 

**Heat Transfer (AME 3720)**

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| **Course Objectives** | Summary of the main learning outcomes for students enrolled in the course:  • Understanding the steady and unsteady one and two-dimensional heat conduction; Numerical analysis of steady and unsteady conduction; Free and forced convection for external and internal flows; Heat exchangers; Properties and processes of radiation, radiation exchange between surfaces. Laboratory experiments concerning different modes of heat transfer both as a single and combined mode involving air and water. |
| **Course Outcomes** | 1. Identify basic modes of heat transfer and apply energy balance over control volumes and surfaces. 2. Determine temperature distributions and heat transfer rates in conducting media using different coordinate systems and boundary conditions. 3. Compute enhancement of heat transfer by using fins. 4. Analyze conduction problems under time-dependent conditions. 5. Solve complex conduction problems by using the finite-volume method. 6. Determine normalized convection transfer equations and obtain functional form of solutions. 7. Apply various empirical correlations for forced and natural convection to different flow situations. 8. Classify types of heat exchangers and carry out thermal analysis for both design and performance problems. 9. Calculate radiation heat transfer from ideal and actual surfaces and enclosures. |
| **Course**  **Activities and Assessment** | From time to time I shall give you home assignments to inculcate critical thinking ability. There will be two Mid Term examinations and four quizzes (average of three). |
| **Make-up Policy** | I shall not conduct any make-up examination except for those who provide public sector hospital certificate. |
| **Attendance**  **Policy** | All students are advised to attend all of my classes punctually. Any student who participate in class activities will be eligible for 5 Marks. If your attendance is below 75% of scheduled classes then you will not be allowed to sit in final examination. |
| **Books:** | Fundamentals of Heat and Mass Transfer, by Incropera, DeWitt, Bergman, and Lavine; 6th Ed., Wiley, 2007 ( or any latest version) |
| **Grading Policy** | |  |  |  |  | | --- | --- | --- | --- | | No. | Assessment task | Date due  (Academic Week) | Proportion of Final Assessment | | 1 | Assignments | After every main topics | 5% | | 2 | Quizzes (4) | 3rd, 5th, 9th & 11th | 10% | | 3 | Laboratory | Every Week | 15% | | 4 | Mid-term Examination | 6th &10th | 30% | | 5 | Final Examination | As scheduled by the university | 40 % | |

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| 1. Topics to be Covered | | |
| Topics | No of  Weeks | Contact hours |
| **Physical origins and rate equations for conduction, convection, and radiation.** | **1** | **3** |
| **Conservation of energy for control volumes and surfaces.** | **1** | **3** |
| **Thermal properties; Heat conduction equation in different coordinate systems; Boundary and initial conditions.** | **1** | **3** |
| **One-dimensional, Steady-State Conduction: Plane wall; Alternative conduction analysis; Radial systems; Thermal networks; Conduction with energy generation; Heat transfer from extended surfaces.** | **1** | **3** |
| **Two-dimensional, Steady-State Conduction: Method of separation of variables; Conduction shape factor and dimensionless conduction heat rate; Finite-volume method.** | **2** | **6** |
| **Transient Conduction: Lumped capacitance method; Plane wall with convection; Semi-infinite solid; Finite-volume method.** | **2** | **6** |
| **Introduction to Convection: Boundary layers; Local and average convection coefficients; Laminar and turbulent flow; Boundary layer equations; Similarity parameters; Boundary layer analogies.** | **1** | **3** |
| **External Flow: Empirical method; Flat plate in parallel flow; Cylinder in cross flow; Sphere; Flow across banks of tubes.** | **1** | **3** |
| **Internal Flow: Hydrodynamic and thermal considerations; Energy balance; Thermal analysis and convection correlations for laminar flow in tubes; Turbulent flow; Correlations for ducts and tube annulus.** | **1** | **3** |
| **Free Convection: Physical consideration; Governing equations; Similarity; Laminar free convection on a vertical plate; Effects of turbulence; Empirical correlations for external free convection flows.** | **1** | **3** |
| **Heat Exchangers: Basic types; Overall heat-transfer coefficient; LMTD method; Effectiveness-NTU method.** | **1** | **3** |
| **Thermal Radiation: Physics of radiation; Radiation properties; Shape factors; Radiation exchange between surfaces; Solar radiation.** | **1** | **3** |
| Total number of weeks and contact hours per semester | **14** | **42** |