CERTIFICATE COURSE IN CHEMICAL SAFETY

(6 MONTHS DURATION)

STATE BOARD OF TECHNICAL EDUCATION AND TRAINING
SANKETHIKA VIDYA BHAVAN,
MASAB TANK, HYDERABAD – 500 028

LIST OF EQUIPMENT (EQUIPMENTS FOR PRACTICALS)

S.No	Equipment	Qty. Required No's.
1	Noise Measuring Instrument	1 No's
2	Fire Protection Equipment - Fire extinguisher- different types-CO2, Foam, ABC, DCP	2 No's Each
3	Lux Meter	1 No's
4	Fire Hydrant (with Sufficient Water Capacity) and Different types of Monitors and Nozzles	1 No's
5	Different types of PPE	2 No's each
6	First Aid Box	1 No.
7	SCBA (Self Contained Breathing Apparatus) set	1 No.

CHEMICAL SAFETY SUPERVISOR COURSE

SCHEME OF INSTRUCTION AND EXAMINATION

Subject Code	**Name of the Subject**	**Scheme of Examination**			
		Duration	**Sessional**	**End exam marks**	**Total Marks**
CH-101	Principles of Accident Prevention, Hazard Identification Techniques, Control Techniques	3 HRS	--	100	100
CH-102	Chemical Safety, Industrial Hygiene, Chemical Emergency Procedures & Fire Safety	3 HRS	--	100	100
CH-103	Project Work	3 HRS	40	60	100
	Total	--	40	260	300

Subject Title : Principles of Accident Prevention, Hazard Identification Techniques,Control Techniques

Subject Code: CH-101

Periods / weeks: 15

Periods / Year 60

TIME SCHEDULE

S.No	Topic	No. of Periods	Short Questions (5 Marks each)	Long Question s (12 marks each)
1	Basic Philosophy of Industrial Accident – Causation & Prevention	12	1	1
2	Techniques of Identification of Hazards	10	2	1
3	Prevention & Control Techniques	8	1	1
4	Counseling and Motivating for Safety & Health	10	1	1
5	Statutory Provisions	12	2	2
6	Safety Audit, Accident Investigation and Analysis	8	1	2
	Total	60	8	8

Detailed Contents

Chapter No.	Contents
1	**1.1 Basic Philosophy of Industrial Accidents – Causation & Prevention** ➢ 10 axiom of industrial Safety, theories of accidents occurrence ➢ Heinrich domino sequence ➢ Updated frank bird model ➢ Multi-causation theory ➢ Foundation of Major Injury ➢ Basic Motives for the occurrence of unsafe acts, basic methods for preventing accidents, ➢ Accident Causation Models **1.2 Safety & Health Policy:** ➢ Legal requirement for safety policy, basis for formulation & effective implementation of safety policy. ➢ Areas to be touched in safety policy **1.3 Types of hazards:** ➢ Physical- Heat stress, Noise, Fatigue, Radiation, Vibration, Illumination ➢ Chemical- Exposure to toxic material, contact with corrosivematerial, spillage ➢ Electrical – Fire, Burn, Shock ➢ Mechanical - Hazards due to on running nips of machinery parts & mechanism, working at height, hazards due to improper manual & mechanical handling. **1.4 Role of Supervisor in promotion Safety & Health:** ➢ Responsibilities of Supervisors, Acceptance of Responsibility for Safety ➢ Role of Supervisor in Safety **1.5 Formulation of Accidents Prevention Programme:** ➢ Planning- Management leadership, Goal setting, budgeting

	➢ Organising- Organisation structure, delegation of power, span of control, safety education & training and 5 min. pep talk, safety content. ➢ Directing- Communication system, safety committee, safety manual, SOP's, suggestion scheme. ➢ Coordinating- Motivational Activities (safety contest, display ofposters, celebration of safety day and safety week) ➢ Controlling- Accidents reporting, record & analysis, accountability, surveillance. **1.6 Case Study** ➢ Bhopal disaster, Flixborough disaster, Mexico disaster etc.
2	Techniques of Identification of Hazards **2.1 Plant Safety Inspection:** • Responsibility for inspection, types of inspection, planning for inspections, conducting inspections, inspection report, Development of checklist for storage & process areas and Safetysampling. **2.2 Hazard & Operability Study:** • Objective, operation deviation, guide words, principles of examination, methodology, benefits of HAZOP study and a casestudy. **2.3 Job Safety Analysis:** • Responsibility for J.S.A. & its use, conducting J.S.A. with an example **2.4 Hazard Identification and Risk Assessment (HIRA)** • HIRA work sheets, Risk Matrix, Probability and Consequence, Prevention and Control Measures
3	**PREVENTION & CONTROL TECHNIQUES** 3.1 Dilution & Substitution

	❖ Substitution – Replacing material/process with less hazardous substances/process ❖ Dilution – Handling of material in dilute from like use of dilute nitric acid in place of concentrated fuming nitric acid & similar examples 3.2 Isolation & Segregation – ❖ Material Classification for volatile liquid, Electrical Area Classification and Various methods of Isolation of equipment & Pipelines 3.3 Enclosure, Barricading and Guarding ❖ Equipment Barricade & Provision of enclosures; Principles of machine guarding, type of guards, Selection, Maintenance & Repair of Guards – Interlocks 3.4 Industrial Ventilation ❖ Types of Ventilation and their application
4	**COUNSELLING AND MOTIVATING FOR SAFETY & HEALTH** **4.1 Total quality management and ISO Series** **4.2 Communication skills for safety & health at work:** • Types of communication, barriers of effective communicationand how to overcome these barriers. **4.3** Total Safety Culture • Risk Behaviour • Discretionary Performance • Motivational Models • Human Errors – Predictions, Prevention and Control
5	**STATUTORY PROVISIONS** **5.1 The Factories Act & Rules** ➢ Definition – Adult, Adolescent, Young Person, Child, Competent Person, Hazardous Process, Manufacturing Process, Worker, Factory, Occupier ➢ General duties of occupier & manufactures, power of Inspectors & certifying surgeons

	➢ Provisions relating to Safety, Health & Welfare measure and rulesmade there under ➢ Dangerous operations and schedule on chemical works - Notice of accidents, dangerous occurrences and Certain diseases - Obligation & Right of workers **5.2 : Environmental Protection Act** ➢ Manufacture, Storage & Import of Hazardous chemical rules, 1989 ➢ Hazardous waste (Management & Handling) Rules, 1989 **5.3 : Petroleum Act & Rules** ➢ Petroleum & its classification ➢ General Provisions for transportation of petroleum by vehicles & pipelines ➢ Bulk storage, type of licenses & their terms and conditions ➢ Electric Installation in Hazardous areas **5.4 : Indian Explosive Act & Rules** ➢ Handling, Precautions & General Provisions of explosive rules1983 ➢ Classification of explosives & safety distances, Magazines & Store house, transport of explosive by road **5.5 : SMPV Rules** ➢ Definition of design pressure, Pressure Vessel, Compressed Gas,Filling Density ➢ Testing & Inspection of Pressure Vessels - Fittings on Vessels ➢ Provision relating to loading & unloading other operations ➢ General Provision for storage & licenses for storage and import ➢ Any other notification under SMPV rules, 1981 **5.6 : Indian Boiler Act & Rules** ➢ Definition of Boiler - Inspection procedure & Preparation of boilerfor inspection & Hydraulic tests - Defects & repairs of boilers **5.7 : Insecticide Act & Rules -** General Provisions **5.8 : Gas Cylinder Rules**

	• General Provisions, Licence, Notice of accidents, Conditions for storage of LPG Cylinders
6	**Safety Audit and Accident Investigation, Analysis** **6.1 Safety Audit:** • Safety Audit – Definition, Objectives, Types of Audit, Methodology, Developing checklist for safety audit – technical aspects & management aspects. **6.2 Accidents Investigation:** • Need for accidents investigation, pre-accident plan, investigation at accident site, persons to make investigation, identifying key fact & causes, first aid report, supervisor's investigation report, notification of accident, accident record register, personal injury record card. **6.3: Accidents Analysis:** • Injuries, employment, No. of working factories, rate of injuries, injuries by states/union territories, injuries by industries, injuries by causes. • Frequency Rate, Severity Rate, Incidence Rates, Accident-free period, uses accidents rates. **6.4: Principal factors for Classification:** • Standard classification of factor associated with accident. (IS- 3786)

Subject Title : **Chemical Safety, Industrial Hygiene, Chemical Emergency Procedures & Fire Safety**

Subject Code : **CH-102**

Periods / weeks : **15**

Periods / Year : **90**

TIME SCHEDULE

S.No	Topic	No. of Period s	No. of Short Questions	No. of Essay type Questions
1	Chemical Hazards and	14	2	2
2	Control Methods	12	1	1
3	Fire and Explosion Hazards	20	2	2
4	Health hazards due to chemical exposure	15	1	1
5	Chemical Emergency Procedures	20	1	2
6	Behavioral Based Safety	9	1	
Total		90	8	8

DETAILED CONTENTS

CHAPTER	CONTENTS
1	**1.1 CHEMICAL HAZARDS AND SPECIFIC CONTROL MEASURES STORAGE, HANDLING AND TRANSPORTATION OF CHEMICAL –** ▪ Handling and Storage of dangerous materials & their classification(UN); ▪ HAZCHEM Code; ▪ TREM Cards; ▪ Types of Bulk Storage & their layout, Bunds, Pressure Vacuum valves, Flame arresters, Atmospheric Vents, Fire relief Valves, Inspection of storage tanks; ▪ Storage of Chlorine, LPG, ammonia, Class "A" Petroleum Product, Hydrogen; ▪ Loading & Unloading facilities of chemicals; ▪ Hazard Communication **1.2 PERMIT TO WORK –** ▪ Need for permit to work system, areas to be covered, types of work permit, contents of permit format, Monitoring of permit system, confined space work permit system **1.3 SAFETY IN SHUTDOWN & STARTUP PROCEDURES:** ▪ Standard Operating Procedures, Standard Maintenance Procedure, Startup Procedure (Phases of Startup), Typical errors on startup of Plants, Start up after emergency shut down ▪ Shutdown procedure – Normal shut down, Emergency Shutdown ▪ Modification Procedure – Classification of Modification **1.4 COLOR CODING OF PIPELINES, CYLINDERS & VALVES** ▪ Pipe work & valves, Inspection, Examination, Testing of Pipelines, Cylinder Valves, Color coding of Pipe lines (BIS 2379-1990) ▪ Tank farm Safety ▪ Dyke arrangements **1.5 INSTRUMENTATION**

	▪ Basic Instrumentation and designed safety methods like Control of variables like temperature, Pressure level, PH, Density, Flow ratios etc.; Multipoint recorders, Process alarm, Interlock system, Operators records like log book, log sheet; Safety Instrumentation system
2	**2.1 CHEMICAL SAFETY DATA SHEET** • Contents of MSDS of Rules 1989& its preparation • MSDS of Cl2, MSDS of NH3, MSDS of LPG and MSDS ofBenzene; • Hazard Communication
	2.2 PERSONAL PROTECTIVE EQUIPMENT (RESPIRATORY & NON-RESPIRATORY) • Non-Respiratory personal protective devices – Head Protection, Ear Protection, Face and Eye Protection, Hand Protection, Feet Protection, Body Protection; • Use Care & maintenance of PPE; Breathing Apparatus; Classification of respiratory personal protective devices and their uses; • Selection of Respirators
	2.3 HOUSE KEEPING • Typical accidents due to poor housekeeping, Disposal of Scrap &other trade wastes; Prevention of Spillage, Making of Gangways & other locations; Clean up Campaigns
	2.4 PERSONAL HYGIENE & HEALTH AWARENESS • Washing facilities • Drinking water • Facilities for storing work clothing, Personal Clothing, Drying cloths (Clock Room), • Storage of food items in Plant & Prohibition of consuming food etc.; • Special bathing accommodation, Health awareness Do's andDon'ts

3	**FIRE AND EXPLOSION HAZARDS** 1 DEFINITION • Flammability • Flash point • Fire Point • Flammable Range, • Auto ignition • boiling point • vapor pressure • vapor density • ignition energy • Spontaneous ignition
	2 CHEMISTRY OF FIRE • Factors contributing towards fire • Chemistry of fires, Classification of fires • Common causes of industries fires
	3 PORTABLE & FIXED FIRE FIGHTING SYSTEMS • Portable extinguishers • Water system • CO2 System • Foam extinguisher System • Chemical extinguishing system • Fire Detection & Alarm System – Heat Detector, Smoke Detector, Detector for special purpose etc., • Sprinkler system
	4 HAZARDOUS AREA CLASSIFICATION & ELECTRICALINSTALLATION • Hazardous area classification • Control of Hazards due to Static Electricity • Flame proof electrical equipment's • Precautions in their Selection, maintenance & Use

	5DOW FIRE & EXPLOSION INDEX • Knowledge of exothermic & Endothermic reactions & their hazards • Material Factor • Assessment of Fire & Explosion Index • Toxicity Index
	6TESTING AND EXAMIANTION OF FIRE FIGHTING SYTEM • Importance of Maintenance • Preventive Maintenance Program for Portable and Fixed firefighting equipment, • Extinguisher Card, • Fire alarm System inspection, Testing & Maintenance
	7HEALTH HAZARD DUE TO FIRE AND EXPLOSION AND ITS FIRST-AID MEASURES: - Burn, Unconsciousness, Shock
4	**HEALTH HAZARDS DUE TO CHEMICAL EXPOSURE** **UNIT-1: Permissible limit of exposure:** TLV – TWA, STEL, Ceiling, Skin, Additive effect, Nuisance Dust, Carcinogenesis. **UNIT-2: The modes of entry & action of toxic materials:** • Classification of contaminants & route of entry • Physical classification – Gases & vapour, particulate matter like dust, jog, fume, smoke, smog, aerosol etc. • Chemical classification – Irritants, Asphyxiant, Anaesthetics & Narcotics, and Systemic poisons, Sensitizers, particulate matter other than systemic poisons (Bacteria & other microorganisms). **UNIT-3: Work Environment Monitoring – Techniques & Procedures:** • Strategy for representative quantitative surveys. • Air sampling – Integrated sampling, gas sampling, impingement • Analysis of samples – Gravimetric technique, colorimeter procedure & evaluation of samples. • Direct Reading Techniques – colorimetry, explosive meter, other electronic monitor.

	• Industrial Hygiene Engineering Control. **UNIT-4: Demonstration of Equipment in Laboratory** • Measurement of dust concentration in work environment bycounting method using Midget Impinger & Microscope • Estimation of H2S in air • Sampling and analysis of NH3 and Cl2 • Determination of concentration of inflammable vapours • Visit to medical laboratory **Unit-5: Health Monitoring:** • Common occupational diseases & mode of causation of these diseases. • Diagnostic methods & methods of prevention. • Pre employment & periodical medical examination. • Monitoring of occupational health by maintaining records. **UNIT-6: First Aid:** • Artificial respiration techniques and cardiac message (CPR), bandaging, burn, fracture etc.
5	**CHEMICAL EMERGENCY PROCEDURES** **UNIT-1: The Onsite Emergency Plan:** • The general contents of onsite emergency plan, identification of credible events, categorisation of emergency level. • Key persons & their responsibilities, alarms, control room, evaluation, assembly points, medical organisation/responses for major accident hazard control • Rehearsals & Rehabilitation of the affected area. • Medical response in chemical emergency. **UNIT-2: The offsite Emergency Plan:** • Response time, contents of offsite E.P. together withresponsibilities • Role of emergency planning officer.

	• Rules on Emergency, Planning, Preparedness & Responses for chemical accidents-96 **Unit-3: Other Emergency Procedures** • Emergency Eye wash & Showers, • Emergency Kit for Chlorine and Ammonia **Unit-4: Disaster Management Planning** • Disaster Management Planning in Chemical Industries • Disaster Management Act • Legal Compliance
6	**BHEAVIOURAL BASED SAFETY** • Behavioral aspects of Safety • Physiological aspects of Safety • Resilience Engineering

PROJECT WORK

Subject Title : **Project Work**

Subject Code : **CH-103**

Periods/ year **130**

Internal -- 40 Marks

External -- 60 Marks

The external practical examination must be assessed by three persons, one fromIndustry, second from Institution having chemical Engg. Background, Safety Management and the third internal examiner.

External Exam (Marks – 60)

		Marks Secured
1) Data Collection	--	**10**
2) Analytical Applications	--	**10**
3) Result	--	**10**
4) Report	--	**15**
5) Viva Voice	--	**15**
		60

"Pass marks in Project Work: 50% in external examNo minimum for Internal Exam"

REFERENCE LITERATURE

BOOK NAME	AUTHOR NAME
Fundamentals of Industrial Safety and Health Volume I & II	Dr. KU Mistry
Safety in Chemical Plants/Industry & ITS Management	Dr. BK Bhaskar Rao, RK Jai, Vineet Kumar
Industrial Safety, Health and Environment Management Systems	RK Jain, Sunil S Rao
Safety Occupational Health & Environment Management Systems	SC Sharma, Vineet Kumar
Fire Fighting (Volume-I)	Barendra Mohan Sen
Fire Technology (Second Edition)	RS Gupta
Manual of Fire Safety	N Sesha Prakash
Industrial Safety Management	Nishith Kumar Tarafdar, Koustuv Jyoti Tarafdar
Practical Guide to Electrical Safety	RK Jain
Hand book of Fire Technology	RS Gupta, Universities Press
Guide Book on Safety	National Safety Council
Principles of Fire Safety Engineering	Anilkumar Das
Practical Boiler Operation Engineering and Power Plant	Amiya Ranjan
What went wrong – Case Historeis of Process Plant Disasters – 2nd Edition & 5th Edition	Trever Kletz
Still Going Wrong – Case Historeis of Process Plant Disasters -2nd Editions	Trever Kletz
Practical Process Safety management	Karthikeyan
National Building Code - 2005	
Building Construction	PC Varghese, PHI Learning PVt Ltd,
ISO 9000 to OHAS 18001	DR KC Arora
Environmental Laws	Pendyala Satyanarayana
Manual of HSE Management	Dr. Ram S Hamsagar

Labor Laws	Dr. Madabusi Sridhar
Essentials of Safety Management	HL Kala, A singh, S Ravishkar, SV Kamat
Guidelines for Hazard Evaluation Procedures – Second Edition	Centre for Chemical Process Safety
Scaffolding	Richard Doughty, Longman Scientific & Technical
Guidelines for Chemical Process Quantitative Risk Analysis	Centre for Chemical Process Safety
ABC of Ear, Nose and Throat	Harold Ludman MB, FRCS, Centre for Chemical Process Safety
Essentials of Safety Management	HL Kaila, A Singh, S Ravishankar ,SV Kamat
Rules of Thumb for Chemical Engineers	Carl R Branan, Editor
A Guide to the Ergonomics of Manufacturing	Martin Helander
Hazard and Operability Studies	R Ellis Knowlton
Design of Industrial Exhaust Systems – 4th Edition	JOHN L ALDEN
Cryogenics Safety Manual – A Guide to good practice – 3rd Edition	Safety Panel British Cryogenics council
Engineering Design for Safety	Thomas A Hunter, Ph.D
Safety in Process Plant Design	GL Wells
Respiratory Protection(Principles and applications)	BRYAN SALLANTYNE, PAUL H SCHWABE
Industrial Furnaces – Volume II, III, IV	W Trinks
Risk Management of Chemical	Mervy L Richardvon
Handbook of Ventilation for Contaminant Control	Emey J MnDermatt
Spray Drying Hand Book	K Masters
Boiling, Condensation and Gas – Liquid flow	PB Whalley
Electric Melting Practice	AGE Robiette
Corrosion Guide	Erich Rabald
Effects of Exposure to toxic gases first aid and medical treatment	William Harker

CRC Hand Book of Laboratory Safety – 4th Edition	A KEITH FURR
Industrial Refrigeration Principles, Design and Application	PC Koelect
Impact and Explosion Analysis and Desin	MYH Bangash
The Loss rate concept in Safety Engineering	RL Browning
Monitoring for Health hazards at work	Indira Ashton
Major Industrial Hazards	John Withers- Gower Technical Press
Industrial Health Engineering	Allen D Brandt
Risk Analysis for Process Plant, Pipelines and Transport	JR Taylor, E&FN Spon
Injury Prevention and Control	Edited by Dinesh Mohan and Geetam Tiwari
Injury Control a Global View	Lawrence R Berger
Lessons from Disaster	Trevor Kletz
A Safe Place of work	DWB James,
Guidelines for Technical Management of Chemical Process Safety	Center for Chemical Process Safety
Guidelines for Safe storage and Handling of toxic hazard materials	Arthur D Little, INC
Handbook of Pulp and Paper Technology Second Edition	Keneth W Britt
Pump Operation & Maintenance	TYLER G HICKS
A Guide to practical Human Reliability Assessment	Barr Kirwan
Steel Hand book (A book on Cast iron and Steel Castings)	Published by VISHWAS Techno Publication
Quality Assurance of Pharmaceuticals	Volume 2 , GMP and Inspection, Pharma Book Syndicate
Heat treatment principles and techniques	PV Rajan
SOP Guidelines	DH Shah
Reliability Engineering	E Balaguruswamy

Pharmaceutical Engineering K Sambamurthy

IPCS (International Programme for Chemical Safety) Booklets