diffraction in research and development for the study of internal structures of materials.	PO 1 , PO 2	2
AHS008.05	CLO 5	Identify various types of defects in crystals and their effect on structure sensitive properties.	PO 1 , PO 2	2
AHS008.06	CLO 6	Understand the basic principles involved in the production of Laser light and also real-time applications of lasers.	PO 1 , PO 2	2
AHS008.07	CLO 7	Explain the principle involved in working of different types of laser systems.	PO 1 , PO 4	1
AHS008.08	CLO 8	Analyze basic laws of physics to correlate the mechanism of sensors in day to day life. Principle of sensor along with their applications.	PO 2 , PO 4	1
AHS008.09	CLO 9	Understand the importance of various sensors in real-time applications like measurement of pressure in aeronautics, detecting submarines in acoustics.	PO 2 , PO 4	2
AHS008.10	CLO 10	Recollect basic principle, construction, types and attenuation of optical fibers.	PO 1 , PO 2	2
AHS008.11	CLO 11	Apply properties of optical fibers in various real-time applications like measurement of pressure, temperature , displacement etc.,	PO 1 , PO 4	3
AHS008.12	CLO 12	Understand the importance of optical fibers in real-time communication system.	PO 1 , PO 2	3
AHS008.13	CLO 13	Interpret phenomenon of interference in thin films using Newton's rings experiment.	PO 1 , PO 4	3
AHS008.14	CLO 14	Identify difference in diffraction phenomenon due to single slit and N-slits.	PO 2 , PO 4	1
AHS008.15	CLO 15	Apply different laws of radiation to understand the phenomenon behind production of light.	PO 1 , PO 4	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3	2											1		
CLO 2	2			2									1		
CLO 3	3			1									1		
CLO 4	1	3													
CLO 5	3	2													
CLO 6	3	2											1		
CLO 7	2			1									1		
CLO 8		2		1											
CLO 9		1		1									1		
CLO 10	3	2											1		
CLO 11	2			1											
CLO 12	3	2											1		
CLO 13	2			1											
CLO 14		1		2									1		
CLO 15	3			2											

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1,PO 2	SEE Exams	PO 1,PO 4	Assignments	PO 4	Seminars	PO 2
Laboratory Practices	PO 1,PO 2	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO 4						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

UNIT-I	CRYSTALLOGRAPHY AND CRYSTAL STRUCTURES
Crystallography and crystal structures: Space lattice, unit cell, lattice parameters, crystal systems, Bravais lattices, directions and planes in crystals, Miller indices, interplanar spacing of orthogonal crystal systems, atomic radius, coordination number and packing factor of SC, BCC, FCC, NaCl and diamond structures.	
UNIT-II	**X-RAY DIFFRACTION AND DEFECTS IN CRYSTALS**
X-ray diffraction: Bragg's law, Laue method, powder method and applications; Defects in crystals: Concepts of point defects, vacancies, substitutional, interstitial, frenkel, schottky defects, line defects and Burger's vector.	
UNIT-III	**LASERS AND SENSORS**
Lasers: Characteristics of lasers, spontaneous and stimulated emission of radiation, metastable state, population inversion, lasing action, ruby laser, semiconductor diode laser and applications of lasers. Sensors: Introduction, basic principles, sensor materials and applications: principle of pressure, optical, acoustic and thermal sensing.	
UNIT-IV	**FIBER OPTICS**
Fiber optics: Principle and construction of an optical fiber, acceptance angle, numerical aperture, types of optical fibers (Single mode, multimode, step index, graded index), attenuation in optical fibers, application of optical fibers and optical fiber communication system with block diagram.	
UNIT-V	**INTERFERENCE AND DIFFRACTION**
Interference: Phase difference, path difference, coherence, conditions for constructive and destructive interference, interference in thin films due to reflected light, Newton rings experiment. Diffraction: Introduction, differences between interference and diffraction, types of diffraction, Fraunhofer diffraction due to single slit, N-slits, diffraction grating experiment.	
Text Books:	
1. V. Rajendran, "Engineering Physics", Tata Mc Graw Hill Book Publishers, 1st Edition, 2010. 2. Dr. K. Vijaya Kumar, Dr. S. Chandralingam, "Modern Engineering Physics", S. Chand & Co., New Delhi, 1st Edition, 2010.	
Reference Books:	
1. P. K. Palanisamy, "Engineering Physics", Scitech Publishers, 4th Edition, 2014. 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.	

XIV. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Acquire knowledge of basic terms related to crystal structures.	CLO 2	T1:13.5 R1:1.3
2	Discuss different crystal systems.	CLO 2	T1:13.5 R1:1.3
3	Identify and sketch various planes in the crystal using the	CLO 3	T1:13.5 R1:1.3

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
	Miller indices concept.		
4	Derive and calculate the distance between two adjacent parallel planes.	CLO 3	T1:14.7 R1:3.4
5	Determine co-ordination Number and packing Factor of SC structure.	CLO 3	T1:15.7 R1:4.10
6	Determine co-ordination Number and packing Factor of BCC structure.	CLO 3	T1:16.8 R1:4.15
7	Determine co-ordination Number and packing Factor of FCC structure.	CLO 3	T1:16.9 R1:5.4
8	Determine co-ordination Number and packing Factor of DC structure.	CLO 3	T1:17.9 R1:5.8
9	Discuss in detail NaCl structure.	CLO 2	T1:18.10 R1:6.8
10	Analyze the concept of X-ray diffraction in crystals using Bragg's law.	CLO 4	T1:19.10 R1:6.13
11	Apply Bragg's law to Laue method.	CLO 4	T1:19.9 R1:7.5
12	Determine crystal structure using powder method and discuss its applications.	CLO 4	T1:23.10 R1:7.5
13	Illustrate point defects like vacancies, substitutional and interstitial defects.	CLO 5	T1:23.10 R1:8.1
14	Recall basics of Frenkel and Schottky defects.	CLO 5	T1:23.1 R1:9.2
15	Understand the concept of edge dislocation.	CLO 5	T1:23.1 R1:9.4
16	Understand the concept of screw dislocation..	CLO 5	T1:23.1 R1:9.9
17	Find the magnitude of Burger's vector.	CLO 5	T1:23.1 R1:9.10
18	Apply Bragg's law for finding parameters related to crystal structures.	CLO 5	T2:27.5 R1:10.2
19	Review basic phenomena's of laser	CLO 6	T2:27.7 R1:11.3
20	Acquire knowledge of basic terms related to lasers	CLO 6	T2:27.8 R1:11.6
21	Explain the construction of ruby laser	CLO 6	T2:27.12 R1:11.7
22	Explain the working of Ruby laser	CLO 7	T1:19.9 R1:7.5
23	Explain the principle and working of semiconductor diode laser and also Discuss the uses of lasers.	CLO 7	T1:23.10 R1:7.5
24	Understand the basic principle in sensors.	CLO 8	T1:23.10 R1:8.1
25	Analyze different sensing materials.	CLO 8	T1:23.1 R1:9.2
26	Recognize functioning of sensors in different fields.	CLO 8	T1:23.1 R1:9.4
27	Recognize functioning of sensors in different fields.	CLO 9	T1:23.1 R1:9.9
28	Recall the principle of fiber optics.	CLO 10	T1:23.1 R1:9.10
29	Derive relation for acceptance angle.	CLO 10	T2:27.5 R1:10.2

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
30	Calculate numerical aperture.	CLO 10	T2:27.20 R2:14.5
31	Classify optical fibers based on modes.	CLO 11	T2:30.19 R2:14.5
32	Classify optical fibers based on the refractive index profile.	CLO 11	T2:30.20 R2:15.5
33-34	Identify losses in fibers.	CLO 11	T2:32.19 R2:16.5
35-37	Examine the application of fibers.	CLO 12	T2:32.20 R2:16.5
38	Understand optical fiber communication system.	CLO 12	T2:33.1 R2:16.6
39-41	Solve problems in optical fibers.	CLO 12	T2:34.1 R2:17.1
42-43	Recall the basic principle of interference.	CLO 13	T2:35.1 R2:17.1
44-45	Describe interference in thin films.	CLO 13	T2:36.1 R2:18.1
46-48	Demonstrate the formation of Newton rings.	CLO 13	T2:38.19 R2:16.5
49	Demonstrate the formation of Newton rings.	CLO 14	T2:39.19 R2:16.5
50-53	Understand the phenomenon of diffraction.	CLO 14	T2:40.19 R2:16.5
54-55	Examine Fraunhofer diffraction due to single slit	CLO 14	T2:41.19 R2:16.5
56-57	Examine Fraunhofer diffraction due to single slit	CLO 15	T2:42.19 R2:16.5
58-59	Examine Fraunhofer diffraction due to N slits.	CLO 15	T2:42.19 R2:16.5
60	Identify Diffraction grating experiment	CLO 15	T2:42.19 R2:16.5

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	To improve standards and analyze the concepts.	Seminars	PO 1	PSO 1
2	Conditional probability, Sampling distribution, correlation, regression analysis and testing of hypothesis	Seminars / NPTEL	PO 4	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 2	PSO 1

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