Academic Course Description

BHARATH UNIVERSITY

Faculty of SCIENCE AND HUMANITIES

Department of PHYSICS

FIRST Semester, 2015-16 (EVEN Semester)

Course (catalog) description

This course

Understand about properties and advancements of conducting materials.
Understand the principle and properties semiconducting materials.
Acquire Knowledge on magnetic and Super Conducting materials
Acquire Knowledge on dielectric materials
To Understand the impact of Advanced Engineering materials in technical uses

Compulsory/Elective course: Elective course

Credit hours : 3 credits

Course Coordinator : Dr.R.Velavan Associate Professor

Instructors :

Name of the instructor	Class handling	Office location	Office phone	Email (domain:@ bharathuniv.ac.in	Consultation
Faculties of Physics Department	First year	First year Block		Hod.physics@bharathuniv.ac.in	9.00-9.50 AM

Relationship to other courses:

Pre –requisites **:** +2 level Physics

Assumed knowledge : The students will have a physics and mathematics background obtained at a higher secondary (or equivalent) level.

Syllabus Contents

UNIT I: CONDUCTING MATERIALS: 9

Conductors – classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.

UNIT II: SEMICONDUCTING MATERIALS: 9

Intrinsic semiconductor – carrier concentration derivation Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – compound semiconductors -direct and indirect band gap-derivation of carrier concentration in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration –– Hall effect –Determination of Hall coefficient – Applications.

UNIT III: MAGNETIC AND SUPERCONDUCTING MATERIALS: 9

Origin of magnetic moment – Bohr magneton – comparison of Dia, Para and Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – antiferromagnetic materials – Ferrites and its applications Superconductivity : properties – Type I and Type II superconductors – BCS theory of superconductivity(Qualitative) - High Tc superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

UNIT IV: DIELECTRIC MATERIALS: 9

Electrical susceptibility – dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – internal field – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – uses of dielectric materials (capacitor and transformer) – ferroelectricity and applications.

UNIT V: ADVANCED ENGINEERING MATERIALS: 9

Metallic glasses: preparation, properties and applications. Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, Nanomaterials– Preparation -pulsed laser deposition – chemical vapour deposition – Applications – NLO materials –Birefringence- optical Kerr effect – Classification of Biomaterials and its applications.

TOTAL PERIODS: 45

OUTCOMES:

The students will have the knowledge on physics of materials and that knowledge will be used by them in different engineering and technology applications.

TEXT BOOKS:

1. Jayaraman D Engineering Physics II. Global Publishing House ,2014.
2. Palanisamy P.K. Materials Science. SCITECH Publishers, 2011.
3. Senthilkumar G. Engineering Physics II. VRB Publishers, 2011.

REFERENCES:

1. Arumugam M., Materials Science. Anuradha publishers, 2010
2. Pillai S.O., Solid State Physics. New Age International(P) Ltd., publishers, 2009
3. Marikani A. Engineering Physics. PHI Learning Pvt., India, 2009
4. http://ocw.mit.edu/courses/find-by-topic
5. http://nptel.ac.in/course.php?disciplineId=122
6. https://en.wikipedia.org/wiki/Engineering_physics

Computer usage: Yes

Professional component

General	-	10%
Basic Sciences	-	80%
Engineering sciences & Technical arts	-	10%
Professional subject	-	0%

Broad area : Conducting Materials, Semiconducting Materials, Magnetic and Superconducting Materials, Dielectric Materials and Advanced Engineering Materials

Test Schedule

S. No.	Test	Tentative Date	Portions	Duration
1	Cycle Test-1	February 2nd week	Session 1 to 14	2 Periods
2	Cycle Test-2	March 2nd week	Session 15 to 28	2 Periods
3	Model Test	April 2nd week	Session 1 to 45	3 Hrs
4	University Examination	TBA	All sessions / Units	3 Hrs.

Mapping of Instructional Objectives with Program Outcome

To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology. This course emphasizes:	Correlates to program outcome		
	H	M	L
Understand about properties and advancements of conducting materials.	a,e	g.i	k
Understand the principle and properties semiconducting materials.	c	e,j	b.h
Acquire Knowledge on magnetic and Super Conducting materials	d	b	i
Acquire Knowledge on dielectric materials	a	c,m	d,f
To Understand the impact of Advanced Engineering materials in technical uses		g	b,c

H: high correlation, M: medium correlation, L: low correlation

Draft Lecture Schedule

Session	Topics	Problem Solving (Yes/No)	Text / Chapter
Unit -I : Conducting Materials			
1.	Conductors - Introduction	No	[T1] Chapter -1,
2.	classical free electron theory of metals	No	
3.	Electrical conductivity	Yes	
4.	Thermal conductivity	Yes	
5.	Wiedemann – Franz law – Lorentz number	Yes	
6.	Draw backs of classical theory	No	
7.	Quantum theory , Fermi distribution function	Yes	
8.	Density of energy states	Yes	
9.	Carrier concentration in metals.	Yes	

Unit Ii: Semiconducting Materials			
10.	Intrinsic semiconductor– Introduction	No	[T1] Chapter -2
11.	carrier concentration derivation	Yes	
12.	Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination	Yes	
13.	compound semiconductors -direct and indirect band gap	No	
14.	Derivation of carrier concentration in n-type semiconductor	Yes	
15.	Derivation of carrier concentration in p-type semiconductor	Yes	
16.	variation of Fermi level with temperature and impurity concentration	Yes	
17.	Hall effect –Determination of Hall coefficient	No	
18.	Hall effect - Applications	No	
Unit Iii: Magnetic And Superconducting Materials			
19.	Origin of magnetic moment – Bohr magneton -Introduction	No	[T1]Chapter-3 &4
20.	comparison of Dia, Para and Ferro magnetism	No	
21.	Domain theory	No	
22.	Hysteresis – soft and hard magnetic materials	No	
23.	Anti ferromagnetic materials – Ferrites and its applications	No	
24.	Superconductivity : properties	Yes	
25.	Type I and Type II superconductors, BCS theory of superconductivity	No	
26.	High T_c superconductors	No	

27.	Applications of superconductors – SQUID, cryotron, magnetic levitation.	No	
Unit Iv: Dielectric Materials			
28.	Electrical susceptibility – dielectric constant	No	[T1]Chapter-5
29.	Electronic, ionic polarization	Yes	
30.	orientational and space charge polarization	Yes	
31.	Frequency and temperature dependence of polarization	No	
32.	Internal field	Yes	
33.	Claussius – Mosotti relation (derivation)	Yes	
34.	Dielectric loss – dielectric breakdown	No	
35.	Uses of dielectric materials (capacitor and transformer)	No	
36.	Ferro electricity and applications.	No	
Unit V: Advanced Engineering Materials			
37.	Metallic glasses: preparation	No	[T1] Chapter 6, 7
38.	Metallic glasses -properties and applications	No	
39.	Shape memory alloys (SMA): Characteristics	No	
40.	Shape memory alloys (SMA): properties of NiTi alloy, applications	No	
41.	Nanomaterials– Preparation -pulsed laser deposition – chemical vapour deposition	No	
42.	Nanomaterials– Applications	No	
43.	NLO materials –Birefringence- optical Kerr effect	No	
44.	Classification of Biomaterials	No	
45.	Applications - Biomaterials	No	

Teaching Strategies

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Laboratory sessions, which support the formal lecture material and also provide the student with practical construction, measurement and brainstorming skills.
- Small periodic quizzes, to enable you to assess your understanding of the concepts.

Evaluation Strategies

Cycle Test – I	-	10%
Cycle Test – II	-	10%
Model Test	-	25%
Attendance	-	5%
Final exam	-	50%

Addendum

ABET Outcomes expected of graduates of B.Tech / ECE / program by the time that they graduate:

Engineering Graduate will have

a)an ability to apply knowledge of mathematics, science, and engineering fundamentals.

b)an ability to identify, formulate, and solve engineering problems

c)an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

d)an ability to design and conduct experiments, as well as to analyze and interpret data

e)an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

f)an ability to apply reasoning informed by a knowledge of contemporary issues

g)an ability to broaden the education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

h) an ability in understanding of professional and ethical responsibility and apply them in engineering practices

i) an ability to function on multidisciplinary teams

j) an ability to communicate effectively with the engineering community and with society at large

k) an ability in understanding of the engineering and management principles and apply them in Project and finance management as a leader and a member in a team.

Program Educational Objectives

PEO1: PREPARATION:

To provide strong foundation in mathematical, scientific and engineering fundamentals necessary to analyze, formulate and solve engineering problems in the field of Electronics And Communication Engineering.

PEO2: CORE COMPETENCE:

To enhance the skills and experience in defining problems in Electronics And Communication Engineering design and implement, analyzing the experimental evaluations, and finally making appropriate decisions.

PEO3: PROFESSIONALISM:

To enhance their skills and embrace new Electronics And Communication Engineering Technologies through self-directed professional development and post-graduate training or education

PEO4: SKILL:

To provide training for developing soft skills such as proficiency in many languages, technical communication, verbal, logical, analytical, comprehension, team building, inter personal relationship, group discussion and leadership skill to become a better professional.

PEO5: ETHICS:

Apply the ethical and social aspects of modern communication technologies to the design, development, and usage of electronics engineering.