



**DEPARTMENT OF PHYSICS
NATIONAL INSTITUTE OF TECHNOLOGY
TIRUCHIRAPPALLI**

COURSE OUTLINE			
Course Title	Basics of Engineering Materials		
Course Code	PH613	No. of Credits	03
Department	Physics	Faculty	Dr.S. Manivannan
Pre-requisites Course code	Nil		
Course Coordinator(s)	Dr.M. Ashok		
Other Course Teacher(s)/ Tutor(s) E-mail	Details available with coordinator	Telephone No.	3616
Course Type	<input type="checkbox"/> Elective course		
COURSE OVERVIEW			
The PH613 course is offered in the first semester (odd) as elective to M.Tech (NDT) students.			
COURSE OBJECTIVES			
<ul style="list-style-type: none"> ❖ This introductory course is aimed to obtain basic exposure to the concepts of crystalline solids, its imperfections and basics of various advanced engineering materials finding wide spread application in several industries. ❖ Understanding these material systems are vital for investigating the defects and their nature on these classes of materials. 			
COURSE OUTCOMES (CO)			
Upon completion of the course, the student will be able to:			
<ol style="list-style-type: none"> 1. Select different materials and emphasis the need of modern materials other than conventional metals and alloys for specific engineering applications. 2. Understand the heat treatment of steels using TTT and CCT diagrams. 3. Analyze the various metallurgical factors influencing the performance of materials for different structural engineering applications. 4. Define various mechanical properties of materials and their importance in materials selection criteria. 5. Classify different mechanical properties and how they can influence the materials behavior with respect to applied load. 			
COURSE TEACHING AND LEARNING ACTIVITIES			
Week	Topic	Mode of Delivery	
II, III week of Aug.	Structure of Metals: Different types of bonding in solids – Elements of crystal structure- Imperfections in crystals – dislocation theory - Grain boundaries and poly crystalline aggregates.	Lectures & power point presentation (PPT).	
IV and last week of Aug.	Principles of Alloying – Solid solutions and intermediate phases – Gibbs phase rule and equilibrium diagram - types of binary phase diagrams - Isomorphous – Eutectic - Peritectic and Peritectoid, eutectoid reactions.	Lectures & power point presentation (PPT).	

I and II week of Sep.	Steel :The Iron-carbon system – structural changes on slow and rapid cooling – martensitic transformation –concept of hardenability – TTT and CCT diagrams. Effects of carbon and alloying elements – Classification of steels.	Flipped classes, tutorials & seminars.
III and last week of Sep.	Heat Treatment of Steels : Annealing (various types), normalizing, quenching and tempering – Case hardening, Austempering and martempering – Solidification of Metals and alloys – Nucleation and crystal growth from the liquid phase – Ingot structure dendrite freezing – Segregation effects and grain size control – strength mechanisms – solute, dispersion and precipitation hardening.	Flipped classes, tutorials & seminars.
I week of Oct.	Non-Ferrous Metals & Ceramics :Aluminum, Aluminum alloys, Advantages and Application, Copper & Copper Alloys, Application and advantages, Titanium & Titanium Alloys, Advantages & Applications,	PPT & group discussions.
II week of Oct.	Defects in Non ferrous metals – types, significance. Industrial importance of engineering ceramic materials, building stone, clay products, refractories, cement and concrete, ceramic matrix composite materials; high temperature ceramic materials. Application of engineering ceramic materials– Defects in ceramic materials.	PPT & group discussions.
III week of Oct.	Composites :Importance of composites – constituents – functions of fiber and matrix – properties of fibers: aligned and random fiber composites-types of fibers-glass fiber, carbon fiber, metallic fibers, ceramic fibers-Matrix materials – Metallic and Polymer matrix composites.	PPT.
IV and last week of Oct./I week of Nov.	Manufacture methods – hand lay up & prepreg techniques, pultrusion, pulforming, thermforming, resin-transfer moulding, injection moulding, Bulk moulding compound, sheet moulding compound- Defects in Composites – Fabrication & In-service Defects.	PPT.
II and III week of Nov.	Mechanical behavior of materials : Elements of elastic and plastic deformation – stress-strain relation-work hardening, recovery, recrystallization and grain growth, types of fractures in materials and their identification.	Flipped classes & seminars.
IV week of Nov.	Mechanical testing of metals – Tensile, Hardness, Fatigue, Creep tests and their interpretation. Mechanical testing on composites – compression, tension, ILSS, flexural.	Flipped classes & seminars.

COURSE ASSESSMENT METHODS

Mode of Assessment	Week (topics)	Time	% Weightage
Assessment I (multiple choice, short questions, problems)	I week of Sep. (Structure of Metals)	30 min	10%
Assessment II (Seminar presentation*)	I-III week of Sep. (Steel and Heat Treatment of Steels)	20 min	5%
Assessment III (short & long descriptive questions and problems)	III week of Oct. (Structure of Metals, Steel and Heat Treatment of Steels, Non-Ferrous Metals & Ceramics)	90 min	30%

Assessment IV (Seminar presentation*)	II, III and IV week of Nov. (Mechanical behaviour of materials)	20 min	5%
Assessment V -Semester Exam (short and long descriptive questions, problems)	As per NITT regular time table/I week of Dec. (All the topics)	180 min	50%
		Total	100 %

*Appropriate marks/weightage (ranging from 0-5%) will be given for seminars based on material preparation, presentation skill, communication, teaching aids, independent effort, answering questions, attitude, etc. If any student(s) is/are interested and identified by faculty having skill to do mini-project related to this course will also be permitted and appropriate marks/weightage (ranging from 0-10 marks) will be awarded instead of seminar presentation.

ESSENTIAL READINGS

Text Books:

1. W. D. Callister, *Materials Science and Engineering: An Introduction*, Wiley, 7th edition, (2006).
2. V. Raghavan, *Materials Science and Engineering*, Prentice Hall of India, 5th edition (2013).
3. G.E. Dieter, *Mechanical Metallurgy*, Mc-Graw Hill, 3rd edition (2004).
4. A.V.K. Suryanarayana, *Testing of Metallic Materials*, Prentice -Hall of India, 2nd edition (2007).
5. V. B. John, *Introduction to Engineering Materials*, Palgrave Mac-millan Limited, 3rd edition (1992).

Reference Books:

1. Robert E. Reed Hill and R. Abbaschian, *Physical Metallurgy Principles*, PWS-Kent Publishing Company 3rd edition (1992).
2. L. H. Van Vlack, *Elements of Materials Science and Engineering*, Addison Wesley, 6th edition (1989).
3. I. J. Polmear, *Light Alloys: Metallurgy of the Light Metals*, Wiley, 3rd edition (1995).
3. V. Raghavan, *Physical Metallurgy: Principles and Practice*, PHI Learning Private Limited, 2nd edition (2006).

COURSE EXIT SURVEY

- Performance in the assessment methods.
- Questionnaire about the effectiveness of the delivery method, topics and the knowledge gained.

COURSE POLICY

- ❖ 75% attendance (including medical and on duty) is mandatory to take up the final examination. If the students are not satisfying the required attendance criteria, they have to redo the course during vacation.
- ❖ Those who are absent for assessments I & III on genuine grounds shall be given an opportunity only once for the retest with the prior permission of the concerned faculty member. The retest shall be conducted before the end semester exam and the portions would be Structure of Metals, Steel, Heat Treatment of Steels, Non-Ferrous Metals, Ceramics and Composites.
- ❖ The marks for group tasks/seminar shall be awarded based on independent effort, presentation skill, ability to answering the questions, attitude, viva, etc.
- ❖ A student has to score minimum 40 marks to get a pass.
- ❖ Those who fail in the course can appear for the supplementary exam. The internal marks (assessments I-IV) shall be considered till his programme duration.
- ❖ Any misbehavior, indiscipline in the classroom/exam hall will be dealt with seriously. Those who indulge in malpractice such as copying, plagiarism, discussion, etc. shall be awarded zero marks in the respective assessment. In the worst case, the institute disciplinary committee is empowered to debar the student from the course.

ADDITIONAL COURSE INFORMATION

The lecture materials such as hand outs, hard copy of power point presentations, video lectures shall be available with the faculty member. The faculty can be contacted through office phone or in person for clarifications on a mutually convenient time.

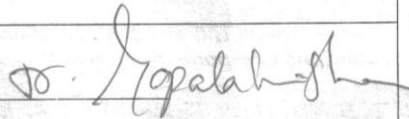
The seminar presentations materials, problems and solutions, reports and materials shall be circulated among students through faculty member well before the commencement of the task.

FOR SENATE'S CONSIDERATION

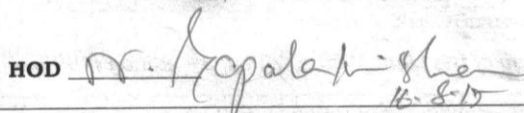
Course Faculty


16/8/17

CC-Chairperson



HOD


16-8-17