RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Fire Technology & Safety Engineering, VII-Semester

FT 701 Heat Transfer

COURSE OBJECTIVE:

To understand the fundamentals of heat transfer mechanisms in fluids and solids and their applications in various heat transfer equipment in process industries.

COURSE CONTENT:

CONDUCTION: Modes of heat transfer one dimensional and two dimensional, heat rate equations, Theory of insulation, critical radius calculations, types of insulation material, conduction through slab, cylinder and sphere.

CONVECTIVE HEAT TRANSFER: Heat transfer in boundary layer and in films, natural and forced convection, co/counter/cross current contacting for heat transfer, individual and overall heat transfer coefficient, fouling factor.

RADIOACTIVE HEAT TRANSFER: Black body radiation, concept of shape factor, methods of determination of shape factor, radiation exchange in enclosure with black surfaces.

HEAT TRANSFER UNDER PHASE CHANGE CONDITIONS: Boiling and condensation of pure components, heat flux temperature diagram for boiling and condensation under vertical and horizontal surfaces, nucleate & pool boiling, effect of surface condition on condensation, correlation for heat transfer under condensation. Evaporation- Type of evaporators and their applications single and multiple effect evaporators, design and operation of forward– backward and mixed feed operations, effect of boiling point elevation and hydrostatic head vapour recompression.

HEAT EXCHANGE EQUIPMENT: Introduction to general design of double pipe, shell and tube exchangers, condensers, extended surface equipments, heat exchanger equation – coil to fluid, jacket to fluid.

COURSE OUTCOME:

1. Students will be able to understand modes of heat transfer, heat rate equation, theory of insulation
2. Students will be able to solve convective heat transfer problems, individual and overall heat transfer coefficient, fouling factor.
3. Students will be able to solve radiative heat transfer problems.
4. Students will be able to understand heat transfer under phase change conditions, boiling & condensation and to design forward and backward evaporators
5. Students will be able to design of double pipe shell and tube exchanger, condensers, extended surface equipment.

LABORATORY:

1. To determine the thermal conductivity of metal rod.
2. To determine the equivalent thermal conductivity of composite wall.
3. To determine heat transfer coefficient in force convection.
4. To determine heat transfer coefficient in Natural convection.
5. To determine heat transfer coefficient with the help of Stefan Boltzmann Apparatus.
6. To calculate emissivity of the test plate by emissivity measurement apparatus.
7. To determine heat transfer coefficient in double pipe heat exchanger.
8. To study the heat transfer characteristics of a shell and tube heat exchanger (heating/cooling) of water.
9. To determine heat transfer coefficient in parallel and counter flow heat exchanger.
10. To measure the rate of evaporation using an open pan evaporator.
11. To measure the rate of condensation of pure water vapour and to determine the heat transfer coefficient.
12. Demonstrate the film-wise drop-wise condensation and determination of the heat transfer coefficient.
13. To study the single effect evaporator and find out the heat transfer coefficient.

EVALUATION:

Evaluation will be continuous an integral part of the class as well through external assessment.

REFERENCES:

Donald Q. Kern; Process Heat Transfer; Tata McGraw Hill.
Alan J. Chapman; Heat Transfer; Collier McMillan.
Rao Y.V.C; Heat Transfer; PHI

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New Scheme Based On AICTE Flexible Curricula

Fire Technology & Safety Engineering, VII-Semester

Departmental Elective, FT 702(A) Fire Fighting Installation

COURSE OBJECTIVE:

1. To describe and design the water based hydrant system in different types of occupancies.
2. To explain the relevant code of practice and design the automatic sprinkler system for a given occupancy.
3. To learn about the foam based fire fighting systems at different applicable fire desirous sites.
4. To solve the problem of fire loss due to water and foam by applying clean extinguishing agent at precious locations.
5. To learn about the special dry chemical and their systems applicable to highly reactive metals.

COURSE CONTENT:

WATER BASED FIRE PROTECTION: Fire water demand calculation, water storage tank capacity, water storage tank equipment and accessories, relationship of air pressure and volume in tanks, calculating fire flow rates by Insurance service office method (ISO), Iowa state university method (ISU), fire flow duration, factors affecting water requirement. Hydrant System- Definition and basic components, Pressure and discharge requirement, spacing between hydrant post, pipe material and size.

AUTOMATIC SPRINKLER SYSTEM: Fundamental of performance- Fire suppression Analogy, Design Consideration, Response time Index, Thermal sensitivity and temperature rating. Sprinkler System layout- Sprinkler system zoning, tree system, looped system, gridded system, placement of mains and branch lines, Sprinkler system spacing, maximum area permitted for protection, spacing between branch lines and sprinklers. Hydraulic calculation and back flow protection. Sprinkler system type- wet pipe system, dry pipe system, pre-action system and deluge system.

FOAM BASED FIRE PROTECTION: System types –Fixed, Semi fixed and mobile foam systems. Fixed cone roof, external floating roof and internal floating roof protection with foam- water sprinkler system. Diked and non diked area protection. Medium and high expansion foam systems, mobile foam apparatus and their application, Foam Fire Fighting at fixed sites- Size of fire, type of fuel, depth of fuel and application rate. Storage tank fire tactics for cone roof, floating roof and horizontal tanks.

GAS BASED FIRE PROTECTION: Halogenated Agents and System- Chemical mechanism, chemical composition, Classification and Properties, Toxic and irritant effect, application systems, flooding system, design consideration- NFPA-12A and NFPA-12B, Halon Replacement agents and systems- Extinguishing Mechanism, Halocarbon agents and Inert Gas agents Ozone depletion, Clean agent system design, Agent quantity and discharge time. Carbon Dioxide Application System- Concentration for extinguishment, life safety consideration NFPA-12, methods of application total flooding, local application, hand hose lines, stand pipe systems and mobile supply, components of carbon dioxide system- Carbon dioxide storage, piping system, valves and operating devices, discharge nozzles, system controls, control panels, alarms. Quantity and venting requirements for different system, use and limitation of systems.

DRY CHEMCIAL BASED FIRE PROTECTION SYSTEM: Method of application, system design NFPA-17, storage of chemical and expellant, system actuation and distribution system. Quantity and application rate of dry chemical. Inspection, testing and maintenance procedures for chemical systems. Listed agents for metal fires MET-L-X powder, Na-X powder, other combustible metal extinguishing agent, non proprietary combustible metal extinguishing agents.

COURSE OUTCOME:

1. Students will be able to describe and design water based fire protection system for a given occupancy.
2. Students will be able to design and estimates the sprinkler system for a given occupancy.
3. Students will be able to explain and evaluate the foam based fire protection systems for class-B liquid fires.
4. Students will be able to justify the use of gaseous based fire protection inside the precious locations.
5. Students will be able to plan chemical powder based fire fighting systems and able to estimate the cost of the system.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

REFERENCES

Fred Stowell, Principles of Foam Fire Fighting International Fire Service Training Association.
Robert M Gagnon, Designer's Guide to Automatic Sprinkler Systems, NFPA-2005.
Operation of Fire Protection System NFPA Special Edition.
Tariff Advisory committee, Fire Protection Manual- Hydrant System.
Tariff Advisory committee, Manual for Water Spray System.
Fire Service Manual, Fire Service Technology Equipment and media Fire Fighting Foam Technical Volume-1.
Arthur E. Cote, P.E., Fire Protection Handbook, Section-10 and 11, National Fire Protection Association.

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New Scheme Based On AICTE Flexible Curricula

Fire Technology & Safety Engineering, VII-Semester

Departmental Elective FT 702(B) Special Fire Hazards

COURSE OBJECTIVES:
To learn about the special locations for hazards such as aviation industry, marine and high-rise building with their control measures.

COURSE CONTENT:

Constructional features of an Air Craft, Types of Engines, Basic Fire-Hazards in Aircraft, Nature of Air Crashes, Emergency Landings including belly leading; Access to Fire Service Personnel and Escape of trapped persons problems, Types of Safety Belts, Ejection-Seats; and their methods of release; Rescue and Fires in Air Craft and methods of fire-fighting; Problems of fire-fighting. Problems in dealing with Air Craft carrying ammunition, bombs nuclear weapons, Action to be taken in case of accidents involving Radio Active Cargo

Hazards in Airport, Protection & Types of Hangers, Refueling and Defiling in Air Cargo, Crash Fire Tender: Provision of Crash, Fire Tenders including Rapid Intervening appliances, Categorization of Air-Port, their extinguishing media and determination of the appliances for each category as per International Standard. B:

Marine Fire- The maritime environment, organizational role, vessel types, construction & systems of fire detection & suppression systems, Vessel plans, drawings & documents, cargo vessel hazards & safety, Incident strategies & tactics training & planning, vessel fire incidents, Marine incidents & Rescue operations.

C:HIGH RISE BUILDINGS
Fundamentals of Fire Safe Building design, Building and site planning for fire-safety, structural integrity during fire confinement of fire in building, Life safety systems for high, rise structures. Evacuation: Need of Evacuation plans in high rise buildings, Making of Evacuation Plans, types of Evacuation, Procedure of Evacuation.

Alarm signaling in high-rise building – Smoke movement in building – Residential highrise building-High-rise building with complex occupancy. Basic fire-fighting strategy. Study of model code of practice for high-rise building in metropolitan cities (Building Bye Laws).

COURSE OUTCOMES:
1. Student will be able to explain constructional features of air craft with safety measures.
2. Student will be able to describe hazards and their protection in all category of airport.
3. Student will be able to explain vessel plan, drawing and document used in marine.
4. Student will be able to explain life safety systems in high-rise buildings.
5. Student will be able to describe building bye laws in metropolitan cities.

EVALUATION
Evaluation will be continuous an integral part of the class as well through external assessment.

REFERENCES

Aero plane knowledge for Rescue Personnel by F. Engineering Division.
Fire Protection and Maintenance of Aircraft by N.F.P.A.
The Fire Hazards of Fuelling Aircraft in the Open by D.S.I.R., H.M.S.O. London.
I.C.A.O. Standard
Marine fire manual
High-Rise building fires and fire safety – N.F.P.A.
High-Rise Fire & Life Safety by B. Hagan
N.F.P.A.
National Building Code of India.

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New Scheme Based On AICTE Flexible Curricula

Fire Technology & Safety Engineering, VII-Semester

Open Elective FT 703(A) Electrical Fire Safety

COURSE OBJECTIVE

1. To learn about measurement and error analysis are a fundamental part of experimental science and also learn about role of transducer in Instrument, Classification.
2. To learn about analog to digital, digital to analog conversion techniques.
3. To learn about the automatic fire detection type and their design.
4. To understand the how to controlling electrical fire hazards.
5. To Teach the effect of electric shocks on human body with its prevention.

COURSE CONTENT:

MEASUREMENT AND ERROR

Accuracy & precision, Sensitivity, Linearity, Resolution, Hysteresis, Loading effect. Measurement of current, Voltage, Power and Impedance. DC & AC Ammeter, AC Voltmeter using Rectifier.

Transducer: Classification of Transducers, Strain Gauge, Displacement Transducer- LVDT (Linear Variable Differential Transformer), Temperature Transducer- RTD (Resistance Temperature Detector), Thermistor, Thermocouple, Piezo Electric Transducer, Optical Transducer- Photo emissive, Photo conductive, Photo Voltaic, Photo- diode Photo Transistor.

DIGITAL MEASUREMENT AND INSTRUMENT

Advantage of Digital instrument over Analog Instrument, DAC (Digital Analog Converter), Variable resistive type, R-2R ladder type, Binary ladder, Weighted Converter using Op-amp and Transistor, ADC (Analog to Digital Converter) - Ramp Technique, Dual slope.

FIRE DETECTION CUM ALARM SYSTEM

Detector and their design- Smoke- Ionization smoke detector, Photo electric smoke detector, Air sampling type smoke detectors, Heat- Rate compensation detectors, Rate of Rise Detector, Electronic Spot type heat detectors, Gas Sensing Fire Detectors, Radiant Energy Sensing Fire Detector- Flame detector, Spark/Ember Detector, Selection of Detector.

CONTROLLING ELECTRICAL FIRE HAZARDS

Over current protection- Relay Fuses, Circuit Breaker, Insulator, Earthing- Their method and applications, Lighting Phenomena & Protection, Cables & Wiring – Polyvinyl Chloride, Mineral Insulated, Silicon Rubber Cable, Cross linked Polyethylene.

ELECTRICAL CURRENT EFFECT IN THE HUMAN BODY

Introduction to electrical safety, Possibility of Getting Electric Shock, Effect of high current, AC shocks versus DC Shock, prevention from Electrical Fire.

COURSE OUTCOME

1. Students will be able to get the basic idea of measurement and the error associated with measurement and differentiate between the types of transducers available.
2. Students will be able to analysis and design digital to analog converter and analog digital converter.
3. Students will be able analyze and design automatic fire detection.
4. Students will be able identity and prevent various electrical hazards.
5. Students will be able to understand impact of electric current in human body.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

REFERENCE

H.S. Kalsi, Electronics Instrument, TMH.
K. Sawhney, Instrumentation & Measurement, Dhanpat Rai & Co.
J. Maxwell Adams, Electrical Safety a Guide to the Causes and Prevention of Electrical Hazards, IEE Power series-19.
D.C. Winburn, Practical Electrical Safety, Marcal Dekker.
S.Rao, Prof. H.L. Saluja, Electrical Safety, Fire Safety Engineering and Safety Management.

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New Scheme Based On AICTE Flexible Curricula

Fire Technology & Safety Engineering, VII-Semester

Open Elective FT 703(B) Safety in Textile Industry

COURSE OBJECTIVE:

To understand and identify the hazards associated in textile industry with safety management system.

COURSE CONTENT:

INTRODUCTION
Introduction to process flow charts of short staple spinning, long staple spinning, viscose rayon and synthetic fibre, manufacturer, spun and filament yarn to fabric manufacture, jute spinning and jute fabric manufacture-accident hazard, guarding of machinery and safety precautions in opening, carding, combing, drawing, flyer frames and ring frames, doubles, rotor spinning, winding, warping, softening/spinning specific to jute.

TEXTILE HAZARDS I
Accident hazards, sizing processes- cooking vessels, transports of size, hazards due to steam, Loom shed shuttle looms and shuttless looms, knitting machines, non-wovens.

TEXTILE HAZARDS II
Scouring, bleaching, dyeing, punting, mechanical finishing operations and effluents in textile processes.

HEALTH AND WELFARE
Health hazards in textile industry related to dust, fly and noise generated-control measures-relevant occupational diseases, personal protective equipment-health and welfare measures specific to textile industry, Special precautions for specific hazardous work environments.

SAFETY STATUS
Relevant provision of factories act and rules and other statues applicable to textile industry – effluent treatment and waste disposal in textile industry.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

REFERENCES

100 Textile fires – analysis, findings and recommendations LPA
Groover and Henry DS, Hand book of textile testing and quality control
Quality tolerances for water for textile industry, BIS
Shenai, V.A,. A technology of textile processing, Vol.I, Textile Fibres
Little, A.H.,Water supplies and the treatment and disposal of effluent
Safety in Textile Industry Thane Belapur Industries Association, Mumbai.

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New Scheme Based On AICTE Flexible Curricula

Fire Technology & Safety Engineering, VII-Semester

Open Elective FT 703(C) Safety in Mines

COURSE OBJECTIVE:

To understand and identify the hazards associated in mines with safety management system.

COURSE CONTENT:

OPENCAST MINES
Causes and prevention of accident from: Heavy machinery, belt and bucket conveyors, drilling, hand tools-pneumatic systems, pumping, water, dust, electrical systems, fire prevention. Garage safety – accident reporting system-working condition-safe transportation – handling of explosives.

UNDERGROUND MINES
Fall of roof and sides-effect of gases-fire and explosions-water flooding-warning sensors-gas detectors-occupational hazards-working conditions-winding and transportation.

TUNNELLING
Hazards from: ground collapse, inundation and collapse of tunnel face, falls from platforms and danger from falling bodies. Atmospheric pollution (gases and dusts) – trapping –transport-noise- electrical hazards-noise and vibration from: pneumatic tools and other machines – ventilation and lighting – personal protective equipment.

RISK ASSESSMENT
Basic concepts of risk-reliability and hazard potential-elements of risk assessment – statistical methods – control charts-appraisal of advanced techniques-fault tree analysis-failure mode and effect analysis – quantitative structure-activity relationship analysis-fuzzy model for risk assessment.

ACCIDENT ANALYSIS AND MANAGEMENT
Accidents classification and analysis-fatal, serious, minor and reportable accidents – safety auditsrecent development of safety engineering approaches for mines-frequency rates-accident occurrenceinvestigation-measures for improving safety in mines-cost of accident-emergency preparedness – disaster management.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

REFERENCES

Kejiriwal, B.K. Safety in Mines, Gyan Prakashan, Dhanbad, 2001.
DGMS Circulars-Ministry of Labour, Government of India press, OR Lovely Prakashan-DHANBAD, 2002.
Michael Karmis ed., Mine Health and Safety Management, SME, Littleton, Co.2001.

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New Scheme Based On AICTE Flexible Curricula

Fire Technology & Safety Engineering, VII-Semester

FT 704 Fire Fighting Drills

COURSE OBJECTIVE:

To understand and command aim, principle and instruction method of squad drill and fire fighting drills.

COURSE CONTENT

LABORATORY:

1. Introduction
2. Aim of Drill
3. Basic Principles
4. Squad Drill
5. Appliance Drill
   - Hose drill
   - Hydrant drill
   - Pump drill
   - CFT drill
   - Ladder drill
   - Ambulance drill
6. Miscellaneous Drill
   - Knots
   - Rescue Techniques
7. Emergency Evacuation Drill
8. Fitness Training
   - Yoga
   - Meditation
   - Physical training
9. Emergency Communications

COURSE OUTCOME

1. Student will able to conduct and command squad drill of fire fighting crew in an organization.
2. Student will able to trained fire fighting crew in different squad drills and fire fighting drills.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

REFERENCES

AFS – Drill Manual

Drill manual for Fire Services of India by Govt. of India.

Fire Fighters Skill drill manual by NFPA.

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Fire Technology & Safety Engineering, VII-Semester

FT 705 Fire Protection Lab

COURSE OBJECTIVE:

To understand the layouts drawing used in fire protection plan of different occupancy and familiarize the water demand calculation with fundamental of pipe design.

COURSE CONTENT:

Design Procedure for Internal Water Supply System- flow rate (Q) and Loading Units (Z) – From Probability Equation - Hazen Williams Formula for Head Loss Calculations.

Internal Water Supply Piping Sizing Calculations- Pumping Calculations- HP / Watts -Number of tapping to be connected in Bigger Diameter Pipe, Material used in Internal Water Supply System. External water Supply System Number of populations Served Number of fixtures served by each pipe.

Design Procedure for external water supply system - External water supply pipe sizing calculations - Material used in external water supply system - Water Supply schematic Layout - Plumbing Drawings, Design of Fire Protection Schematic Layouts & Pipe sizing - Design of Fire water storage & pumping calculations

LABORATORY:

1. To draw the suction and delivery arrangement of main, standby and jockey pump for a given sample of pump house and calculate the fire water demand.
2. To summarize the Sprinkler system components and draw the sprinkler installation for a given sample of an occupancy.
3. To recognize the major components of hydrant system and draw the hydrant system installation for a given sample of an occupancy.
4. To plan the foam based fire protection system and design for medium and high expansion foam system inside a given sample of flammable liquid tank.'
5. To analyze and evaluate the inert gas fire protection system drawing for a given sample of an occupancy.
6. To draw the major components of dry chemical based fire protection system in a given sample of hazardous location.
7. To draw and analyze the components of water spray system in a given sample of LPG bullet storage facility.
8. To draw and describe the components water mist/emulsify system for a given sample of transformer model.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

REFERENCES

Fred Stowell, Principles of Foam Fire Fighting International Fire Service Training Association.
Robert M Gagnon, Designer's Guide to Automatic Sprinkler Systems, NFPA-2005.
Operation of Fire Protection System NFPA Special Edition.
Tariff Advisory committee, Fire Protection Manual- Hydrant System