COURSE CONTENTS

1. Gasoline Vehicles: Engine Technology - Fuel Quality and Emission
2. Diesel Vehicles: Engine Technology, Fuel Quality and Emission
3. Alternative Fuel Vehicles
4. Role of Lubricants for Pollution Control
5. Central Motor Vehicles Rules for CNG and LPG Vehicles
6. Road safety for rural and urban areas
7. Maintenance and Calibration of Portable Gas Analyzers & Smoke meter
8. Effects of Vehicular Pollution on Human Health including the Road Safety and Supporting Aid, Aspects

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[VII] Training Programme on "ELECTRIC VEHICLES FOR FUTURE URBAN MOBILITY - CHALLENGES AND OPPORTUNITIES" (1 week)

1. Basics of the Electric Vehicle (EV) and Hybrid Electric Vehicle
2. Charging Infrastructure: present and future scenario
3. Battery technologies
4. In-vehicle energy management
5. New driving cycles for EVs and test methods
6. Effect of different drive modes on energy consumption of EVs
7. Electric Drives and Power electronics
8. Hybrid and Electrical Vehicles : Current and future Scenario
9. Diagnostic system management in EVs
10. Technology comparison of IC Engine vehicle and EV
11. Effect of ICE vehicular pollution on human health and environment
12. On-road mobility options

Practical / Lab Demonstrations

- Max. speed and energy consumption measurements of EVs
- Solar Charging Station
- Retro-fitment of old & polluting petrol-diesel vehicles in EVs
- Electric Powertrain System

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[VIII] Training Programme on "HEAT EXCHANGER DESIGN AND TROUBLESHOOTING" (3 days)

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

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[IX] Training Programme on "CORROSION CONTROL AND MATERIAL SELECTION IN REFINERIES" (1 week)

1. Principle of Low Temperature (wet) Corrosion
2. Various forms of wet Corrosion and remedial measures
3. High temperature corrosion principles
4. (High Temperature Corrosion) : Oxidation, Sulphidation, Liquid Metal corrosion
5. Fuel ash Corrosion and HTHA (Nelson Curve) & Case study.
6. Corrosion Monitoring methods: direct and indirect, intrusive and non-intrusive methods, coupon method,
7. ER & LRP monitoring, NDT and analytical methods of monitoring
8. Mitigations: Materials Selection, Design for corrosion control, coatings, cathodic & anodic protections and modification of environment.
9. Classification of Engineering Material (metals, composites and non- metals)
10. Properties and Application of (Ferrous, Ni-Cr-Fe Alloys, Non- ferrous Alloys.
11. Properties and Application of Duplex and NACE-Material).
12. Material Selection Methodology, Specification, code & standards
13. Material Degradation& Mechanical Failures Material Degradation Carburization/Graphitization, Temper Embrittlement Sensitization / Sigma phase)
14. Mechanical Failures (Overloading, Creep, Fatigue, wrong material selection / Metallurgy mix-up, Material abuse and Thermal shock)
15. Crude oil characteristics, API gravity and corrosivity. Impact of crude oil impurities on process unit corrosion. Overhead Corrosion control
16. High TAN(Naphthenic Acid) and sour crude corrosion and mitigation and material selection.
17. Erosion – Corrosion, Stress Corrosion Cracking (Polythionic and Chloride
18. Stress Corrosion Cracking), material selection and MOC
19. Hydroprocess (Hydro Cracker, Hydrotreater and Desulfurizer)
20. Ammonium Bisulfide Corrosion and mitigation.
21. High temperature H_2/H_2S Corrosion, corrosion rate curves for alloys and copper-Gorman curve , corrosion mitigation, material selection and MOC, SS321 Vs SS347 application. Stress relaxation cracking (SRC) and stabilization heat treatment.
22. Lighter End and Auxiliary Units (LPG & Amine treating and SRU Units
23. Sour environment corrosion (Wet-H2S Corrosion). Amine Cracking, PWHT, Material Selection and MOC, NACE Material & NACE-RP 103
24. Caustic embrittlement , causting gauging and cracking, material and PWHT requirement.

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[X] Training Programme on "ADVANCED AUTOMOTIVE TECHNOLOGY AND INDIAN ROAD TRAFFIC PATTERN- CHALLENGES & OPPORTUNITIES." (1 week)

1. Fundamentals of Internal combustion engine and perspective of Automotive Fuel Quality and Emissions
2. Advanced Alternative engine concepts for improvement in efficiencies
3. Advance Exhaust treatment systems in vehicles (BS IV and BS VI) for reduction of emissions
4. Current and new generation CNG and LPG engine/vehicle design and developments
5. Fundamentals of Electric and Hybrid power train and their role in reduction of on-road emissions and fuel consumption
6. Real world driving emissions: A review of the worldwide activity and its applicability in Indian context
7. New Generation engine oils for advance I C Engines
8. Engine performance and emission measurements on transient, steady state engine dynamometer
9. Indian vehicle population/roads infrastructure and its correlation with ambient air quality

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