**Name of Institute: Institute of Technology and Engineering**
**Name of Faculty:Dr.K. Santhy**

**Course code:MT0705**
**Course name: Selection of Materials and Failure Analysis**
Pre-requisites: Plastic deformation of Metals
Credit points: 4
Offered Semester: 7th Semester

**Course Coordinator (weeks 01-15)**
Full name:Dr.K. Santhy
Department with sitting location: Physical Metallurgy Lab (lab 3 in ground floor)
Telephone:9787710922
Email: santhyk.mt@indusuni.ac.in
Consultation times:4.15-5.00PM

**Course Lecturer (weeks 01 - 15)**
Full name:Dr.K. Santhy
Department with sitting location: Physical Metallurgy Lab (lab 3 in ground floor)
Telephone:9787710922
Email: santhyk.mt@indusuni.ac.in
Consultation times:4.15-5.00PM

Students will be contacted throughout the Session via Mail / phone with important information relating to this Course.

## Course Objectives

By participating in and understanding all facets of this Course a student will:

1) To understand various factor involved in product design
2) To impart broad knowledge of Metallurgical aspects of engineering in materials selection & technology practices to support design, application, installation, manufacturing, operation and maintenance for successful careers in Academics/ Research & industry that meet the needs of Society and multinational companies.
3) To understand various failure mechanisms for engineering materials.

## Course Outcomes (CO)

1) To develop basic scientific principles and engineering fundamentals necessary for material selection for a product developments.
2) To apply the concept of manufacturing in product design
3) To analyze and apply their understanding in order to perform failure analysis of various engineering materials and components.

## Course Outline

(Key in topics to be dealt)
Selection of Materials
Role of mechanical properties in material selection
Ashby Diagram
Failure analysis
Fracture Mechanism
Fatigue Failure
Corrosion Failure

## Method of delivery

Interactive lectures, Power point presentation, Case studies, Problem solving

## Study time

5 classes per week

## CO-PO Mapping (PO: Program Outcomes)

Co 1: PO 1, 2, 3, 4
Co 2: PO 1, 2, 3, 5
Co 3: PO 1,2, 3, 4

## Blooms Taxonomyand Knowledge retention(For reference)

(Blooms taxonomy has been given for reference)


Figure 1: Blooms Taxonomy

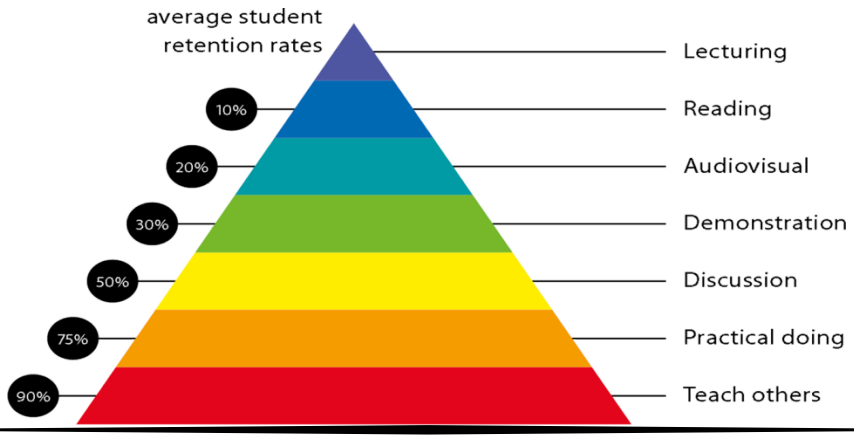

Figure 2: Knowledge retention

## Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

| General Graduate Qualities | Specific Department of under Graduate Capabilities |
|---|---|
| **Informed**<br>Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas. | **1 Professional knowledge, grounding & awareness** |
| **Independent learners**<br>Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others. | **2 Information literacy, gathering & processing** |
| **Problem solvers**<br>Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards. | **4 Problem solving skills** |
| **Effective communicators**<br>Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication. | **5 Written communication**<br>**6 Oral communication**<br>**7 Teamwork** |
| **Responsible**<br>Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities. | **10 Sustainability, societal & environmental impact** |

## Practical work:

(Mention what practical work this Course involves)

## Lecture/tutorial times

(Give lecture times in the format below)

| | | | |
|---|---|---|---|
| ***Example:*** | | | |
| Lecture | Monday | 2.00 – 03.00 pm | Google Meet |
| Lecture | Tuesday | 3.10 – 04.10 pm | Google Meet |
| Lecture | Thursday | 12.20 – 1.20 pm | Google Meet |
| Tutorial | Friday | 2.00 – 03.00 am | Google Meet |

## Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the Course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for mid and end semester examinations.

## Details of referencing system to be used in written work

## Text books

1) F. A. A. Cranes and J. A. Charles, "Selection and Use of Engineering Materials", Butterworth-Heinemann, 3rd Edition, 1989, ISBN: 9780750615495.
2) M. F. Ashby and D. R. H. Jones, "Engineering Materials – Vol. 1", Butterworth-Heinemann, 4th Edition, 2011, ISBN: 9780080966656.
3) H. J. Sharp, "Engineering Materials-Selection and Value Analysis", Heywood Books-Elsevier, 1st Edition, 1966, ASIN: B0000CMZQ9.
4) V. J. Colangelo and F. A. Heiser, "Analysis of Metallurgical Failures", Wiley-Interscience, 2nd Edition, 1987, ISBN: 9780471891680.
5) C. R. Brooks and A. Chaudhary, "Failure Analysis of Engineering Materials", McGraw-Hill Education, 1st Edition, 2001, ISBN: 9780071357586.
6) K. Das, "Metallurgy of Failure Analysis", McGraw-Hill Professional, 1st Edition, 1997, ISBN: 9780070158047.
7) 7. M. F. Ashby and D. R. H. Jones, "Engineering Materials – Vol. 1", Butterworth-Heinemann, 4th Edition, 2012, ISBN: 9780080966687

## Additional Materials

1) American Society of Metals, "Metals Handbook –Failure Analysis and Prevention", American Society of Metals, 8th Edition, 1975, ASIN: B0026SIT3E.
2) American Society of Metals, "Metals Handbook – Fractography and Atlas of Fractographs", American Society of Metals, 8th Edition, 1974, ASIN: B000I1VM9Y.
3) M. Kutz, "Handbook of Materials Selection", Wiley, 1st Edition, 2002, ISBN: 9780471359241.
4) G. T. Murray and M. Dekker, "Handbook of Materials Selection for Engineering Applications", CRC Press, 1st Edition, 1997, ISBN: 9780824799106.

## ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

| Example: | |
|---|---|
| CIE | 60 % |
| Mid Semester Exam | 40% |
| Attendance | 05% |
| Presentation | 05% |
| Assignment (Min. 2) | 10% |
| ESE | 40 % |

## SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in mid semester or end semester will be considered for supplementary assessment in the respective components (i.e mid semester or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (mid semester or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

### Practical Work Report/Laboratory Report:

A report on the practical work is due the subsequent week after completion of the class by each group.

### Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of 10% of the maximum mark per calendar day

### Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

### Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

### University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

**Plagiarism** - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

***Do not copy the work of other students.***
***Do not share your work with other students (except where required for a group activity or assessment)***

## Course schedule(subject to change)

**(Mention quiz, assignment submission, breaksetcas well in the table under the Teaching Learning Activity Column)**

| | Week # | Topic & contents | CO Addressed | Teaching Learning Activity (TLA) |
|---|---|---|---|---|
| | Weeks 1 | Importance of failure analysis and its relationship to material selection, fundamental causes of failure, general practice in failure analysis. | 1 | Interactive teaching using PPT |
| | Weeks 2 | Failure- types and characteristics: Identification and characterization of ductile and brittle type of failures. | 1,2 | Interactive teaching using PPT |
| | Week 3 | Fracture mechanism, fracture modes and micro fractographic features | *1,2* | Interactive teaching using PPT. |
| | Week 4 | Identification and characterization of fatigue failures, types of fatigue, corrosion fatigue and contact fatigue, etc. | 1,2 | Interactive teaching using PPT |
| | Week 5 | Corrosion and corrosion related failures such as hydrogen embrittlement, stress corrosion cracking and high temperature failures. | 1,2 | Interactive teaching using PPT |
| | Week 6 | In-process failures: Case studies, Service failures: Case studies. | *3,5* | Interactive teaching using PPT and video. Seminar & Quiz I |
| | Week 7 | Philosophy of material selection, motivation for selection, relationship to available resources, concept of resource base. | 1,2 | Interactive teaching using PPT |
| | Week 8 | Criteria for selection of engineering materials – service requirements, ease of manufacturing, availability of materials and cost effectiveness. | 1,2 | Interactive teaching using PPT |
| | Week 9 | Selection for mechanical properties like strength, toughness, stiffness, fatigue, creep and temperature resistance. | *1,2* | Interactive teaching using PPT and video |
| | Week 10 | Selection for surface durability like corrosion resistance, wear resistance. Relationship between material | 1,2 | Interactive teaching using PPT and block |

| | | | | |
|---|---|---|---|---|
| | | nd ma sing. | | |
| | Week 11 | Identification of required properties. Selection of materials based on available property data and optimization to select the best material. | 3,4 | Interactive teaching using PPT and video |
| | Week 12 | Case studies in material selection like materials for bearings, gears, automobile structures, aircraft components, ship structures, etc. | 3,4 | Interactive teaching using PPT and video. Quiz II |

## Program map for Bachelor of Technology (Materials and Metallurgical Engineering)

| Sem | *Subjects* |
|---|---|
| 1st | |

| | |
|---|---|
| 2nd | Integral Calculus & Linear Algebra; Engineering; Mechanical Workshop; Elements of Mechanical Engineering; Computer Programming; Engineering; Environmental Science; Business Communication and |
| 3rd | Differential Equations & Integral Transforms; Structural Metallurgy & Physics of Materials; Physical Metallurgy of Ferrous Alloys; Mineral Processin; Fuels, Furnace & ; Human Values & Professional Ethics; Environmental Pollution & Control in Metallurgical Industries |
| 4th | Complex Analysis & Numerical; Physical Metallurgy of Non-Ferrous Alloys; Introduction to Process Metallurgy; Transport Phenomena; Metallurgical Thermodynamics; Energy Economy & Waste Management; Cyber Security & Intellectual Property Right |
| 5th | Heat Treatment Principles & Practices; Iron Making; Non Ferrous Extractive Metallurgy; Foundry Technology; Plastic Deformation of Metals; Surface Engineering; Technical Communication & Soft Skills |
| 6th | Steel Making; Powder Metallurgy; Electrometallurgy & Corrosion; Metal Forming; Computational Materials Science (EL-1); Material Characterization (EL-1); Nano Technology (EL-2); Composite Materials (EL-2); Advanced Technical Communication & Soft Skills |
| 7th | Metal Joining Processes; Non-Destructive Testing; Alloy Design; Disaster Management; (EL-3); Material Testing &Standards; **Selection of Material & Failure analysis**; (EL-3) |
| 8th | Project |

**Pre-requisite**
**Co-requisite**