NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF PHYSICS

COURSE PLAN – PART I			
Name of the programme and specialization	**II Semester – M.Tech. NDT**		
Course Title	**Electrical, Magnetic and Optoelectronic Materials**		
Course Code	**PH618**	**No. of Credits**	**3**
Course Code of Pre-requisite subject(s)	**NIL**		
Session	**January. 2019**	**Section (if, applicable)**	**NIL**
Name of Faculty	**Dr. M. Dhavamurthy**	**Department**	**Physics**
Official Email	**dhavam@nitt.edu**	**Telephone No.**	**NIL**
Name of Course Coordinator(s) (if, applicable)	**Dr. B. Karthikeyan**		
Official E-mail	**bkarthik@nitt.edu**	**Telephone No.**	**0431-250-3616**
Course Type (please tick appropriately**)**	☐ **Core course**	☐ **Elective course**	

Syllabus (approved in BoS)

Electrical and Dielectric Materials

Review of electrical conduction – discussion on specific materials used as conductors (OFHC, Ag, Al, other alloys) – temperature dependent resistivity of Copper and CuNi alloy – Nordheim rule – CuAu alloy – dielectric phenomena – concept of polarization – effects of composition, frequency and temperature on these properties – discussion on specific materials used as dielectrics (ceramics and polymers) – BaTiO3 – dielectric loss, dielectric breakdown – ferro electricity – piezo and pyro electricity.

Magnetic Materials

Introduction to dia, para, ferri and ferro magnetism – hard and soft magnetic materials – ironsilicon alloys – iron, nickel alloys – ferrites, garnets and LCMO – rare earth alloys – Pt alloys – fine particle magnetism – applications of hard and soft magnetic materials – Giant Magneto Resistance – magnetocaloric effect – spintronics – multiferroics – nanomagnetic materials.

Superconducting and Semiconducting

Materials Concept of super conductivity – theories and examples for high temperature superconductivity – discussion on specific super conducting materials – Nb3Sn – YBCO – MgB2 – Carbon based – comments on fabrication and engineering applications – review of semiconducting materials – concept of doping – simple and compound semiconductors – amorphous semiconductor – oxide semiconductors – organic semiconductor – low dimensional semiconductor – materials for solar cell applications – Hall effect – homojunction – schottky barrier – heterojunction – materials and applications.

Production of Electronic Materials

Binary alloy phase diagram (PbSn and CuNi) – homogeneous and heterogeneous nucleation – methods of crystal growth for bulk single crystals – Czochralski – Bridgman – low and high temperature solution growth – floating zone method - synthesis of epitaxial films by LPE, VPE, PVD, MBE and MOCVD techniques – lithography – production of silicon – applications.

Optical and Optoelectronic Materials

Principles of photoconductivity – simple models – effect of impurities – principles of luminescence – types and materials, Laser Principles – ruby, He-Ne, injection, Nd-YAG and Dye lasers – LED materials – binary, ternary photo electronic materials – Optical storage materials – LCD materials – photo detectors – applications of optoelectronic materials – introduction to optical fibers – light propagation – electro optic effect – electro optic modulators – Kerr effect – Pockel's effect.

COURSE OBJECTIVES

- To review physics and chemistry in the context of materials science & engineering.
- To understand the fundamentals and applications of electrical, magnetic and optical properties of materials.
- Give an introduction to the relation between processing, structure, and physical properties.
- Apply a multi-disciplinary approach to plan, design, identify and address future needs of all the conventional and novel materials utilizing their properties for the society.
- Give the beginning student an appreciation of recent developments in materials science & engineering within the framework of this class.
- Give the beginning student an opportunity for teamwork in research.

MAPPING OF COs with POs

Course Outcomes	**Programme Outcomes (PO)** (Enter Numbers only)
1. Given a type of electrical and dielectric materials, be able to qualitatively describe their general physical properties, as well as possible applications.	**P1, P4, P6**
2. Gain an introduction to the electronic, magnetic properties of bulk and nano-structured materials. Conceptually explain the classification of magnetic materials that are used to categorize engineering materials.	**P1, P4, P6**
3. To develop an understanding of the unique properties and characteristics of magnetic materials.	**P1, P3, P9, P10**
4. Obtain experience in performing in-depth research into a topic in electronic materials and summarizing their findings in written and oral reports.	**P1, P4, P6, P7**
5. Learn the fundamental properties of materials science that will serve as a foundation to understanding the electrical and optical properties of optoelectronic materials.	**P1, P4, P6**

COURSE PLAN – PART II			
COURSE OVERVIEW			
- The Physics- II course (Code: PH-IR12) is offered in the second semester to all the branches of engineering. - The subject has 3 credit theory and 1 credit lab weightage.			
COURSE TEACHING AND LEARNING ACTIVITIES			**(** Add more rows)
S.No.	**Week/Contact Hours**	**Topic**	**Mode of Delivery**
1	14-19 Jan.2019	Review of electrical conduction – discussion on specific materials used as conductors (OFHC, Ag, Al, other alloys) – temperature dependent resistivity of Copper and CuNi alloy.	Chalk & Talk, CD
2	21-25 Jan.2019	Nordheim rule- CuAu alloy-dielectric phenomena – concept of polarization – effects of composition, frequency and temperature on these properties	Chalk & Talk, CD, PPT
3	28-01 Jan.- Feb.2019	Discussion on specific materials used as dielectrics – BaTiO3 – dielectric loss, dielectric breakdown- ferro-electricity – piezo and pyro electricity.	Chalk & Talk, CD, PPT
4	04-08 Feb.2019	Introduction to dia, para, ferri and ferro magnetism – hard and soft magnetic materials – ironsilicon alloys – iron, nickel alloys – ferrites, garnets and LCMO	Chalk & Talk, CD, PPT
5	11-15 Feb.2019	Rare earth alloys – Pt alloys – fine particle magnetism – applications of hard and soft magnetic materials.	Chalk & Talk, CD, PPT
6	18-22 Feb.2019	Giant Magneto Resistance – magneto-caloric effect – spintronics – multiferroics-nanomagnetic materials.	Chalk & Talk, CD, PPT
7	25-01 Feb.-Mar.2019	Materials Concept of super conductivity – theories and examples for high temperature superconductivity – discussion on specific super conducting materials – Nb3Sn – YBCO – MgB2 – Carbon based – comments on fabrication and engineering applications.	Chalk & Talk, CD, PPT
8	04-08 Mar.2019	Review of semiconducting materials – concept of doping – simple and compound semiconductors – amorphous semiconductor – oxide semiconductors – organic semiconductor.	Chalk & Talk, CD, PPT

9	11-15 Mar.2019	Low dimensional semiconductor – materials for solar cell applications – Hall effect – homojunction – schottky barrier – heterojunction – materials and applications.	Chalk & Talk, CD, PPT
10	18-22 Mar.2019	Binary alloy phase diagram (PbSn and CuNi) – homogeneous and heterogeneous nucleation – methods of crystal growth for bulk single crystals.	Chalk & Talk, CD, PPT
11	25-29 Mar.2019	Czochralski – Bridgman - low and high temperature solution growth – floating zone method	Chalk & Talk, CD
12	01-05 Apr.2019	Synthesis of epitaxial films by LPE, VPE, PVD, MBE and MOCVD techniques - lithography - production of silicon - applications.	Chalk & Talk, CD, PPT
13	08-12 Apr.2019	Principles of photoconductivity – simple models – effect of impurities – principles of luminescence – types and materials,	Chalk & Talk, CD
14	15-19 Apr.2019	Laser Principles – ruby, He-Ne, injection, Nd-YAG and Dye lasers. LED materials – binary, ternary photo electronic materials – Optical storage materials.	Chalk & Talk, CD, PPT
15	22-26 Apr.2019	photo detectors – applications of optoelectronic materials – introduction to optical fibers – light propagation electro optic effect – electro optic modulators – Kerr effect – Pockel's effect	Chalk & Talk, CD, PPT

COURSE ASSESSMENT METHODS (shall range from 4 to 6**)**

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Cyclic Test - I	Feb. 2nd Week	60 min	20
2	Quiz/Seminar	Mar. 1st Week	30 min	10
3	Cyclic Test - II	Mar. 4th Week	60 min	20
CPA	Compensation Assessment	Apr. 2nd Week	60 min	20 (or) 10
4	Final Assessment	Apr. 4th Week	180 min	50
Total Marrks				100

COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)

- Asking summary of each class at the end of class.
- Performance in the assessment methods.
- Questionnaire about the effectiveness of the delivery method, topics and the knowledge gained.

COURSE POLICY (including compensation assessment to be specified**)**

MODE OF CORRESPONDENCE (email/ phone etc)

- Both e-mail and phone

COMPENSATION ASSESSMENT POLICY

- It is a test with duration of 60 min. Appropriate weightage (20 or 10) will be calculated.

ATTENDANCE POLICY (A uniform attendance policy as specified below shall be followed)

- At least 75% attendance in each course is mandatory.
- A maximum of 10% shall be allowed under On Duty (OD) category.
- Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' grade.

ACADEMIC DISHONESTY & PLAGIARISM

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.
- The above policy against academic dishonesty shall be applicable for all the programmes.

ADDITIONAL INFORMATION, IF ANY

ESSENTIAL READINGS : Textbooks, reference books, website addresses, journals, etc

1. C. Kittel, Introduction to Solid State Physics, John Wiley and Sons, 7th edition, New Delhi, (2004).
2. A. J. Dekker, Electrical Engineering Materials, Prentice Hall, NJ, (1959).
3. L. H. Van Vlack, Elements of Materials Science and Engineering, Addison –Wesley, 6th edition, New York, (1989)
4. V. Raghavan, Materials Science and Engineering, Prentice Hall of India, 5th edition, New Delhi, (2013).

5. B. G. Yacobi, Semiconductor Materials: An Introduction to Basic Principles, Springer, 1st edition, New York, (2013).
6. S. Kasap and P. Capper (eds.), Handbook of Electronic and Photonic Materials, Springer, New York, (2007).
7. Ed. Charles P. Poole, Jr., Handbook of Superconductivity, Academic Press (2000).
8. Nicola. A. Spaldin, Magnetic Materials: Fundamentals and Applications, 2nd Edn., Cambridge Univ. Press. (2002)

Websites:

1. www.doitpoms.ac.uk/tlplib/dielectrics/index.php
2. nptel.ac.in/course.php

FOR APPROVAL

Course Faculty …… (DS) **CC- Chairperson …….. (DS)** **HOD ……. (DS)**

Guidelines

a) The number of assessments for any theory course shall range from 4 to 6.

b) Every theory course shall have a final assessment on the entire syllabus with at least 30% weightage.

c) One compensation assessment for absentees in assessments (other than final assessment) is mandatory. Only genuine cases of absence shall be considered.

d) The passing minimum shall be as per the regulations.

B.Tech. Admitted in				P.G.
2018	2017	2016	2015	
35% or (Class average/2) whichever is greater.		(Peak/3) or (Class Average/2) whichever is lower		40%

e) Attendance policy and the policy on academic dishonesty & plagiarism by students are uniform for all the courses.

f) Absolute grading policy shall be incorporated if the number of students per course is less than 10.

g) Necessary care shall be taken to ensure that the course plan is reasonable and is objective.