**TEMPLATE FOR COURSE SPECIFICATION**

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| HIGHER EDUCATION PERFORMANCE REVIEW: PROGRAMME REVIEW |

**COURSE SPECIFICATION**

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| This Course Specification provides a concise summary of the main features of the course and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. It should be cross-referenced with the programme specification. |

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| College of Engineering  University of Baghdad | ***1. Teaching Institution*** |
| Mechanical Engineering Department (MED) | ***2. University Department/Centre*** |
| Heat Transfer / ME303  Heat Transfer, is a required course for mechanical engineering students. The course presents the two modes of heat transfer: conduction and convection. One-dimensional steady and transient conduction is studied for planar, cylindrical, and spherical geometries. The lumped capacitance analysis is used for transient conduction when appropriate. Analytical and numerical methods are presented for two-dimensional conduction problems, including the analysis of extended surfaces. Convection heat transfer is studied in both internal and external geometries and under laminar and turbulent flow regimes. External flows include cooling on flat plates due to laminar and turbulent boundary layer flows, and cooling of cylinders due to cross flow. The convection heat transfer analysis in internal flows considers laminar and turbulent pipe flows. Free convection is also considered where heat transfer is due to flow induced by fluid buoyancy. Heat exchangers is an application studied in the course. Radiation heat transfer is studied by considering the general characteristics of radiation as well as the properties of radiating surfaces and radiation heat transfer between surfaces. Additionally, solution for total emissive power using radiation functions and shape factors for various bodies is involved. The course is taught through 3 hrs per week. | ***3. Course title/code& Description*** |
| Mechanical Engineering (ME) Program | ***4. Programme(s) to which it Contributes*** |
| Annual System ; There is only one mode of delivery, which is a “Day Program”. The students are full time students, and on campus. They attend full day program in face-to-face mode. The academic year is  composed of 30-week regular subjects. | ***5. Modes of Attendance offered*** |
| 1st & 2nd / Academic Year 2016 – 2017 | ***6. Semester/Year*** |
| 90 hrs. / 3 hrs. per week | ***7. Number of hours tuition (total)*** |
| 26 October 2017 | ***8. Date of production/revision of this specification*** |
| ***9. Aims of the Course*** | |
| * This course is designed to introduce a basic study of the phenomena of heat transfer, to develop methodologies for solving a wide variety of practical engineering problems, and to provide useful information concerning the performance and design of particular systems and processes. Teach students to analyze heat transfer problems in conduction and convection, formulate the necessary equations and calculate the temperature distributions and rates of heat transfer; and to apply the basic concepts of heat transfer to heat exchanger design. Also teach them how to compute steady and unsteady heat conduction problems employing Finite-difference. Additionally, teach the physics of the blackbody distribution function and radiation properties, thermal radiation, view factor, and radiation exchange between surfaces. Furthermore, teach the fundamental concepts of solar radiation and the basic definitions of the angles. | |

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| ***10·Learning Outcomes*** |
| 1. Understand the basic laws of heat transfer. 2. Account for the consequence of heat transfer in thermal analyses of engineering systems. 3. Analyze problems involving steady state heat conduction in simple geometries. 4. Develop solutions for transient heat conduction in simple geometries. 5. Obtain numerical solutions for conduction heat transfer problem. 6. Understand the fundamentals of convective heat transfer process. 7. Evaluate heat transfer coefficients for natural convection. 8. Evaluate heat transfer coefficients for forced convection inside ducts. 9. Evaluate heat transfer coefficients for forced convection over exterior surfaces. 10. Analyze heat exchanger performance by using the method of log mean temperature difference. 11. Analyze heat exchanger performance by using the method of heat exchanger effectiveness. 12. Use the blackbody distribution function and radiation properties (emissivity, transmissivity, and absorbtivity) to find average radiation properties for solving radiation heat exchange problems. 13. Use shape factors and the gray body assumption to solve radiation heat transfer problems in diffuse enclosures. 14. Analyze the definition of solar radiation and the main concepts and definition of solar energy. 15. Evaluate the main angles and important values used in solar energy. |
| ***11.Teaching and Learning Methods*** |
| 1. Lectures. 2. Tutorials. 3. Homework and Assignments. 4. Tests and Exams. 5. In-Class Questions and Discussions. |
| ***12. Assessment Methods***   1. Homework. Assignment questions are provided so that students will have the opportunity to use the information provided in the lectures and textbooks and to test their degree of understanding of the discussed topics. 2. Quizzes. Topics discussed during the period shall be included in the quiz. This enables the students to develop self-confidence, accuracy and readiness for the major exams. 3. Major Exams. There will be two (2) major exams, i.e. midterm and final. All exams will be in-class, closed-book, and closed-notes. 4. Problem Sets (Exercises). Working on assigned problems is one way to gain detailed understanding of the topic and prepares the students to pass the examinations. There will be regular problem sets to be solved and to be submitted before the schedule of every major exam. While the students are encouraged to discuss the problem sets with their classmates, they must do the exercises on their own. Copying someone else’s work is unacceptable. |
| ***13. Grading Policy***     1. Quizzes: There will be a ( 8 – 10 ) closed books and notes quizzes during the academic year. The quizzes will count 20% of the total course grade. 2. Tests, 2-3 Nos. and will count 10% of the total course grade. 3. Extracurricular Activities, this is optional and will count extra marks ( 1 – 5 % ) for the student, depending on the type of activity. 4. Final Exam: The final exam will be comprehensive, closed books and notes, and will take place on June 2017 from 9:00 AM - 12:00 PM in rooms ( M12 + M13 ). The final exam will count 70% of the total course grade |

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| ***14. Course Structure*** | | | | | |
| Assessment Method | Teaching Method | Unit / Module or Topic Title | LOs (Article 10) | Hours | Week |
| 1-4 of Article (12) | 1-5 of Article (11) | Introduction, Thermodynamics and heat transfer, Conduction, Convection, Radiation heat transfer, Thermal conductivity. Simultaneous heat transfer mechanisms. | 1,2 | 3  2 the.  1 tut. | 1 |
| 1-4 of Article (12) | 1-5 of Article (11) | One-dimensional heat conduction equation in large plane wall, long cylinder, and sphere. General heat conduction equation in rectangular, cylindrical, and spherical coordinates, Boundary and Initial conditions. | 3 | 3  2 the.  1 tut. | 2 |
| 1-4 of Article (12) | 1-5 of Article (11) | Solution of Steady one-dimensional heat conduction problems. Heat Generation in a solid, Variable thermal conductivity. | 3 | 3  2 the.  1 tut. | 3 |
| 1-4 of Article (12) | 1-5 of Article (11) | Thermal resistance concept, Thermal resistance network, Multilayer plane walls. Thermal contact resistance, Multilayered Cylinders and spheres. | 3 | 3  2 the.  1 tut. | 4 |
| 1-4 of Article (12) | 1-5 of Article (11) | Critical radius of insulation, fin equation. Fin efficiency and effectiveness, Proper length of a fin. | 3 | 3  2 the.  1 tut.. | 5 |
| 1-4 of Article (12) | 1-5 of Article (11) | Steady two-dimension heat conduction, analytical, graphical, and shape factor methods. | 3 | 3  2 the.  1 tut. | 6 |
| 1-4 of Article (12) | 1-5 of Article (11) | Lumped system analysis, Transient heat conduction in large plane walls, long cylinders, and spheres. Transient heat conduction in semi-infinite solids and multidimensional systems. | 4 | 3  2 the.  1 tut. | 7 |
| 1-4 of Article (12) | 1-5 of Article (11) | Numerical methods in heat conduction, Finite difference formulation. One- dimensional steady heat conduction. | 5 | 3  2 the.  1 tut. | 8 |
| 1-4 of Article (12) | 1-5 of Article (11) | Two- dimensional steady heat conduction. | 5 | 3  2 the.  1 tut. | 9 |
| 1-4 of Article (12) | 1-5 of Article (11) | Transient heat conduction. | 5 | 3  2 the.  1 tut. | 10 |
| 1-4 of Article (12) | 1-5 of Article (11) | Physical mechanism on convection, Thermal boundary layer, Laminar and Turbulent flows. | 6 | 3  2 the.  1 tut. | 11 |
| 1-4 of Article (12) | 1-5 of Article (11) | Derivation of differential equations. Solutions of convection equations for a flat plate, Non-dimensionalized convection equations and similarity. | 6 | 3  2 the.  1 tut. | 12 |
| 1-4 of Article (12) | 1-5 of Article (11) | External forced convection, Drag force and heat transfer in external flow. | 9 | 3  2 the.  1 tut. | 13 |
| 1-4 of Article (12) | 1-5 of Article (11) | Parallel flow over a flat plates. Flow across cylinders and spheres, Flow across tube banks. | 9 | 3  2 the.  1 tut. | 14 |
| 1-4 of Article (12) | 1-5 of Article (11) | Internal forced convection, Mean velocity and mean temperature, The entrance region. | 8 | 3  2 the.  1 tut. | 15 |
| 1-4 of Article (12) | 1-5 of Article (11) | General thermal analysis, Laminar flow in tubes, Turbulent flow in tubes. | 8 | 3  2 the.  1 tut. | 16 |
| 1-4 of Article (12) | 1-5 of Article (11) | Physical mechanism of natural convection, Equation of motion and the Grashof number. | 7 | 3  2 the.  1 tut. | 17 |
| 1-4 of Article (12) | 1-5 of Article (11) | Natural convection over surfaces. | 7 | 3  2 the.  1 tut. | 18 |
| 1-4 of Article (12) | 1-5 of Article (11) | Natural convection from finned surfaces. Natural convection inside enclosures, Combined natural and forced convection. | 7 | 3  2 the.  1 tut. | 19 |
| 1-4 of Article (12) | 1-5 of Article (11) | Heat exchangers, Types of heat exchangers. The overall heat transfer coefficients, | 10,11 | 3  2 the.  1 tut. | 20 |
| 1-4 of Article (12) | 1-5 of Article (11) | Analysis of heat exchangers. The log mean temperature difference method. | 6,7,8,9,10,11 | 3  2 the.  1 tut. | 21 |
| 1-4 of Article (12) | 1-5 of Article (11) | The effectiveness-Ntu method. Selection of heat exchangers | 6,7,8,9,10,11 | 3  2 the.  1 tut. | 22 |
| 1-4 of Article (12) | 1-5 of Article (11) | Fundamentals of Thermal Radiation, Radiation Intensity | 12 | 3  2 the.  1 tut. | 23 |
| 1-4 of Article (12) | 1-5 of Article (11) | Radiative Properties. | 12 | 3  2 the.  1 tut. | 24 |
| 1-4 of Article (12) | 1-5 of Article (11) | Atmospheric and Solar Radiation, The View Factor. | 12, 13 | 3  2 the.  1 tut. | 25 |
| 1-4 of Article (12) | 1-5 of Article (11) | View Factor Relations, Radiation Heat Transfer: Black Surfaces. | 12, 13 | 3  2 the.  1 tut. | 26 |
| 1-4 of Article (12) | 1-5 of Article (11) | Radiation Heat Transfer: Diffuse, Gray Surfaces, Radiation Shields and the Radiation Effect | 13 | 3  2 the.  1 tut. | 27 |
| 1-4 of Article (12) | 1-5 of Article (11) | Solar Radiation, The Sun, The Solar Constant, Spectral Distribution of Extraterrestrial Radiation. | 14 | 3  2 the.  1 tut. | 28 |
| 1-4 of Article (12) | 1-5 of Article (11) | Variation of Extraterrestrial Radiation, Definitions. | 14,15 | 3  2 the.  1 tut. | 29 |
| 1-4 of Article (12) | 1-5 of Article (11) | Beam Radiation, Extraterrestrial Radiation on a Horizontal Surface | 15 | 3  2 the.  1 tut. | 30 |

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| ***15. Infrastructure*** | | |
| ***References***   1. “Heat Transfer” J. P. Holman, McGraw-Hill, Inc., 10th edition, 2010. 2. “*Heat and Mass Transfer A Practical Approach*”; by Yunus A. Çengel, McGraw-Hill, Third Edition, 2007. 3. “*Fundamentals of Heat and Mass Transfer*”; by F.P., Incropera, and D.P., DeWitt, Seventh Edition, 2011.   ***Others:***   1. Notebook prepared by the instructor of the course. 2. Collection of sheets of solved and unsolved problems and Exams questions | Required reading:  · CORE TEXTS  · COURSE MATERIALS  · OTHER | |
| Available websites related to the subject. | Special requirements (include forexample workshops, periodicals,IT software, websites) | |
|  | Community-based facilities  (include for example, guest  Lectures , internship,field studies) | |
| ***16. Admissions*** | | |
| ME101 and ME201 Courses | | Pre-requisites |
|  | | Minimum number of students |
| 60 | | Maximum number of students |
| ***Instructor:***  **Dr. Luma F. Ali**  Assistant Professor of Mechanical Engineering / Thermo-Fluids  Mech. Engr. Dept.  College of Engineering  University of Baghdad  Tel: +00964-7901558338  Email: luma.fadhil@yahoo.com ; | | ***17. Course Instructors*** |

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