

| MM 468 Introduction to Fracture Mechanics |                                                                                                                                                                                                                                                                                                                                                                                                                                             |        |      | DEPARTMENT of MECHANICAL ENGINEERING |          |                     |       |                |             |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------|--------------------------------------|----------|---------------------|-------|----------------|-------------|
| Semester                                  | Methods of Education                                                                                                                                                                                                                                                                                                                                                                                                                        |        |      |                                      |          |                     |       | Credits        |             |
|                                           | Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                     | Recit. | Lab. | Project/Field Study                  | Homework | Other               | Total | Credit         | ECTS Credit |
| 8                                         | 42                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0      | -    |                                      |          | 33                  | 75    | 3              | 3.0         |
| Language                                  | Turkish                                                                                                                                                                                                                                                                                                                                                                                                                                     |        |      |                                      |          |                     |       |                |             |
| Compulsory / Elective                     | Elective                                                                                                                                                                                                                                                                                                                                                                                                                                    |        |      |                                      |          |                     |       |                |             |
| Prerequisites                             | None                                                                                                                                                                                                                                                                                                                                                                                                                                        |        |      |                                      |          |                     |       |                |             |
| Course Contents                           | Types of fracture in metals. Griffith theory of brittle fracture, crack propagation, ductile fracture, elastic-plastic fracture mechanics, notch effects. Energy-temperature curves. Determination of stress intensity factor, fracture design philosophy; temper brittleness, hydrogen embrittlement, Unstability of linear elastic and elastic-plastic fracture, fatigue crack propagation, corrosion fatigue, stress corrosion cracking. |        |      |                                      |          |                     |       |                |             |
| Course Objectives                         | Understanding of basic principles relating to fracture behaviour of engineering materials                                                                                                                                                                                                                                                                                                                                                   |        |      |                                      |          |                     |       |                |             |
| Learning Outcomes and Competences         | To gain the knowledge about the behaviour of engineering materials having microscopic flaws, learning the fracture toughness test methods and examination of macroscopic and microscopic fracture surfaces, learning the component failure and analysis data, design methods in fracture mechanics, application of these methods for design and development                                                                                 |        |      |                                      |          |                     |       |                |             |
| Textbook and /or Reference                | 1) E.E. Gdoutos, Fracture Mechanics, Kluwer Academic Publishing, Boston, 1993.<br>2) R.W. Hertzberg, Callister, Deformation and Fracture Mechanics of Engineering Materials, Fouth Edition, John Wiley and Sons, Inc., 1996.                                                                                                                                                                                                                |        |      |                                      |          |                     |       |                |             |
| Assessment Criteria                       |                                                                                                                                                                                                                                                                                                                                                                                                                                             |        |      |                                      |          | If any, mark as (x) |       | Percentage (%) |             |
|                                           | Midterm Exams                                                                                                                                                                                                                                                                                                                                                                                                                               |        |      |                                      |          | X                   |       | 60             |             |
|                                           | Quizzes                                                                                                                                                                                                                                                                                                                                                                                                                                     |        |      |                                      |          |                     |       |                |             |
|                                           | Homeworks                                                                                                                                                                                                                                                                                                                                                                                                                                   |        |      |                                      |          |                     |       |                |             |
|                                           | Projects                                                                                                                                                                                                                                                                                                                                                                                                                                    |        |      |                                      |          |                     |       |                |             |
|                                           | Term Paper                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |      |                                      |          |                     |       |                |             |
|                                           | Laboratory Work                                                                                                                                                                                                                                                                                                                                                                                                                             |        |      |                                      |          |                     |       |                |             |
|                                           | Other                                                                                                                                                                                                                                                                                                                                                                                                                                       |        |      |                                      |          |                     |       |                |             |
|                                           | Final Exam                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |      |                                      |          | X                   |       | 40             |             |
| Instructors                               |                                                                                                                                                                                                                                                                                                                                                                                                                                             |        |      |                                      |          |                     |       |                |             |
| Week                                      | Subject                                                                                                                                                                                                                                                                                                                                                                                                                                     |        |      |                                      |          |                     |       |                |             |
| 1                                         | Introduction to fracture mechanics, theoritical cohesive strength,                                                                                                                                                                                                                                                                                                                                                                          |        |      |                                      |          |                     |       |                |             |
| 2                                         | The stress concentration factor, external variables affecting fracture,                                                                                                                                                                                                                                                                                                                                                                     |        |      |                                      |          |                     |       |                |             |
| 3                                         | Microscopic fracture mechanisms                                                                                                                                                                                                                                                                                                                                                                                                             |        |      |                                      |          |                     |       |                |             |
| 4                                         | Macroscopic fracture mechanisms and surface examination                                                                                                                                                                                                                                                                                                                                                                                     |        |      |                                      |          |                     |       |                |             |
| 5                                         | Slow crack growth,                                                                                                                                                                                                                                                                                                                                                                                                                          |        |      |                                      |          |                     |       |                |             |
| 6                                         | Types of fracture                                                                                                                                                                                                                                                                                                                                                                                                                           |        |      |                                      |          |                     |       |                |             |
| 7                                         | Griffith crack theory, energy approach method                                                                                                                                                                                                                                                                                                                                                                                               |        |      |                                      |          |                     |       |                |             |
| 8                                         | Design philosophy, crack tip plastic zone size estimation,                                                                                                                                                                                                                                                                                                                                                                                  |        |      |                                      |          |                     |       |                |             |
| 9                                         | Fracture mode transition: plane stress vs plane strain,                                                                                                                                                                                                                                                                                                                                                                                     |        |      |                                      |          |                     |       |                |             |
| 10                                        | Plane strain fracture toughness testing,                                                                                                                                                                                                                                                                                                                                                                                                    |        |      |                                      |          |                     |       |                |             |
| 11                                        | Elastic-plastic fracture mechanics: crack opening displacement method,                                                                                                                                                                                                                                                                                                                                                                      |        |      |                                      |          |                     |       |                |             |
| 12                                        | J integral method,                                                                                                                                                                                                                                                                                                                                                                                                                          |        |      |                                      |          |                     |       |                |             |
| 13                                        | Impact energy fracture toughness correlations,                                                                                                                                                                                                                                                                                                                                                                                              |        |      |                                      |          |                     |       |                |             |
| 14                                        | Fatigue corrosion cracking, stress corrosion cracking                                                                                                                                                                                                                                                                                                                                                                                       |        |      |                                      |          |                     |       |                |             |