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**Cairo University
Faculty of Engineering**

**Department of Mining, Petroleum,**

**and Metallurgical Engineering**

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| **Course Specifications** |
| **Program(s) on which this course is given:** | **Materials and Metallurgical Engineering** |
| **Department offering the program:** | **Department of Mining, Petroleum, and Metallurgical Engineering** |
| **Department offering the course:** | **Department of Mining, Petroleum, and Metallurgical Engineering** |
| **Academic Level:** | **Metallurgical Engineering B.Sc.** |
| **Date**  | **April, 2015** |
| **Semester (based on final exam timing)** |  **Fall Spring** |
| **A- Basic Information** |
| **1. Title:** | **Heat Transfer** | **Code:** | **MET 308** |
| **2. Units/Credit hours per week:**  | **Lectures** | **4** | **Tutorial** | **2** | **Practical** | **---** | **Total** | **6** |
| **B- Professional Information**  |
| **1. Course description:** | **Topics include the followings: steady and unsteady heat conduction; forced and free convection; external and internal flows; and radiation heat transfer.** **Objectives:**1. **Make students familiar with fundamental heat transfer concepts: conservation of energy, and mechanisms of heat transfer (conduction, convection, and radiation).**
2. **Evaluate the relative contributions of different modes of heat transfer.**
3. **Teach balance of energy applied to integral- and differential-volumes.**
4. **Know the basic differential equations for heat transfer.**
5. **Formulate basic equation for heat transfer problems.**
6. **Solve differential and algebraic equations associated with thermal systems using analytical and numerical approaches.**
7. **Teach the physics of steady thermal conduction in solids (metals, plastics) and composites such as insulation through walls, cylinders, and spheres and define thermal conduction resistance.**
8. **Calculate and evaluate the impacts of initial and boundary conditions on the solutions of a particular heat transfer problem.**
9. **Apply heat transfer principles to design and to evaluate performance of thermal systems.**
10. **Understand the critical radius of insulation and the heat transfer in fins.**

 **11.Have students become knowledgeable in unsteady one-dimensional heat**  **conduction.** **12.Understand the differences between laminar and turbulent flows.** **13.Have students become knowledgeable in internal and external forced convection.** **14.Understand the basics of free convection.** **15.Teach physics of thermal radiation and surface properties.** **16.Define view-factor resistance.** **17.Calculate radiation heat transfer between objects with simple geometries.**  **18.Determine the reduction in radiation heat transfer using radiation shields.**  |
| **2. Intended Learning**  **Outcomes of Course**  **(ILOs):** | **a) Knowledge and Understanding** |
|  **1. Know heat transfer modes (conduction, convection, and radiation).** **2. Understand how heat is transferred between the elements of a system for**  **different configurations.**  |
| **b) Intellectual Skills** |
|  **3. Analyze problems to choose appropriate correlation.** **4. Find a suitable mathematical relationship between the measured variables.** **5. Solve application problems.**  |
| **c) Professional and Practical Skills** |
|  **6. Make right assumptions and approximations for tackling practical situations.** **7. Apply fundamental heat transfer concepts to obtain design data relevant to**  **selective illustrative problems.****33 8. Apply finite difference method to engineering problems.** |
| **d) General and Transferable Skills** |
|  **9. Work effectively in a team group to achieve goals.** **10. Develop an understanding of how heat transfer is accomplished in metallurgical**  **engineering process operations.** |
| **3. Contents** |
| **Topic** | **Total hours** | **Lectures hours** | **Tutorial/ Practical hours** |
| **[1] Basic concepts of thermodynamics and heat transfer** | **3** | **3** | **---** |
| **[2] Modes of heat transfer** | **3** | **2** | **1** |
| **[3] Conservation of energy** | **2** | **1** | **1** |
| **[4] Integral and differential volume energy equations containing**  **heat transfer by conduction, convection, and radiation** | **2** | **2** | **---** |
| **[5] Introduction to conduction** | **2** | **2** | **---** |
| **[6] Heat conduction equation** | **2** | **2** | **---** |
| **[7] Boundary and initial conditions & formulation of heat conduction**  **Problems** | **3** | **2** | **1** |
| **[8] One-Dimensional steady state conduction** | **3** | **2** | **1** |
| **[9] Conduction through wall and composite walls** | **5** | **3** | **2** |
| **[10] Conduction through cylinder and composite cylinders** | **5** | **3** | **2** |
| **[11] Conduction through sphere and composite spheres** | **5** | **3** | **2** |
| **[12] Overall heat transfer coefficient** | **2** | **1** | **1** |
| **[13] Critical radius of insulation** | **2** | **1** | **1** |
| **[14] Temperature varying conductivity** | **2** | **1** | **1** |
| **[15] Heat transfer in fins** | **4** | **2** | **2** |
| **[16] Transient conduction** | **5** | **3** | **2** |
| **[17] Numerical methods in heat conduction** | **3** | **2** | **1** |
| **[18] Convection ….. basic concepts**  | **1** | **1** | **---** |
| **[19] Nusselt, Prandtl, and Reynolds numbers** | **1** | **1** | **---** |
| **[20] Laminar and turbulent flows** | **1** | **1** | **---** |
| **[21] Analytical relations and correlations for the Nusselt number** | **1** | **1** | **---** |
| **[22] Forced convection – external Flow** | **2** | **1** | **1** |
| **[23] Forced convection - internal Flow** | **2** | **1** | **1** |
| **[24] Free Convection** | **4** | **2** | **2** |
| **[25] Radiation basic concepts** | **1** | **1** | **---** |
| **[26] Blackbody radiation** | **1** | **1** | **---** |
| **[27] Radiation: processes and properties** | **1** | **1** | **---** |
| **[28] View factors** | **2** | **1** | **1** |
| **[29] Radiation exchange between surfaces & thermal circuit**  **Diagram** | **6** | **4** | **2** |
| **[30] Radiation shields** | **2** | **1** | **1** |
| **Total** | **78** | **52** | **26** |
| **4. Teaching and Learning Methods** | **Lectures** **( √ )** | **Practical Training/ Laboratory ( )** | **Seminar/****Workshop** **( )** |
| **Class Activity ( )** | **Case****Study**  **( √ )** | **Projects** **( )** |
| **E-learning ( )** | **Assignments /Homework ( √ )** | **Other:** |
| **5. Student Assessment**  |
| * + - * **Method**
 | **To assess (with reference to the ILOs)** |
| **- Assessment 1; Homework assignments** | **1, 2, 3, 4, 5, 8** |
| **- Assessment 2; Report and presentation** | **1, 2, 9,10­** |
| **- Assessment 3; Quizzes**  | **1, 2, 3, 4, 5** |
| * **Assessment 4; Fins exam**
 | **1, 2, 3, 4, 5** |
| * **Assessment 5; Mid-term exam**
 | **1, 2, 3, 4, 5, 6, 7, 8** |
| **- Assessment 6; Final exam**  | **1, 2, 3, 4, 5, 6, 7, 8, 10** |
| * **Assessment Schedule**
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 | **Week** |
| **- Assessment 1; Homework assignments** |  **2,3,4,5,6,7,8,10,11,12** |
| **- Assessment 2; Report and presentation** |  **12** |
| **- Assessment 3; Quizzes** |  **3, 5, 7, 11** |
| * **Assessment 4; Fins exam**
 |  **8** |
| * **Assessment 5; Mid-term exam**
 |  **9** |
| **- Assessment 6; Final exam**  |  **At end of term** |
| * **Weighting of Assessments**
 |
| **- Assessment 1; Homework assignments** | **4%** |
| **- Assessment 2; Report and presentation** | **2.67%** |
| **- Assessment 3; Quizzes** | **6.66%** |
| * **Assessment 4; Fins exam**
 | **3.33%** |
| * **Assessment 5; Mid-term exam**
 | **16.67%** |
| **- Assessment 6; Final exam**  |  **66.67%** |
| **- Total** |  **100%** |
| **6. List of References** |
| **- M.N. Ozisik, Heat Transfer, A Basic Approach, McGraw-Hill, New York, 1985.****- Y. A. Cengel, Heat Transfer, A Practical Approach, Second Edition, McGraw-Hill, New York, 2003.****- J. H. Lienhard IV and J. H. Lienhard V, A Heat Transfer, Third Edition, Textbook, Phlogiston**  **Press, Cambridge, Massachusetts, U.S.A., 2008.****- J.P. Holman, Heat transfer, Ninth Edition, McGraw Hill, New York, 2001.****- F.P. Incropera and D.P. De Witt, Fundamentals of heat and mass transfer, Six Edition,Wiley, New York, 2007.** |
| **7. Facilities Required for Teaching and Learning** |
|  **Board, and datashow.** |
| **Course Coordinator:** | **Dr. Moetaz Mohamed Nabil Mohamed Mohamed Ahmed** |
| **Head of Department:** | **Prof. Dr. El-Sayed Mahmoud El-Banna** |

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