Scheme of Examination B.E. First year (All Branches of Engineering)

Second Semester

Sub Code	Subjects	Workload in hrs			Credits	Marks					Minimum Passing Marks	
		L	T/A	P		Theory		Practical		Total		
						Internal	Uni	Internal	Uni		Theory	Practical
BSE2-1T	Mathematics-II	3	1	-	4	30	70	-	-	100	45	-
BSE2-2T	Advanced Engineering Materials	2	2	-	3	30	70	-	-	100	45	-
BSE2-3T	Applied Chemistry	3	2	-	4	30	70	-	-	100	45	-
BSE2-4T	Computational Skills	2	-	-	2	15	35	-	-	50	23	-
BSE2-6T	Basics of Electrical Engineering	2	-	-	2	15	35	-	-	50	23	-
BSE2-7T	Engineering Mechanics	2	-	-	2	15	35	-		50	23	-
BSE2-8T	Indian Culture & Constitution	2	-	-	Audit	50	-	-	-	Audit	-	-
BSE1-5P	Workshop Practices	-	-	4	2	-	-	50	50	100	-	50
BSE2-2P	Advanced Engineering Materials	-	-	2	1	-	-	25	25	50	-	25
BSE2-3P	Applied Chemistry			3	1.5	-	-	25	25	50	-	25
BSE2-4P	Computational Skills			2	1	-	-	25	25	50	-	25
Three weeks Induction Program												
	Total	**16**	**5**	**11**	**22.5**	**135***	**315**	**125**	**125**	**700**		

- L- Lecture , P-Practical, T- Tutorial, A- Activity (Half Credit per Hour)

* Audit course marks are not counted in total marks

Guidelines

- Energy and Environment shall be taught by faculty of Chemistry and will come under board of Applied Science and Humanities (only by Chemistry Dept)
- Advance Engineering Materials shall be taught by faculty of Physics and will come under board of Applied Science and Humanities (only by Physics Dept)

B.Tech. Semester II Advanced Engineering Materials (Total Credits 3)

Teaching Scheme **Examination Scheme**

Lectures: 2 Hours/Week Theory, **T(U): 70 Marks T(I): 30 Marks**

Tutorial/Activity: 2 Hours/week **Duration of University Exam: 3 Hours**

Unit - 1: Band theory of solids (6 Hrs) 14 Marks

Basic idea of free electron theory of metals, expression of conductivity of a metal. Formation of energy bands in Solids, Fermi energy and Fermi level.

Classification of solids on the basis of energy band diagram: Conductors, Semiconductors and Insulators, concept of Fermi energy.

Unit-2: Semiconductor Devices (7 Hrs) 14 Marks

Types of Semiconductor diodes, P-N junction Diode: Characteristics of P-N junction Diode, Tunnel Diode, Zener Diode, LED, Photodiode.

Transistors . Hall effect, Hall voltage and Hall coefficient; its applications,

Unit 3: Magnetic and Superconducting Materials (10 Hrs) 14 Marks

Diamagnetic, Paramagnetic, Ferromagnetic, Ferri-magnetic and anti ferromagnetic materials: Explanation on the basis of domain. Hysteresis curve, Characteristics of ferromagnetic, diamagnetic and paramagnetic materials and their applications.

Superconductors: Basics of superconductivity: Zero electrical resistance, Persistent current Effect of Temperature, Effect of Magnetic Field, Critical Current; The Meissner Effect.Type-I and type-II superconductors, London Equation: The penetration depth, Bardeen-Cooper-Schrieffer (BCS) theory.

Unit 4: Lasers (7 Hrs) 14 Marks

Quantum Transitions: Absorption, Spontaneous emission & stimulated Emission, Metastable states, Principle of laser, Laser characteristics, Coherence length and coherence time, Pumping schemes: Three level and Four level.

Optical Resonator, Construction & working of Ruby laser and He-Ne laser, Applications of laser.

Unit 5: Nanoscience and Nanomaterials (6 Hrs) 14 Marks

Introduction to Nanoscience, Classification of nano materials, Types of Synthesis of Nanomaterials, Comparison of properties of nanomaterials with bulk materials,

Some special nanomaterials: 1) Zeolites, 2) Graphine, Application of nanomaterials in engineering.

Course Outcomes

Students will be able to

CO1. Learn the concept of formation of energy bands and to classify solids on its basis.

CO2. Identify and explain different types of diodes, transistors and its applications

CO3. Learn the concepts of magnetism and superconductivity, classify and analyze various types of magnetic and superconducting materials.

CO4. Learn and explain quantum transitions and apply it to working of lasers.

CO5. Learn the concept of nano materials and compare its properties with those of bulk materials.

Suggested Text Books &Reference Books

1. *Solid state Physics, S. O. Pillai, New Age publications.*
2. *Charles Kittel, Introduction to Solid State Physics, Wiley Eastern, 5th edition,(1983).*
3. *A.J. Dekker Electrical Engineering Materials, Prentice Hall of India(1971).*
4. *Fundamentals of Physics by D. Halliday, R. Resnick and J. Walker, John Wiley and Sons Inc.*
5. *K. Thyagarajan and A. K. Ghatak, Lasers Theory and Applications, Mcmillan(1981).*
6. *A textbook of Engineering Physics, Dr. M. N. Avdhanulu, Dr. P. G. Kshirsagar, S. Chand Publication*
7. *A text Book of Advanced Engineering Materials, Dr. D. S. Hardas, , Dr.S.Shastri, Dr. (Mrs)S.P. Wankhede, Dr. D. S. Bhoumik, Dr.(Mrs.)S.U.Bhonsule, Dr.Shruti Patle, , Das Ganu Publication ISBN-978-93-84336-70-7 (2021)*
8. *A text Book of Advanced Physics, Dr. D. S. Hardas, Dr.A. R. Panat , Das Ganu Publication ISBN-978-93-81660-49-2 (2013)*
9. *Advanced physical science for Engineers, Dr. S. Patle, Dr. S. U. Bhonsule, Dr. N. Ugemuge, Dr. S. P. Wankhede, DNA publication*
10. *Advanced Engineering Materials, M. N. Avdhanulu, Shilpa A. Pande, Arti R. Golhar, Mohan Giriya, S. CHAND*
11. *W. Saslow, Electricity, Magnetism and light.*
12. *Solid state Physics by R. L. Singhal, Kedarnath Ramnath & Co.Meerut*
13. *Introduction to Lasers Theory and Applications by M. N. Avadhanulu, S. Chand and Company*
14. *Engineering Physics by P. K. Palaniswamy, Scitech(2005)*
15. *Engineering Physics by H. Malik and A. K. Singh,TMH(2010)*
16. *Engineering Physics by D. K. Bhattacharya and A. Bhaskaran, Oxford University Press (2010)*
17. *Materials Science and Engineering- A First course by V. Raghavan, PHILearning*

List of Activities

1. Study of band gap of various semiconducting materials.
2. Variation of Fermi energy with respect to various parameters.
3. Identification of N-type & P-type semiconductor on virtual lab.
4. Testing of resistor, transistor, diode, capacitor with the help of multimeter / CRO.
5. Compare Cut-in-voltages of various LEDs.
6. Study of lines of force using bar magnet & iron fillings.
7. Gather information about Maglev train.
8. Write up on History of superconductivity.
9. Study of application of superconductor.
10. Measure the divergence of various sources of light such as torch, laser, tubelight, etc.
11. Understanding the phenomenon of stimulated emission, absorption & stimulated emission.
12. Laser applications in day to day life.
13. Collect information about Holography.
14. Write short note on Discovery of nano materials
15. Applications of nano materials.
16. Industrial Visit

Note : Performance of at least one activities is compulsory in a semester.

B. E. Semester II Advanced Engineering Materials (Practical)

(Total Credits: 1)

Teaching scheme **Examination Scheme**

Lectures: 2 hrs/Week **P(I): 25 Marks P(U) : 25 Marks**

List of Experiments

1. Energy gap of semiconductor /thermistor
2. Parameter extraction from V-I characteristics of PN junction diode.
3. Parameter extraction from V-I characteristics of Zener diode.
4. Parameter extraction from V-I characteristics of PNP/NPN transistor in CB and CE mode.
5. V-I Characteristics of Tunnel diode.
6. V-I Characteristics of Light Emitting Diodes.
7. Study of Diode rectification.
8. Study of Hall Effect and determination of Hall Voltage of given sample.
9. Variation of Hall coefficient (R_H) with temperature.
10. To study B-H curve and to find out the values of coercivity, retentivity and saturation magnetisation of experimental material.
11. Laser source: Determination of wavelength by diffraction grating.

Note: Performance of at least **six** experiments is compulsory in a semester.

Scope of the syllabus

Second Semester: Advanced Engineering Materials

Unit - 1: Band theory of solids

Free electron theory in metals; Derivation for expression of conductivity of a metal, drift velocity, Band theory of solids, Energy Bands, Energy Gap, classification of solids, Fermi function and its variation with temperature; Detailed discussion of relative positions of conduction band and valence band in conductor, insulator and semiconductor.

Concept of effective mass, Semiconductors: Intrinsic and Extrinsic Semiconductors, conduction process in Semiconductors, Energy band diagrams of Intrinsic and Extrinsic Semiconductors at T=0K and T> 0K, expression for fermi energy in Intrinsic Semiconductors without derivation,

Unit-2: Semiconductor Devices

P-N junction Diode, Unbiased, forward biased & reversed biased mode, Transistor action, Hall effect, Hall Coefficient , Characteristics of Tunnel Diode, Zener Diode, LED,Photodiode

Unit 3: Magnetic and Superconducting Materials

Introduction to magnetic materials, magnetic field, magnetic dipole moment, magnetic induction, magnetization, magnetic susceptibility, magnetic permeability, classification of magnetic materials (diamagnetic, paramagnetic, ferromagnetic), domain hypothesis, B-H curve , antiferromagnetic, ferrimagnetism, Applications: Alnico and magnetic storage

Introduction to superconductivity: Zero electrical resistance, Persistent current Effect of Temperature, Effect of Magnetic Field, Critical Current; The Meissner Effect, Type-I and type-II superconductors, London Equation: The penetration depth, Bardeen-Cooper-Schrieffer (BCS) theory.

Unit 4: Lasers

Meaning of coherence length of laser, expression for coherence length and coherence time, Laser Emission, Lasing action, optical resonant cavity: Construction and its role in LASERS, three and four level pumping scheme, Laser characteristics: Directionality, Divergence, Intensity, Coherence, Monochromaticity.

Unit 5: Nanoscience and Nanomaterials

Introduction to nanoscience, Classification of nano materials, Types of Synthesis of Nanomaterials, Reasons for drastic changes in properties at nanoscale,Comparison of properties of nanomaterials with bulk materials, Some special nanomaterials: 1) Zeolites, 2) Graphine, Applications of nanomaterials in engineering.