

SE 601 LEGAL ASPECTS OF SAFETY, HEALTH AND ENVIRONMENT

MODULE - I

Factories Act– Definitions, Preliminary, Inspecting staff, Health, Safety, Provisions relating to hazardous processes, Welfare, Working hours of adults, Employment of young persons, Special provisions.

Dock workers (Safety, Health and Welfare) Act and Regulations - Definitions, Powers of Inspectors, Power of Govt. to direct Inquiry, Obligation of dock workers. Duties of Safety Officers, Reporting of accidents, Emergency Action Plan, Safety Committee.

MODULE - II

Workmen’s Compensation Act: Definitions, Employer’s liability for compensation, Calculation of amount of compensation. **ESI Act and Rules:** Applicability to Construction, Definitions and Benefits as per the Act & the Rules.

Public Liability Insurance Act and Rules- Definitions, Calculation of amount of relief, Environmental Relief Fund, Advisory Committee, Powers of District Collector, Extent of Liability, Contribution to Relief Fund.

MODULE – III

Explosives Act and Rules - Definitions, Categories of Explosives, General Safety Provisions, Use of Explosives Grant of license, Notice of Accidents, Inquiry into ordinary and more serious accidents, Extension of definition to other explosive substances.

Petroleum Act & Rules - Definitions, Control over Petroleum import, transport, storage, production, refining and blending, Need for license, exemption, Notice of Accidents and Inquiries.

MODULE- IV

Water Act- Definitions, Powers and Functions of Boards, Provisions regarding prevention and control of water pollution, Power to make rules, Rules on Consent for Establishment and Operation.

Air Act - Definitions, Power & Functions of Boards, Prevention & Control of Air Pollution, Consent as per Air Pollution Rules. **Environment (Protection) Act and Rules-** Definitions, general powers of central government, prevention, control and abatement of environmental pollution, standards for emission, prohibition and restrictions on siting and operation of industries. **MSIHC Rules-** Definitions, Duties of Authorities, Notification of Major Accidents Safety Reports, Safety audit, MSDS, On-site & Off-site Emergency Plan, Giving safety information to public.

References

1. Factories Act, 1948 with amendments of 1976 & 1987.
2. Dock Workers (SHW) Act, 1986; Rules, 1990 & Regulations, 1990.
3. Explosives Act and Rules.
4. Petroleum Act and Rules.
5. Environmental Acts & Rules as above.

Type of Questions for University Examination

Q1. Eight short answer questions of 5 marks each with two questions from each of the four modules.

Q2 to Q5 : Two questions A & B of 15 marks from each module with option to answer either A or B.

SE 602 CHEMICAL PROCESS SAFETY

MODULE I

SAFETY IN THE DESIGN OF CHEMICAL PROCESS PLANTS :-Design principles – reliability and safety in designing – inherent safety – engineered safety - piping and instrumentation – safety during startup and shutdown – safety checks in the design of the equipments – reactor safety - safety in erection and commissioning of chemical plants - non destructive testing methods – pressure and leak testing – emergency safety devices – scrubbers and flares – new concepts in safety design and operation- Pressure vessel testing standards - Gas cylinder rules, SMPV rules – Inspection techniques for boilers and reaction vessels.

MODULE II

SAFETY IN THE OPERATION OF CHEMICAL PROCESS PLANTS:- Properties of chemicals – Material Safety Data Sheets – the various properties and formats used – methods available for property determination. Operational activities and hazards –standards operating procedures – safe operation of pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping systems – effects of pressure, temperature, flow rate and humidity on operations – corrosion and control measures- condition monitoring - control valves – safety valves – pressure reducing valves, drains, bypass valves, inert gases. Chemical splashes, eye irrigation and automatic showers.

MODULE III

SAFETY IN THE STORAGE AND HANDLING OF CHEMICALS AND GASES :-Types of storage-general considerations for storage layouts- atmospheric venting, pressure and temperature relief – relief valve sizing calculations - storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation – pipe line transport – safety in chemical laboratories. Safety provisions like level and flow indicators – alarms, trips – protection of stills, columns and towers from lightening – colour coding for pipe lines and cylinders.

MODULE IV

CHEMICAL REACTION HAZARDS : Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self – heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening, Case studies. Stability and sensitivity tests, Classification of materials with explosive potential, Hazard prediction by thermodynamic calculations, Prevention and control of explosions and detonations – diluting a release, purging and inerting, venting, explosion relief, flame arrestors, explosion suppression, Classification of hazardous areas.

References :

Ralph King and Ron Hirst, *King's Safety in the Process Industries*, Arnold, London, 1998
Industrial Environment and its Evolution and Control :NIOSH
Accident Prevention Manual for Industrial Operations :Vol. I & II NSC Chicago
Sax N Irvin, *Dangerous properties of industrial materials*

Type of Questions for University Examination

Q1. Eight short answer questions of 5 marks each with two questions from each of the four modules.
Q2 to Q5 : Two questions A & B of 15 marks from each module with option to answer either A or B.

SE 603 PROCESS INSTRUMENTATION AND CONTROL ENGINEERING

Module I

Elements of measurement – Fundamental standards, Quality of measurement, Meaning of measurement, Errors in measuring instruments, Precision and accuracy, Calibration principle, Static and dynamic characteristics of measuring instruments.

Measurement of temperature – Bimetallic and pressure thermometers, Thermocouples, Resistance thermometers, Pyrometry, Calibration.

Pressure and vacuum measurement – Manometers, Measuring element, Absolute pressure measurement, Static accuracy of pressure gauges.

Module II

Flow measurement - Orifice installation, Pitot tube, Area flow meters, Open channel meters.

Level measurement – Direct method, Measurement of level in open and pressure vessels.

Measurement of pH and humidity.

Recording Instruments, Indicating and signaling instruments, Signal transmission, and codes.

Module III

Open loop and close loop systems – Transfer function modeling – block diagram representation of mechanical, thermal and liquid level systems.

Transient response analysis – Time response of first and second order system for impulse and step inputs – Effect of damping factors on transient response – Characteristics of proportional, integral, derivative, PI, PD and PID controllers.

Frequency response method of analysis – polar plot – Bode Plot.

Module IV

Introduction to stability – Definition via impulse response function – Routh-Hurwitz stability criterion – Nyquist stability criterion.

Control system components – error detectors – modulators and demodulators – Hydraulic controllers – Pneumatic controllers – PLC.

Introduction to computer control in chemical process industry.

Comparison between discrete data, digital and analogue control systems. Introduction to digital signal processing.

Text Books

1. D Patranabis, *Principles of Industrial Instrumentation*, Second Edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 1996.
2. George Stephanopolous, *Chemical Process Control : An Introduction to Theory and Practice*, Prentice Hall of India Pvt. Ltd, 1990.

References

1. Eckman D P, *Industrial Instrumentation*, Wiley Eastern Ltd, New Delhi, 1990.
2. Ogata, K., *Modern Control Engineering*, Prentice Hall, 1995.
3. Benjamin C. Kuo., *Digital Control Systems*, Oxford University Press, 1992.
4. Stefani R.T, Shahian B, Savant J.C and Hostetter G. H, *Design of Feedback Control Systems*, Oxford University Press, 2002.

Type of Questions for University Examination

Q1. Eight short answer questions of 5 marks each with two questions from each of the four modules.

Q2 to Q5 : Two questions A & B of 15 marks from each module with option to answer either A or B.

SE 604 FIRE ENGINEERING- III

MODULE- I

Fire detection- Need and importance of automatic fire detection system, principle of detection, classification of detectors; Heat detectors – fixed temperature, rate of rise, thermistor rate of rise and rate compensated type detectors; Smoke detectors- optical and ionization type, photo electric light scattering and light obstruction type detectors; Flame detectors – infra red and ultra violet detectors; Flammable gas detection- Pellistor and laser detectors; Testing of fire detection devices as per relevant Indian standards(ISI); Comparison of detectors; Performance characteristics of detectors; Lag time associated with fire detection.

MODULE -II

Principles of Fire Extinguishments-extinction of premixed flames, diffusion flames and burning metals, fire triangle, fire tetrahedron; Basic concept of fire fighting with water, carbon dioxide, powders, foams, inert gases halons; Need for halon replacement and halon substitutes; Extinguishant performance- flame extinguishing concentration, inerting concentration, fire trials.

First aid fire protection – fire bucket, sand bucket, fire blanket, fire pails & water barrels, hoses; Description, working principle, method of operation of different types of portable fire extinguishers- water type, foam type, dry powder type, CO₂ type, vapourizing liquid type; Care, inspection, and maintenance of portable extinguishers;

MODULE –III

Automatic water sprinkler system- requirement and source of water supply, automatic pumps; Automatic sprinkler heads-Quartzoid type, fusible link type, modern types; mounting and protection of sprinkler heads; Sprinkler pipe works-standard and staggered lay out, hangers; Control valves for wet and dry installations; deluge valve. Drenchers; High velocity and medium velocity spray system; Principles of sprinkler system design as per relevant standards (ISI).

Fixed fire fighting system using CO₂, Dry chemical powder, and Foam - concept of total flooding and local application, advantages and disadvantages of each system; Basic system components; Design principles of fixed fire fighting systems for total flooding and for local application as per relevant standards (ISI).

MODULE -IV

Fire alarm system- classification of alarm system as per NBC; Manually operated system; Automatic alarm system; Component and features of Local system, Auxiliary system, Remote station system, Central station system and Proprietary system

Fire ground operations - preplanning, action on arrival and control, methods of rescue, methods of entry. Personnel safety. Control procedure and use of other safety equipment. Ventilation and salvage operations.

Text Books

1. Ron Hirst, “*Underdowns Practical Fire Precautions*”, Gower Publishing Company Ltd., England, 1989.
2. Jain V.K., “*Fire Safety in Buildings*”, New Age International (P) Ltd., New Delhi, 1996
3. Clark, W.E., “*Fire fighting principles & practices*”,
4. HMSO : *Manual of Firemanship, No. 4 to 7.*

Reference Books

1. Kevin Cassidy, “*Fire Safety and loss Prevention*”,
2. N F P A, “*Fire Protection Hand Book*”,
3. Hubert Walker, “*Preventive maintenance/Apparatus*”,
4. Ervin L.W., “*Fire fighting apparatus and procedures*”,
5. *Fire services manual Vol 1 & Vol 2*

Type of Questions for University Examination

Q1. Eight short answer questions of 5 marks each with two questions from each of the four modules.

Q2 to Q5 : Two questions A & B of 15 marks from each module with option to answer either A or B.

SE 605 ENVIRONMENTAL ENGINEERING AND MANAGEMENT

Module I

Air pollution- Sources of air pollution, effects of air pollution , classification of pollutants, Atmospheric transport of pollutants-wind profiles, atmosphere stability, inversion, turbulence, dispersion and diffusion of air pollutants, Gaussian plume dispersion model. Principles and techniques of ambient air and stack emission monitoring; Particulate matter control equipment-working principles of gravity settlers , cyclones, wet scrubbers, fabric filters and electrostatic precipitators; Gaseous control methods- an overview of absorption, adsorption and combustion methods; Biological methods for VOC and odour control.

Module II

Physical, chemical and biological characteristic of waste water; Effects of pollutants on water quality and aquatic life; Physical unit operations in waste water treatment- flow equalization, sedimentation, and flotation; Chemical unit processes in waste water treatment- coagulation and flocculation, chemical precipitation and adsorption; Biological unit processes- kinetics of microbial growth, Aerobic treatment systems: working principle and design parameters of trickling filter, activated sludge process, and rotating biological contactor; Anaerobic treatment systems: mechanism of anaerobic process, low rate and high rate digesters, working principle and applications of anaerobic filters and UASB; Biological nitrification –denitrification; Characteristics and treatment methods for the waste water from fertilizer plants, petroleum refineries, pulp and paper mills and distilleries.

Module III

Solid wastes- environmental ,aesthetic and health risk; Sources, quantities and composition of solid wastes; Storage, collection and transportation of urban solid waste, disposal options- sanitary land fills, composting and its variations, anaerobic digestion, incineration and pyrolysis; Vermi composting; Recovery alternative ; Monitoring of solid wastes. Hazardous wastes- definition and classification, health and environmental effects, treatment, disposal and management of hazardous wastes, legal frame work for hazardous waste management in India.

Module IV

Environmental management in industries- Principles and requirements of ISO 14001 EMS; Environmental auditing and auditing for waste minimization; Environmental impact assessment-description of the environmental setting, prediction and assessment of impacts, methods of impact analysis, Indian scenario, public participation in environmental decision making. Strategies for pollution prevention – recycle and reuse, cleaner technologies. Life cycle assessment – principle and methodology. The concept of industrial ecology. Clean development mechanism (CDM) – carbon trading.

Text Books :

1. C.S. Rao : *Environmental Pollution Control Engineering*, New Age International (P) Ltd Publishers, 1991.
2. M.N. Rao and A.K. Dutta : *Wastewater Treatment*, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi, 1987.

References :

- 1) Pavani, J. L: *Handbook of solid waste Disposal and Management*
- 2) Metcalf and Eddy Inc.: *Waste Water Engineering: Treatment , Disposal , Reuse*
- 3) Canter. L.W :*Environmental Impact Assessment*
- 4) Liu, I (Ed):. *Environmental Engineers Handbook (2nd Edn)*

Type of Questions for University Examination

Q1. Eight short answer questions of 5 marks each with two questions from each of the four modules.
Q2 to Q5 : Two questions A & B of 15 marks from each module with option to answer either A or B.

SE 606 OCCUPATIONAL HEALTH AND HYGIENE MANAGEMENT

MODULE I

Concept and spectrum of health- functional units and activities of occupational health services- occupational and work related disease- Levels of prevention of diseases – notifiable occupational diseases such as silicosis, asbestosis, pneumoconiosis, siderosis, anthracosis, aluminosis and anthrax - Lead-Nickel, chromium and manganese toxicity- gas poisoning (such as CO, ammonia, coal and dust), their effects and prevention - Industrial toxicology – local and systemic and chronic effects, temporary and cumulative effects – threshold limit values, calculation of TLVs – carcinogens, mutagens, teratogens.

MODULE II

Recognition, evaluation and control of physical hazards. Vibration –description and measurement of vibration. Vibration control methods. Effects of whole body vibration on human body and control measures.

Noise- noise measurement, evaluation, noise control methods -hearing loss – causes - Biological effects of noise exposure.

Thermal stress – heat disorders and health effects such as heat exhaustion, heat cramp etc. WBGT index, acclimatization.

Ventilation systems - purpose of ventilation-general principles ventilation requirements. Physiological and comfort level . Natural ventilation - Dilution ventilation - Mechanical ventilation - Local exhaust ventilation - Ventilation measuring instruments. Fundamentals of hood and duct designs. Standards on ventilation.

MODULE III

Man as a system component-allocation of functions-efficiency-occupational work capacity-aerobic and anaerobic work- steady state- evaluation of physiological requirements of jobs-parameters of measurements- categorization of job heaviness – work organization – stress-strain-fatigue-rest pauses- -audiometric test- hearing conservation programme -vision test- vital function test- pre- employment and periodic employment medical examinations. Biological rhythms, shift work and occupational health..

Purpose of lighting. Advantages of good illumination. Lighting and the work. Sources and kinds of artificial lighting principles of good illumination. Design of lighting installation. Maintenance. Lighting and colour. Standards on lighting and illuminations.

MODULE IV

Biological hazards- agents- types sources and prevention. Recognition, evaluation and control of chemical hazards-types-dust-fumes-mist-vapour – fog etc., air contaminants – evaluation – types of sampling – air sampling system – methods of analysis – control measures. Ionizing and non ionizing radiation, Radiation protection. Instruments for Radiation detection and measurement. Early recognition of radiation hazard - personal monitoring devices, Medical support. Hazards associated with the following radiations and preventive measures- Laser, infra red, ultra violet and ELF. Personal protection in the working environment, Types of PPEs, Personal protective equipment- respiratory and non respiratory equipment. Standards related to PPEs.

REFERENCES:

1. *Encyclopaedia of Occupational Health and Safety* : Vol I & II - ILO
2. *Industrial Environment and its evaluation and control* : NIOS
3. D Hunter, *Diseases of Occupation* .
4. M.K. Poltey, *Occupational Health & Safety in manufacturing industries*.
5. Clayton & Clayton, *Patty's Industrial Hygiene and Toxicology* :
Type of Questions for University Examination

Q1. Eight short answer questions of 5 marks each with two questions from each of the four modules.

Q2 to Q5 : Two questions A & B of 15 marks from each module with option to answer either A or B.

SE 607 ENVIRONMENTAL ENGINEERING & MANAGEMENT LAB

1. Determination of pH, turbidity, total hardness, total solids and dissolved oxygen of water samples.
2. Determination of BOD and COD of waste water samples.
3. Jar test for determining the optimum coagulant dose for water treatment.
4. Determination of kinetic constants of activated sludge process.
5. Determination of sulphur dioxide, oxides of nitrogen and particulate matter from chimney sources.
6. Determination of particulate matter, chlorine, ammonia, carbon monoxide and sulphur dioxide in ambient air.
7. Analysis of lead and other heavy metals in air using spectroscopy.
8. Study of pollution prevention and control facilities in industries.
9. Preparation of Environmental Impact Statement (EIS) for an industrial project.
10. Preparation of an Environment Audit Report.

Note : 50 % marks is earmarked for continuous evaluation, and 50 % marks for end semester examination to be assessed by two examiners. A candidate shall secure a minimum of 50 % marks separately for the two components to be eligible for a pass in that subject.

SE 608 MINOR PROJECT

Each batch comprising of around 5 students shall identify a project related to the curriculum of study. At the end of the semester, each student shall submit a project report comprising of the application and feasibility of the project.

Guidelines for evaluation :

1. Attendance and regularity	20
2. Theoretical knowledge and individual involvement	30
3. Quality and contents of project report	30
4. Presentation	20
Total	100 Marks