Course Handout		
1	**Course details**	
	Course Coordinator	**DR.ANIS AHMAD**
	Faculty Name	**Dr. Sanjeev Kumar**
	Programme	B.Tech.
	Semester	II, Winter- 2021-22
	Section	**14**
	Course code	BBS01T1002
	Course Name	SEMICONDUCTOR PHYSICS
2	**Vision of the School of Computing Science and Engineering**	
	To be known globally as a premier school for value-based education, multidisciplinary research and innovation	
3	**Mission of the School of Computing Science and Engineering**	
	1. Create a strong foundation on fundamentals of SCSE through OB-TLP 2. Establish state-of-the-art facilities for Analysis, Design and Implementation to develop sustainable ethical solutions 3. Conduct multidisciplinary research for developing innovative solutions 4. Involve the students in group activity including that of professional bodies to develop leadership and communication skills.	
4	**Programme educational objectives (PEOs)**	
	PEO1	Graduates of Computer Science and Engineering will be globally competent and provide sustainable solutions for interdisciplinary problems as team players.
	PEO2	Graduates of Computer Science and Engineering will engage in professional activities with ethical practices in the field of Computer Science & Engineering to enhance their own stature to contribute society.
	PEO3	Graduates of Computer Science and Engineering will acquire specialize knowledge in trending technologies for research, innovation and product development.
5	**Programme outcomes**	
	PO1	Engineering knowledge
	PO2	Problem analysis
	PO3	Design & Development of Solutions
	PO4	Investigation of Problem
	PO5	Modern tool usage
	PO6	Engineer and society
	PO7	Environment& sustainability
	PO8	Ethics
	PO9	Individual & team work
	PO10	Communication
	PO11	Project management & finance
	PO12	Lifelong learning
6	**Programme specifics outcome (PSO) (if any) -**	

	PSO1	To train students in trending technologies like Machine Learning, Artificial Intelligence, and Augmented reality.
	PSO2	To develop insights for problem solving in Data Analytics and Ubiquitous Computing.
7	**Course outcomes (COs):** After the completion of this course, students will be able to:	
	CO1	Identify the energy band in solids and electron occupation probability
	CO2	Understand the physics of semiconductor and develop the ability to choose the appropriate semiconductor for engineering applications
	CO3	Apply the knowledge of diode to the development of new and novel optoelectronic devices
	CO4	Utilize the knowledge of the low dimensional/ nano materials for engineering applications and understand the basic characterization techniques
	CO5	Apply the knowledge of physics to determine the physical quantities/ constants, diode characteristics using experimental set up and analyses the results with maximum accuracy.

8	**Evaluation Component**	**Duration**	**Marks**	**Date &Time**	**Nature of Component**	Scale down Marks
	CAT-1	90 mins	30	As per Academic Calendar	Closed Book	15
	CAT-2	90 mins.	30	As per Academic Calendar	Closed Book	
	CAT-3 / Presentation (Seminar/mini-project/poster)	5 -15 minutes/ student	30	As per Academic Calendar	Open Book	
	(IA-1 to IA-4) Quiz / Assignments / surprising tests. etc.	10-20 mins for each	4 x 5 = 20	As per Academic Calendar	Closed Book	10
	IA-5	During the session	5	During the session	Co-Curricular Activity	
	IA-6	During the session	5	During the session	Extra-Curricular Activity	
	End Term Examination (ETE)	180 mins.	50	As per Academic Calendar	Closed Book	25
	Practical -IA (IA-1 to IA-5)	(Two Hours)	50	During lab class	Based on performance	25

		/ Per experiment				
	Practical-ETE	One experiment and viva-voce	15+10=25	As per Academic Calendar	By External Examination	25
9	List of teaching –learning pedagogy White board and class discussion/ PPTs presentation					
10	Open hour for students: Monday: 3.00P.M -5.00 PM					
11	Link address for course materials: http://lms.galgotiasuniversity.edu.in/my/					
12	Recommended list of e-books: None					
14	Recommended list of mini projects / projects/ technical training etc: None					
15	Students' Presentation: As per schedule					
16	List of e-books: None					
17	List of NPTEL/MOOCS/SWAYAM/Courses/Video: **Swayam- https://swayam.gov.in/** **NPTEL- https://onlinecourses.nptel.ac.in/**					
18	Content beyond Syllabus: Basic postulates of quantum mechanics					
19	List of mini projects/projects: None					

	Detail academic calendar of lecture topics					
Lecture No.	**Date**	**Topics to be covered**	**Learning outcomes of each topic**	**Related Unit of syllabus**	**Total lecture in the Unit**	**Reference Chap./Sec. (Book)**
1.		Brief Introduction to the Course including its importance to the students in their future career & applications in the profession, Evaluation/Grading pattern, Review (Preliminary topics), Name of Text Books and Reference Books etc.	Overview of course	Unit - 1	06	Course handout
2.		Quantum free electron theory , Fermi Dirac distribution function and Fermi level- part I	free electron theory			Chapter 6 of T5
3.		Quantum free electron theory , Fermi Dirac distribution function and Fermi level- part I	Fermi Dirac distribution function and Fermi level			Chapter 6 of T5
4.		Density of states	Density of states			Chapter 6 of T5
5.		Energy band in solids	Energy band in solids			Chapter 6 of T5
6.		E-K diagram and Brillouin zone,	Brillouin zone			Chapter 6 of T5
7.		Effective mass and concept of holes.	Effective mass			Chapter 6 of T5

8.		Types of semiconductor (Intrinsic and extrinsic) Fermi level in semiconductor	semiconductor types	**UNIT 2**	07	Chapter 2 of T2
9.		Effect of carrier concentration and temperature on fermi level	Effect of carrier concentration and temperature on fermi level			Chapter of T2
10.		Direct-indirect band gap semiconductors	direct-indirect band gap semiconductors			Chapter of T2
11.		compound semiconductors	compound semiconductors			Chapter2 of T2
12.		Conductivity and mobility	Conductivity and mobility			Chapter 2of T2
13.		Hall effect and applications	Hall effect			Chapter 10 of T5
14.		Concept in optical transitions in bulk semiconductors	Optical transitions	UNIT 3	09	Chapter4 of T2
15.		recombination process,	recombination process,			Chapter4 of T2
16.		Absorption and emission-process	Explanation for spontaneous emission-stimulated emission-transition rate			Chapter 4 of T2
17.		Theory of pn junction	p-n junction			Chapter 4 of T2
18.		Biasing of PN –Junction	p-n junction			Chapter 4 of T2

		Diode and V-I characteristics				
19.		optoelectronics devices-LEDs	LEDs			Chapter 9 of T2
20.		laser diode	laser diode			Chapter 9 of T2
21.		Basics of Photovoltaics-photovoltaic effect	Photovoltaics			Chapter of 9 T2
22.		Determination of efficiency of PV cell	Photovoltaics			Chapter 9 of T2
23.		Density of states in 2D – Quantum well	Quantum well	UNIT 4	08	Chapter 9 of T3
24.		Density of states in 1D (Quantum wire) and 0D (Quantum dots)	Quantum wire and Quantum dots			Chapter 9 of T3
25.		Nanomaterials and its properties, Classification of Nanomaterials.	Nanomaterials			Chapter 9 of T3
26.		Carbon nanowires and nanotubes	Carbon nanowires and nanotubes			Chapter 9 of T3
27.		Semiconductor nanomaterials	Semiconductor nanomaterials			Chapter 9 of T3
28.		Graphene	Semiconductor nanomaterials			Chapter 9 of T3

29.		Characterization techniques (basic ideas): Scanning Electron Microscopy	SEM			Chapter 3 of T3
30.		Transmission Scanning Electron Microscopy	TSEM			Chapter 3 of T3

Course Objectives:

1. To prepare students with fundamental knowledge of semiconductor physics.
2. To develop skills necessary for higher-level science and engineering courses

Text Books

1. J. Singh , Semiconductor optoelectronics, Physics and Technology, Mc-Graw –Hill Inc. 1995.
2. S.M. Sze, Semiconductor Devices: Physics and Technology, Wiley 2008.
3. Introduction to Nanotechnology C P Poole, Frank J. Owens, John Wiley & Sons, 2011, ISBN 978-81-265-1099-3.
4. B.Sc. Practical Physics by C.L Arora , S. Chand Limited.
5. S.O. Pillai , Solid State Physics, , New Age International (P) Ltd. Sixth edition ISBN-9788122427264 (2010).

Reference Books

6. B.E.A. Saleh and M.C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., 2007.
7. Introduction to Nanoscience and Nanotechnology, KK Chattopadhyay, A N Banerjee, Phi Learning Pvt Ltd., New Delhi, 2012, ISBN-978-81-203-3608-7.
8. Nanotechnology Science Innovation & Opportunity, Lynn E Foster, Pearson publication, 2008, ISBN-9788131711187.
9. Nouredine Zettili, Quantum Mechanics: concepts and applications, 2nd Edition, Wiley, UK, 2009
10. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House

CONTENTS

Unit 1 Quantum and Band Theory of electron 6 hrs
Quantum free electron theory, Fermi Dirac distribution function and Fermi level, density of states, Energy band in solids, E-K diagram and Brillouin zone, effective mass, concept of holes.
Unit 2 Semiconductor 8 hrs
Types of semiconductor, Fermi level in semiconductor, effect of carrier concentration and temperature on fermi level, direct-indirect band gap semiconductors, compound semiconductors, Conductivity and mobility, recombination process, Hall effect and applications.
Unit 3 Applications of Diodes 8 hrs
Concept in optical transitions in bulk semiconductors- absorption process, recombination process, explanation for spontaneous emission-stimulated emission-transition rate, theory of p-n junction, p-n junction diode and its I-V characteristics, optoelectronics devices-LEDs, laser diode, Basics of Photovoltaics- photovoltaic effect, Determination of efficiency of PV cell
Unit- 4 Low Dimension Physics and Nanomaterials 10 hrs
Density of states in 0D, 1 D and 2D –Low dimensional systems: Quantum well, Quantum wire, Quantum dots, Nanomaterials and its properties, Classification of Nanomaterials, Carbon nanowires and nanotubes, Semiconductor nanomaterials, Graphene, Characterization techniques (basic ideas): Scanning Electron Microscopy and Transmission Scanning Electron microscopy

Continuous Assessment Pattern:

Mode/ Category	Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks (100)
Theory	10	15	25	50
Practical / Laboratory	25	-	25	50

Course Outcomes: After the completion of this course, students will be able to:

CO1	Identify the energy band in solids and electron occupation probability
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CO4	Utilize the knowledge of the low dimensional/ nano materials for engineering applications and understand the basic characterization techniques
CO5	Apply the knowledge of physics to determine the physical quantities/ constants, diode characteristics using experimental set up and analyses the results with maximum accuracy.

Course outcomes (COs) and Program Outcome (POs) Mapping for the course

		Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low											
1	COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	2	2		-	-	-	-	-	-	-	--	-
	CO2	3	2	-	-	-	-	-	-	-	-	-	-
	CO3	3	2	-		-	-	-	-	--	-	-	-
	CO4	3	2	-	-	-	-	--	-	-	-	-	-
	CO5	3	2		-	-	-	-	-	3	-	-	-
3	Category	Basic Sciences (BS)											
4	Approval												

Compliance report

School of Basic and Applied Sciences							
Programme	**B.Tech**						
Programme Chair							
Compliance report of course handout							
Sl No	**Course code**	**Course title**	**Section**	**Taught by faculty**	**Course coordinator**	**Course handout Submission date**	**Remarks by PC if any**
1.	**BBS01T1002**	SEMICONDUCTOR PHYSICS		**DR. SANJEEV KUMAR**	**Dr Anis Ahmad**	**08/03/2022**	

Signature of PC; **Signature of Dean:**

Review by IQAC: