INDIAN INSTITUTE OF TECHNOLOGY KANPUR

Materials Science and Engineering, *I SEMESTER 2017-2018*

Course

ESO205 Nature and Properties of Materials (3-1-3-0) 14 Credits

Schedule

	No.	Days	Timings	Venue	Start, finish
Lectures	~40	M W F	11:00-11:50	L2 *(225)*	31 July, 15 Nov
Tutorials	11	Th	11:00-11:50	T204 (Mon section) T205 (Tue section) T206 (Wed section) T207 (Thu section) T208 (Fri section)	10 Aug, 9 Nov
Lab	12	M (Mon section) T (Tue section) W (Wed section) Th (Thu section) F (Fri section)	14:00-17:00	WL 203, Materials Science Lab	7 Aug, 11 Nov

- Holidays: 15 Aug (Tue), 3 Sept (Sat), 30 Sept (Sat), 2 Oct (Mon), 19 Oct (Thu), 4 Nov (Sat). + Antaragni Day off.
- Quizzes (1 hr): quiz-I→ 12 noon, 26 Aug (Sat), quiz-II→ 12 noon, 21 Oct (Sat). Venue → L18, L19.
- Mid-sem exam : TBA (Period: 18 Sep to 23 Sep (Mon-Sat)).
- Mid-sem break: 24 Sep (Sun) -2 Oct (Mon) 2017.
- End-sem exam: TBA (Period: Nov 18 – 27, 2017 (Sat – Mon)).
- Date, time for special lecture classes (in case a class is missed): dates TBA, Sat 12 noon *(please reserve this time).*

Instructor: Anandh Subramaniam

(Room: WL210B, Ph: 7215, Email: anandh@iitk.ac.in, URL: http://home.iitk.ac.in/~anandh)

Course website

All instructions related to the course, reference material, slides etc will be posted on the website (*http://home.iitk.ac.in/~anandh/ESO205/ESO205.htm*)

Course Contents: (brief version)

- **Introduction** to Materials Science and Engineering. Structure-Processing-Property-performance relations.
- **Crystal Structure.** Space lattices, unit cells, cubic and HCP structures, Miller indices, Packing, interstitials, different ceramic structures. Structure of non-crystalline materials.
- **X-ray diffraction.** (Braggs diffraction and structure actor for cubic lattices).
- **Defects in Crystals.** Point defects, edge and screw dislocations their notation and concepts, energy of a dislocation, stacking fault, grains and grain boundaries, bulk defects.
- **Phase equilibria and phase transformations.** Phase diagrams (phase rule, unary and binary diagrams), Diffusion, Phase Transformation– mechanisms and kinetics, nucleation and growth, TTT curves, Microstructure.
- **Mechanical Properties**. Tensile properties (elasticity, yield and tensile strengths, ductility and toughness). Plastic deformation, slip, dislocation motion, Peierls stress. Strengthening mechanisms. Fracture, Fatigue and creep.
- **Electrical and Magnetic properties**. Conductors, semiconductors and insulators. Band structure. Dielectric Materials (ferroelectrics). Magnetic Properties

Important Points

- Students should feel free to ask questions at anytime during the lecture and other contact sessions (lab & tutorial).
- Attendance is normally expected, except due to medical or other important reasons. Leave on medical grounds should be accompanied with medical certificate for the same.
- Any use of unfair means (copying in exams, etc.) will lead to 'F' grade. It is your responsibility to see that other students do not copy from your exam paper. If unfair means is found then all parties involved will be penalized. Refer to website for detailed instructions regarding exams.
- No make up midsem or quizzes.
- For lecture classes, quizzes and exams seating plan has to be followed.
- If student misses lab due to medical reasons, proper approved procedures need to be followed.

Evaluation

- Mid-Semester Exam : 25%
- End-Semester Exam : 25% *(about 90% of the syllabus is expected to be from the part covered after mid-sem)*
- Quizzes (2) : 20%
- Assignments (10) : 10%

- Lab reports (12) : 10%
- Lab exam/evaluation* : 10%
- **Pass Percentage : 30%**

* Modus operandi will be evolved.

Books and Reference

- MATERIALS SCIENCE & ENGINEERING: A Learner's Guide, Anandh Subramaniam, http://home.iitk.ac.in/~anandh/E-book.htm.
- Materials Science and Engineering, V. Raghavan, Fifth Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
- Materials Science and Engineering: An Introduction, William D. Callister, John Wiley & Sons, 2010.
- The Science and Engineering of Materials, Donald R. Askeland, Pradeep P. Fulay, Wendelin Wright, Kantesh Balani, Cengage Learning, 2012.
- ONLINE: *http://www.tf.uni-kiel.de/matwis/amat/def_en/overview_main.html.*
- ONLINE: *http://lattice.mme.iitk.ac.in/~sangals/eso205_2015-2016-1/index.html*

Lab Schedule

Section /Batch	1	2	3	4	5	6	7	8	9	10	11	12
Mon	7 Aug	14 Aug	21 Aug	28 Aug	4 Sep	11 Sep	**14 Oct***	9 Oct	16 Oct	23 Oct	30 Oct	6 Nov
Tue	8 Aug	**19 Aug***	22 Aug	29 Aug	5 Sep	12 Sep	3 Oct	10 Oct	17 Oct	24 Oct	31 Oct	7 Nov
Wed	9 Aug	16 Aug	23 Aug	30 Aug	6 Sep	13 Sep	4 Sep	11 Oct	18 Oct	25 Oct	1 Nov	8 Nov
Thu	10 Aug	17 Aug	24 Aug	31 Aug	7 Sep	14 Sep	5 Sep	12 Oct	**28 Oct***	26 Oct	2 Nov	9 Nov
Fri	11 Aug	18 Aug	25 Aug	1 Sep	8 Sep	15 Sep	6 Sep	13 Oct	2010	27 Oct	3 Nov	10 Nov

Notes:

- Special Saturday Lab class in lieu of a holiday.
- Cycle-1
- Cycle-2

Instructions to be followed in ESO205 laboratory

1) Personnel safety is of paramount importance. Handle all lab equipment carefully.

2) Consult lab staff in case of any clarifications required.

3) Every student must wear shoes to the lab.

4) To avoid any injury the student must take permission of the laboratory staff before handling equipment.

5) Goggles must be worn for specific experiments (as instructed by TA/tutor/lab staff).

6) Regarding Lab report the following points are to be noted.

- Laboratory report must be submitted on the same day as the experiment is performed (before leaving the lab).
- Lab report must be submitted in standard sheet available at the shopping Centre. Students can contact lab staff for details.
- Laboratory report will be submitted by group-wise.
- The lab report must contain:
  i) Title of experiment,
  ii) Three or four lines starting the objectives,
  iii) A few lines on the background,
  iv) Name of all the equipments & tool used, along with one line description of their use,
  v) Neatly labelled sketches of the observed microstructures (where applicable).
  vi) Calculations performed along with conclusions should be written in the report.

7) Checked reports will be returned to the students at end of set-1 and set-2 experiments.

8) A special day will not be demarcated for Laboratory MAKE-UP. Hence, students are expected to attend all experiments. If student misses lab due to medical reasons, proper approved procedures need to be followed.

9) Optical microscopes contain various lenses; so therefore handle the microscope very carefully.