

| MM 585 Reactive Flows             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |        |      | MECHANICAL ENGINEERING DEPARTMENT |                     |       |                |         |             |
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| Semester                          | Methods of Education                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |        |      |                                   |                     |       |                | Credits |             |
|                                   | Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Recit. | Lab. | Project/Field Study               | Homework            | Other | Total          | Credit  | ECTS credit |
| 1-2                               | 30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 12     | -    | 73                                | 73                  | -     | 188            | 3       | 7.5         |
| Language                          | Turkish                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |        |      |                                   |                     |       |                |         |             |
| Compulsory / Elective             | Optional                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |      |                                   |                     |       |                |         |             |
| Prerequisites                     | None                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |        |      |                                   |                     |       |                |         |             |
| Course Contents                   | Fundamental aspects of reactive flow modelling. Construction of mathematical background. Reactive gas dynamics and general conservation equations for multi-component reacting systems. Reactive laminar flows and flames. Reactive laminar fuel jets and their analyses. Single-media and two-medium reactive laminar flow analyses. Reactive turbulent flows and flames. Reactive turbulent fuel jets and their analyses. Single-media and two-medium reactive turbulent flows and turbulence models.                                                                                                                                                                                                                                                                                                                                                                   |        |      |                                   |                     |       |                |         |             |
| Course Objectives                 | Derivation and analysis of reactive flow conservation equations in a single-media and-two medium. Analysis of flame and fuel jets                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |        |      |                                   |                     |       |                |         |             |
| Learning Outcomes and Competences | Construction of reactive flow model. Analysis of reactive flow parameters and their effects on the flow.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |      |                                   |                     |       |                |         |             |
| Textbook and /or Reference        | 1. K. Kuo, Principles of Combustion, John Wiley & Sons, 2nd Ed. 1986, 810pp.<br>2. B. Spalding, Combustion and Mass Transfer, Pergamon press, 1st Ed. 1979, 409 pp.<br>3. R. B. Bird, W.E. Steward and E.N. Lightfoot, Transport Phenomena, Wiley, 2nd Ed., 2001.<br>4. M. Kaviany, Principles of Convective Heat Transfer, Springer-Verlag, 1994, 675 pp.<br>5. E.R.G. Eckert, R.M. Drake, Analysis of Heat and Mass Transfer, Hemisphere Publ., 1987,<br>6. N. Peters, Turbulent Combustion, Cambridge University Press, 2000, 1st Ed., 264 pp.<br>7. A. Murty Kanury, Introduction to Combustion Phenomena, Gordon and Breach Science Publishers, 1st Ed., 1975, 406 Pages.<br>8. R.A. Strehlow, Combustion Fundamentals, McGraw-Hill, 1984, 538 Pages.<br>9. G.E. Mase, Theory and Problems of Continuum Mechanics, Schaum’s outline series, McGraw-Hill, 1970, 216pp |        |      |                                   |                     |       |                |         |             |
| Assessment Criteria               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |        |      |                                   | If any, mark as (X) |       | Percentage (%) |         |             |
|                                   | Midterm Exams                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |        |      |                                   | X                   |       | 40             |         |             |
|                                   | Quizzes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |        |      |                                   |                     |       |                |         |             |
|                                   | Homeworks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |        |      |                                   | X                   |       | 20             |         |             |
|                                   | Projects                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |      |                                   |                     |       |                |         |             |
|                                   | Term Paper                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |      |                                   | X                   |       | 10             |         |             |
|                                   | Laboratory Work                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |        |      |                                   |                     |       |                |         |             |
|                                   | Other                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |        |      |                                   |                     |       |                |         |             |
| Final Exam                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |        |      | X                                 |                     | 30    |                |         |             |
| Instructors                       | Assoc. Prof. Atilla BIYIKOGLU                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |        |      |                                   |                     |       |                |         |             |
| Week                              | Subject                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |        |      |                                   |                     |       |                |         |             |
| 1                                 | Mathematical background and index notation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |      |                                   |                     |       |                |         |             |
| 2                                 | Mathematical background and index notation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |      |                                   |                     |       |                |         |             |
| 3                                 | Conservation equations for multi-species reactive systems                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |        |      |                                   |                     |       |                |         |             |
| 4                                 | Conservation equations for multi-species reactive systems                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |        |      |                                   |                     |       |                |         |             |
| 5                                 | Reactive gas dynamics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |        |      |                                   |                     |       |                |         |             |
| 6                                 | Reactive gas dynamics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |        |      |                                   |                     |       |                |         |             |
| 7                                 | Laminar reactive flows in a single media                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |      |                                   |                     |       |                |         |             |
| 8                                 | Laminar reactive flows in a single media                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |      |                                   |                     |       |                |         |             |
| 9                                 | Laminar reactive flows in two medium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |        |      |                                   |                     |       |                |         |             |
| 10                                | Laminar reactive flows in two medium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |        |      |                                   |                     |       |                |         |             |
| 11                                | Turbulent reactive flows in a single media                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |      |                                   |                     |       |                |         |             |
| 12                                | Turbulent reactive flows in a single media                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |      |                                   |                     |       |                |         |             |
| 13                                | Turbulent reactive flows in two-medium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |        |      |                                   |                     |       |                |         |             |
| 14                                | Turbulent reactive flows in two-medium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |        |      |                                   |                     |       |                |         |             |