

Ministry of Higher Education and Scientific research



**Department of Mechanical & Mechatronics
Engineering**

College of Engineering

University of Salahaddin

Subject: Material Science and Technology

Course Book – 2nd Year students

Lecturer's name: AHMED SAMIR

Academic Year: 2022-2023

1st semester from 01/10/2022 – 19/1/2023

Course Book

1. Course name	Material Science and Technology
2. Lecturer in charge	Dr. Mohammedtahir M. Mulapeer AHMED SAMIR/ Lab. Lecturer
3. Department/ College	Mechanical Engineering Dept.
4. Contact	e-mail: Mohammedtahir.mulapeer@su.edu.krd Tel: 0750 451 2797
5. Time (in hours) per week	For example Theory: 2hrs / class/week 30hrs / semester
6. Office hours	Sunday 2hrs and Wednesday 2hrs
7. Course code	MME2043
8. Teacher's academic profile	Dr. Mohammedtahir M. Mulapeer was born in Akry city in 1974. He received his BSc in Mechanical Engineering in 1999 and the MSc degree in production engineering in 2002 and he awarded the PhD degree in material science in 2009 from the mechanical engineer dept. of the university of Salahaddin-Erbil. His research area is focused mainly on hard surface coatings on steel products, welding metallurgy, and development of polymeric materials. He is currently teaching Eng. Metallurgy for second year students at the mechanical engineering department.
9. Keywords	material science, metals and alloys, Smart alloys, Polymers.
10. Course overview:	Definition of Material science, the interatomic bonding and its effect on the behaviour of metals, Miller indices and the X-ray analysis, solidification of metals and alloys, thermal equilibrium diagrams, steel alloys and cast irons, crystal imperfections, the plastic behaviour of metals and alloys, annealing and recrystallization of metals, heat treatments of steel and alloys, non ferrous metals[AL alloys , Cu alloys], case hardening of steel alloys, powder technology and finally corrosion of metals and alloys.
11. Course objective:	<ul style="list-style-type: none"> • To formally introduce the fundamental principles of material science. • To examine applications of engineering metals and alloys. • To provide background how to deal with metals and alloys in industry.
12. Student's obligation	<ul style="list-style-type: none"> • With the privilege of attendance at college, come certain obligations and commitments. To ensure that every student derives the maximum benefit from their learning experience, and to further ensure that every student enhances the learning environment for others, the College sets forth the following student obligations. • Every student shall: • The students must take responsibility for maintaining the standards of academic performance as defined by the professors. • The students do not need to breach/violate the basic rights of other students. • The students are responsible for their actions and must comply with the provisions of the laws.

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- The students must not prevent the smooth operation of the services of the college, nor commit acts that could harm the college's assets or to endanger the physical integrity of persons who are in the area of the college. The students' behaviour must comply with the regulations of the college.
- Submit assignments and coursework in a timely manner as expected by the instructor.
- Attend all the classes for which the student is officially registered/scheduled regularly in a way that fully meets expectations of the college.
- Conduct coursework with honesty and integrity, refraining from cheating, plagiarism, or falsification, in accordance with the Academic Honor Code.

13. Forms of teaching:

The essence of the teaching program is prepared on MS power point presentations. Elaborations and explanations of the details are done verbally and when needed on white board. As an assisting instruction tool, multimedia presentations are used to demonstrate the presented ideas through basic diagrams or real life applications. There are also assignments and seasonal projects appointed to individual students or groups that helps the evaluation process and also support the team work effort.

14. Assessment scheme:

Attaining the requirements set to succeed in this study subject requires developing an engineering sense, related to this topic, based on emergent analytical and problem solving skills and memorizing topics cannot secure success.

In this system the maximum mark is (100%). The grading system is based on the summation of Two categories of evaluations:

First, (40%) of the mark is based on the academic year effort of the student which includes but is not restricted to the following:

20% for Assignments, Projects, Quizzes, Home works, Reports,....etc

20% for Mid Semester Exam.

(60%) of the mark is based on final examination that is comprehensive for the whole of the study material reviewed during the semester and it usually occurs during the month of January.

At the end of the evaluation process, if the students could not secure a minimum of (50%), they are given a chance to repeat the final exam in September and they should be able by then to equal or exceed the (50%) limit otherwise they will have to repeat this subject during the next academic year if it did not contradict with the administrative regulations.

15. Student learning outcome:

- Graduates have the ability to acquire and apply the principles of engineering knowledge, science and mathematics to the practice of materials engineering and related fields.
- Graduates have acquired in-depth technical skills in materials engineering discipline
- Graduates have the ability to identify, formulate and solve materials engineering related problems
- Graduates have the ability to design a system, component, or process related to materials engineering to meet desired needs within realistic constraints: economical, environmental and

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societal

- Graduates have the ability to demonstrate the awareness of the sustainability issues in materials engineering
- Graduates have the understanding of the professional and ethical responsibilities of materials engineers
- Graduates have the ability to communicate effectively through written reports, oral presentations and discussion.
- Graduates have the ability to function effectively as an individual and in a team with the capability to be a leader
- Graduates have the awareness of social, global, cultural and environment responsibilities of a material engineer
- Graduates have the potential to enhance their professional development and personal advancement through life-long learning

16. Course Reading List and References:

▪ Key references:

1. R A Higgins "engineering metallurgy" 1998.
2. William D Callister " material science and engineering"-2005

▪ Useful references:

1. The Science and Engineering of Materials, Donald R. Askeland, Pradeep P. Phulé, Chapman & Hall.
2. Foundations of Materials Science and Engineering, 3rd Edition, William F. Smith, William Smith, McGraw Hill, 2004, New York.
3. Introduction to Materials Science for Engineers, 5th Edition, James F. Shackelford, Prentice Hall, 2000, New Jersey.

▪ Using GOOGLE search is highly recommended and encouraged.

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17. The Topics:

Week No.	Subject detail; Engineering Metallurgy
Week 1-week4	Introduction, classification of materials
Oct. 7, 2018	Atomic structure and the interatomic bonding in metals
	The structure of crystalline solids and Crystal imperfections
Week 5 and 7	The iron - carbon system and Steel alloys and the effect of alloying elements on the mechanical behaviour of metals
	Cast irons and Stainless steels + Titanium alloys
Week 8	Heat treatments of plain carbon steels
And 9	Isothermal heat treatments + Surface hardening
Week 10	Aluminium and aluminium base alloys
And 11	Heat treatable and non heat treatable Al alloys
Week 12	Polymers technology + Ceramic materials
Week 13	Smart alloy + Bio Compatible materials+ Mid Term Exam 20%
Week 14	Composite materials + Nanotechnology and nano materials
Week 15 15/01/2019	Semiconducting materials
19/1/2019	Final Exam 60%

19. Examinations:

1. Compositional:

Explain each of the followings:

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1. The high brittleness of white cast iron.
1. Interstitial diffusion of atoms is more rapid than vacancy assisted diffusion.
2. Pure metals recrystallized easier than alloyed metals.
3. Pack carburizing is also called Pack cementation.
4. The use of single crystals of certain alloys in the manufacture of gas turbines and jet engines blades.

2. True or false type of exams:

Answer the followings by **True** or **False** and Correct the False statements if any:

1. Materials with covalent inter-atomic bonding are usually classified as good electrical conductors.
2. Hydrogen bonding is the weakest intermolecular bonding.
3. Composite materials are those containing graphite in its composition.
4. Thermoset plastics can only be heated once, since they will set into permanent rigid shape.
5. During the X-Ray diffraction analysis, the major condition for applying Bragg's equation is that there must be crystallographic planes that cause constructive interference.
6. Most metals undergo transition from ductile to brittle when the temperature decreases.
7. Fatigue is the phenomena by which a metal elongate under the action of both stress and high temperatures.

3. Multiple choices:

Choose **one** answer best suited to each of the following statements:

1. The density of composite materials depend mainly on:
 - a- the type of materials involved;
 - b- the method by which it produced;
 - c- dimensions of the composite;
 - d- all of the mentioned above.
- 2- When the number of neutrons is not the same for all atoms of a given element, then it said to have;
 - a- isotropes;
 - b- isomoles;
 - c- isotopes;
 - d- isopopes.
- 3- Hydrogen bond occurred in molecules in which hydrogen H is covalently bonded to;
 - a- Fluorine;
 - b- Chlorine;
 - c- Oxygen;
 - d- all of them.
- 4- The number of atoms within one HCP unit cell is;

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- a- 4
- b- 6
- c- 5
- d- 3

5- Miller index of family of crystallographic planes is expressed as;

- a- (hkl)
- b- [hkl]
- c- <hkl>
- d- {hkl}

6- During the X-ray diffraction analysis of FCC metals, the value of h , k and l must be;

- a- all even;
- b- all odd;
- c- all even or all odd;
- d- No matter how it is.

7- There are many methods used to measure the hardness of metals and alloys, but the most accurate one is;

- a- Rockwell method HRC;
- b- Brinell Method HB30;
- c- Vickers Method HV100;
- d- Mohs method.

8- Binary Isomorphous phase diagrams occurred between two elements in which they are;

- a- not soluble in each other in the solid state;
- b- totally soluble in each other in the solid state;
- c- partially soluble in each other in the solid state;
- d- Totally soluble in each other in the liquid state.

9- Surface hardening of steel articles can be done by;

- a- heating the article in a high temperature oven and then quenching it;
- b- cooling the article from high temperature;
- c- rapidly heating the surface of the article to high temperature;
- d- Heating the article in an environment rich with nitrogen.

10- One of the following series of Al alloys is heat treatable;

- a- 3000;
- b- 5000;
- c- 2000;
- d- 4000.

20. Extra notes:

NON

21. Peer review :

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