

## TEMPLATE FOR COURSE SPECIFICATION (Heat Transfer).

### HIGHER EDUCATION PERFORMANCE REVIEW: PROGRAMME REVIEW

### COURSE SPECIFICATION

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.

|   |  |
|---|--|
| 1. Teaching Institution   | University of Technology                 |
| 2. University Department/Centre   | Chemical Engineering Department          |
| 3. Course title/code  | Heat Transfer/CE-305                     |
| 4. Programme(s) to which it contributes   | Third year, P&R                          |
| 5. Modes of Attendance offered  | Full                                     |
| 6. Semester/Year  | 2 semester/year                          |
| 7. Number of hours tuition (total)  | Theory (3hr./week) Practical (3hr./week) |
| 8. Date of production/revision of this Specification  | 30/6/2016                                |
| 9. Aims of the Course   |  |
| 1. To introduce and develop an understanding the modes of heat Transfer (conduction, convection and radiation). Derive and discuss all types of equation in these modes of heat transfer. |  |
| 2. Analyze heat transfer rate data in different modes.  |  |
| 3. Characterization the design procedure for different heat transfer equipments as heat exchanger.  |  |
| 4. Provide practice at developing critical thinking skills, solving open ended problems and to work in teams.   |  |

## **10• Learning Outcomes, Teaching, Learning and Assessment Method**

### **A-Knowledge and Understanding**

- A1. Develop a deep understanding of issues related to the heat and energy balance for different chemical process.
2. Define and solve problems in heat transfer mechanisms in various engineering applications. Provide the ability to describe energy variation and its application in flow and pressure measurement and frictional energy losses calculations.
- Master the ability to make appropriate choices regarding the reaction step(s) of a chemical process.
- A3. Explain and derive mass and heat balance equations for the main types of industrial reactors, for single, series, parallel reactor and forward, reversible chemical reactions.
- A4. Apply quantitative methods to Specify and size reactors for simple chemical reaction schemes (isothermal, non-isothermal and adiabatic operation) to achieve production goals for processes involving homogeneous or heterogeneous reaction systems.

### **B. Subject-specific skills**

- B1. Apply Heat Transfer principles in chemical engineering.
- B2. Analyze and interpret the heat transfer data in heat exchanger and discuss the different types of heat exchanger.
- B3. Compare and contrast various heat transfer problems..

### **Teaching and Learning Methods**

Lectures, Tutorials, Example Classes, Informal and formal team work, Weekly homework problems. Team working and presentation skills are developed by carrying out LAB experiments and submitting periodical reports.,

### **Assessment methods**

- Midterm exams, Final exam, Quizzes, Weekly homework, Team and homework problems, Open questions that have a definite answer, or do not have a definite answer. Oral LAB exams to assess the skills of analysis and discussion, for submitted reports.

### **C. Thinking Skills**

- C1. An ability to apply effective, creative and innovative solutions, both independently and cooperatively, to current and future problems.
- C2. Solve reaction engineering problems through logic.
- C3. Characterization and analyses the performance of chemical reactors and evaluate the operation of single and multiple reactor for a range of different reaction types.
- C4. Characterization, analyses and evaluate scientific and engineering information and identify knowledge gaps and opportunities to design a reactor for a given reaction.

### **Teaching and Learning Methods**

Lectures, Tutorials, Example Classes, Informal and formal teamwork, Weekly homework problems, Analysis of cases linked to the work environment, Practical Applications

### **Assessment methods**

Midterm exams, Final exam, Quizzes, Weekly homework, Team and homework problems, partial test (Oral questions :- multiple choice, alternative response), Open questions that have a definite answer, or do not have a definite answer

## D.General and Transferable Skills (others skills relevant to employ ability and personal development).

D1.Work together in same-discipline teams to solve engineering problems.

D2.To review state-of-the-art concepts for process intensification and design approaches used in heat transfer..

D3.Speed intuitive, predictability and evaluate information and ideas in the handling of Heat Transfer issues.

## 11.Course Structure

| Week                           | Hours | ILOs   | Unit/Module or Topic Title  | Teaching Method  | Assessment Method  |
|--------------------------------|-------|--|---|--|--|
| <b>1<sup>st</sup> semester</b> |       |  |   |  |  |
| 1                              | 3     | Ability to characterization and specify of the heat transfer issues related to the heat transfer | <b>. Modes of Heat Transfer:</b><br>Conduction, Convection and Radiation. | Lectures, Tutorials , Example Classes , Practical Applications | partial test (Oral questions :- multiple choice ,alternative response ), Open questions that have a definite answer , or do not have a definite answer |
| 2                              | 3     |  | <b>Steady State Heat Conduction in One Dimension,</b><br>Plane wall.      |  |  |
| 3                              | 3     |  | Radial systems.   |  |  |
| 4                              | 3     |  | Heat source systems.  |  |  |
| 5                              | 3     |  | Boundary surrounded by fluids.  |  |  |
| 6                              | 3     |  | Overall heat transfer coefficient.  |  |  |
| 7                              | 3     |  | Extended surface.   |  |  |
| 8                              | 3     |  | Conduction-convection systems and fins.                                   |  |  |
| 9                              | 3     |  | Solving problems  |  |  |
| 10                             | 3     |  | <b>Principles of Convection</b> , Transport                               | Lectures,  |  |

|                                |   |  |  |  |  |
|--------------------------------|---|--|--|--|--|
|                                |   |  | equations.   | Tutorials ,  |  |
| 11                             | 3 |  | Fluid mechanism aspect of convection.  | Example Classes ,  |  |
| 12                             | 3 |  | Laminar boundary layer, Thermal boundary Layer.  | Practical Applications   |  |
| 13                             | 3 |  | Empirical and practical relations for pipe .   |  |  |
| 14                             | 3 |  | Tube flow and flow normal to single and tube banks.  |  |  |
| 15                             | 3 |  | Examples & Solve problems.   |  |  |
| <b>2<sup>nd</sup> semester</b> |   |  |  |  |  |
| 16                             | 3 |  | <b>Heat Exchangers</b> , Various types and their general characteristics, fouling factor               | Lectures, Tutorials , Example Classes , Practical Applications |  |
| 17                             | 3 |  | Heat exchangers mean temperature difference  |  |  |
| 18                             | 3 |  | Co-current and counter-current flow, Solving problems.   |  |  |
| 19                             | 3 |  | <b>Shell and Tube Exchangers</b> , Types and various specifications                                    | Lectures, Tutorials , Example Classes , Practical Applications |  |
| 20                             | 3 |  | design calculations by conventional and by effectiveness (NTU) methods and optimum design calculation. |  |  |
| 21                             | 3 |  | Examples, Solving design problems in heat exchanger  |  |  |
| 22                             | 3 |  | <b>Condensation and Boiling Heat Transfer</b>  | Lectures, Tutorials , Example Classes , Practical Applications |  |
| 23                             | 3 |  | Condensation of single vapors, Design calculations for condenser                                       |  |  |
| 24                             | 3 |  | Pool and flow boiling Examples & H.W problems.   |  |  |
| 25                             | 3 |  | <b>Radiation and Furnace design</b> , Radiation  |  |  |

|    |   |  |  |  |  |
|----|---|--|--|--|--|
|    |   |  | properties   |  |  |
| 26 | 3 |  | Shape factor, heat exchange for non black bodies, parallel planes, shields.    |  |  |
| 27 | 3 |  | Gas tradition<br>Solving example problems.                                     |  |  |
| 28 | 3 |  | <b>Unsteady State Heat Transfer</b> , Temperature as a function of time        | Lectures, Tutorials , Example Classes , Practical Applications |  |
| 29 | 3 |  | Lumped capacity system, quenching of small bodies and heating of tank reactor. |  |  |
| 30 | 3 |  | Solving problems.  |  |  |

| 12. Infra structure   |  |
|---|--|
| Required reading:<br>· CORE TEXTS<br>· COURSE MATERIALS<br>· OTHER                          | <ul style="list-style-type: none"> <li>○ Lecturers</li> <li>○ Book “J.P. Holman , Heat Transfer, Ninth edition.</li> <li>○ Other support books :- Frank P. Incropera &amp; David P. Dewitt, Fundamentals of Heat and Mass Transfer, Fifth Edition.</li> <li>○ Colulsson , J.M and Richardson J.F. “Chemical Engineering , volume 1”, 3rd edition , Robert Maxwell. M. C. year</li> </ul> |
| Special requirements (include for example work shops, periodicals, IT software, websites)   | websites   |
| Community-based facilities (include for example, guest Lectures, internship, field studies) | field trips  |

| 13. Admissions |  |
|----------------|--|
| Pre-requisites | Before undertaking this module the student should have undertaken the following: Basic Principles of chemical engineering I and II , Fluid flow , Mathematics I and II , as well simultaneous courses:- Thermodynamics , and Applied mathematics |

|                            |    |
|----------------------------|----|
| Minimum number of students | 30 |
| Maximum number of students | 50 |