COURSE CONTENTS

1. Single-phase shell-and tube heat exchangers
   - Overall aims of thermal design
   - Types of heat exchangers
   - Design data required
   - Fundamental correlations for thermal design
   - Optimising tubeside design
   - Optimising shellside design
   - Shell style and baffling
   - Stream analysis
   - Temperature profile distortion
   - Minimisation of pressure drop
   - Minimising shellside pressure drop
   - Minimisation of shellside pressure drop
   - Use of multiple shells in series/parallel
   - Allocation of shellside and tubeside
2. MTD
   - LMTD
   - Co-current flow
   - Counter-current flow
   - Temperature cross
   - 'F', 'G' and 'H' shells for temperature cross
   - Temperature profile distortion (TPD)

3. Thermal design of Condensers
   - The mechanisms of condensing
   - Condensate film
   - Gravity- and shear-controlled condensation
   - Condensation of mixtures
   - Classification of condensers
   - Practical guidelines for thermal design
   - Shell type and baffling
   - Multiple shells in series/parallel
   - Desuperheating
   - Subcooling
   - Special applications: low-fin tubes and reflux condensers

4. TEMA basics
   - Nomenclature
   - Fabrication tolerances
   - General fabrication and performance information
   - Installation, Operation and Maintenance
   - Mech. Standards TEMA Class RCB
   - Flow-induced vibration
   - Thermal relations

- Physical properties of fluids
- General information
- Recommended good practice

5. Thermal design of Reboilers
- Pool boiling and parameters affecting it
- Flow boiling
- Design of distillation column reboilers: kettle, vertical thermosyphon, horizontal thermosyphon and forced flow. Special design considerations: film boiling and very low delta-T. Selection of reboilers, start-up and control of reboilers

6. Fouling - Causes, consequences and mitigation
- Adverse effects of fouling
- Categories of fouling
- Parameters that affect fouling
- The stages of fouling
- How to provide a fouling allowance
- Selection of fouling resistance
- Design guidelines for reducing fouling
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7. Flow-induced vibration analysis
- Introduction
- Mechanics of flow-induced tube vibration
- Modes of tube failure
- Producing a safe design
- The vital link between flow-induced tube vibration and pressure drop
- Acoustic vibration

8. Enhanced heat transfer
- What is enhanced heat transfer?
- The imperative for EHT
- Benefits of EHT
- Techniques for heat transfer enhancement

9. Twisted-tube heat exchangers (TTHE's)
- Shortcomings of the STHE
- Features, advantages and applications of the TTHE
- The retrofit situation
- Comparison with conventional STHE's

10. Helixchangers
- Limitations of conventional baffle design
- Advantages of Helixchangers
- Best applications
- Comparison with conventional STHE's

11. Air-cooled heat exchangers (ACHE's)
- Pros and cons of ACHE's
- Optimising air and water cooling: selection of break temperature

- Construction features

12. Heat exchanger troubleshooting, debottlenecking and revamp

- Excessive cooling water scaling
- Supplementing existing shell
- Missing longitudinal baffle
- Changing from series to parallel operation
- Replacement/modification of tube bundle – tubeside
- Replacement/modification of tube bundle – shellside
- Interchange of fluid sides (two case studies)
- Addition of tube inserts
- Air-cooled heat exchangers
- Increase air flow rate
- Reduce no. of tube passes to handle higher tubeside flow rate Add, supplement or replace trim cooler