

MAHARASHTRA STATE BOARD OF VOCATIONAL EDUCATION EXAMINATION, MUMBAI-51

1	Name of Course	Advance Diploma in Industrial Safety (W.E.F. 2018-19)															
2	Course Code	411217															
3	Max.No.of Students Per Batch	25 Student															
4	Duration	01 year															
5	Type	Part Time															
6	No.Of Days / Week	6 days															
7	No.Of Hours /Days	7 Hours															
8	Space Required	1) Demonstration / Seminar Room - 200 Sq. ft. 2) Classroom - 200 Sq.Ft. Total - 400 Sq.Ft. 3) MOU with Aviation / Pharma / Oiland Gas/ Steel / Shipping / Transportation / Engineering manufacturing / Health. 4) MOU with Laboratory used for Analysis of water and Air Pollution.															
9	Minimum Entry Qualification	Degree in any branch of Engg. Or Technology / Diploma in any branch of engg. Or Technology / Degree in Science with Physics & Chemistry.															
10	Objective Of Course	To create skill manpower for safety in Industry.															
11	Employment Opportunity	Employment opportunity :- 1) Safety Officer in any Industry. 2) Safety Auditor 3) Safety Manager 4) Advisor / Consultant & Safety Analysis 5) SHE Department Self Employment :- 1) Consultant 2) Advisor 3) Auditor															
12	Teacher's Qualification	Degree in Any branch of Engineering with Diploma in Industrial Safety. and 2 Years Experience as a Safety Officer in reputed industries.															
13	Training System	Training System Per Week <table><tr><td>Theory</td><td>Practical</td><td>Total</td></tr><tr><td>6 hrs</td><td>18 hrs</td><td>24 hrs</td></tr></table>										Theory	Practical	Total	6 hrs	18 hrs	24 hrs
Theory	Practical	Total															
6 hrs	18 hrs	24 hrs															
14	Exam System	S. N.	Paper Code	Name of Subject	TH/PR	Hours	Max. Marks	Min. Marks									
		1	41121711	Safety, Health and Environmental Management	TH-I	3 Hrs	100	50									
		2	41121712	Safety Engineering-I	TH-II	3 Hrs	100	50									
		3	41121713	Safety Engineering-II	TH-III	3 Hrs	100	50									
		4	41121714	Quality Control in Occupational Safety, Health and Environment	TH-IV	3 Hrs	100	50									
		5	41121715	Safety, Health and Environmental Legislation	TH-V	3 Hrs	100	50									
		6	41121716	Industrial Hygiene & Occupational Health	TH-VI	3 Hrs	100	50									
		7	41121717	Safety in Chemical Industry	TH-VII	3 Hrs	100	50									
		8	----	Elective Subject	TH-VIII	3 Hrs	100	50									
		9	41121725	Safety , Health and Environmental Management	PR-I	3 Hrs	50	25									
		10	41121726	Safety Engineering – I	PR-II	3 Hrs	50	25									
		11	41121727	Industrial Hygiene & Occupational Health	PR-III	3 Hrs	50	25									
		12	41121728	Project	Project		50	25									
				Total			1000	500									
	Note :- Candidate have to select any one subject for Elective																
15	Code	Subject Name			Code	Subject Name											
	41121718	Safety In Engineering Industry			41121722	Advanced Safety Management And Engineering											
	41121719	Safety In Textile Industry			41121723	Environmental Management											
	41121720	Safety In Transport			41121724	Applied Ergonomics											
	41121721	Safety In Docks															

Theory – I - Safety, Health and Environmental Management

Unit	Contents
1	Role of function of a manager. Element and function of management. Management role, authority, responsibility & poser. Delegation and decentralization of authority. History of safety management in India and abroad. Planning & Organization for safety - Definition, need, nature, principle, policy formulation and effect planning for safety. Organization structure of safety department. Safety committee structure & functions.
2	Directing for safety – Role and function of a leader. Communication with management and employees. Training of worker, training need identification and review of training program. Safety performance in the organisation, safety perception survey and defining safety competencies in organisation.
3	Monitoring for Safety, Health & Environment – Occupational safety, Health & Environment management system, Bureau of Indian standards on safety & Health: 14489-1998 & 15001-2000, ILO and EPA standards
4	Safety suggestion scheme, safety competitions, safety incentives scheme. Appreciation safety culture importance, direct and indirect cost of accident. Analysis of information on accident. Qualitative and quantitative risk
5	Role of safety project manager, Life cycle's. Standards. Methodologies, Managing safety through project cycle, Project Initiation, PMS Process Flow. The Management components: Organise, Plan, Control, The project management safety organisation model, The safety project team, Organisational causes of safety failure in project issues, Performance reporting – monitoring and control, Safety project plan
6	Risk Management Plan – Identifying risks and triggers, Risk response plan, Communication Management Plan - Identifying key stakeholders, Defining information needs and mechanisms Managing project
7	Principles of Accidents Prevention : Definition: Incident, accident, injury, dangerous, occurrences, unsafe acts, unsafe conditions, hazards, error, oversight, mistakes etc. Accident Prevention: Theories/Models of accident occurrences .Principles of accident Prevention. Accident and Financial implication.
8	Safety, Health and Environment (SHE) Education and Training : SHE : Element of training cycle, Assessment of needs. Techniques of training, design and development of training programs. Training methods and strategies types of training. Evaluation and review of training programs. Competence Building Techinque (CBT), Concept for training,safety as a on-line function. Role of Multi-Media, Communication, Applications of Computers. Relevance of WTO regarding Safety, Health and Environment.
9	Introduction to strategy – What is Strategy, Strategic Management, The five competitive forces that shape strategy, Core Competence, Organisational Structure, Process, Culture, Designing Business Level Strategies, Designing Corporate Level Strategies, Global Strategies - Internationalisation: Motivations & Patterns, Building Transnational Corporations, Strategy Implementation & Strategic Change, Leadership & safety Governance, Integrative case study: identifying strengths and weaknesses, Developing strategic options and allocating resources, Evaluation and performance management.
10	Employee Participation in Safety : Employee Participation :Purpose, areas of participation, methods. Role of trade union in Safety Health and Environment Protection. Safety Promotion and Safety Awards and Suggestion Schemes, Safety Competitions Safety Incentives Publicity Schemes, Audio Visual Publicity, other Promotional Methods.
11	Global warming and mitigation measures. Human behavior :Individual differences, behavior as function of self and situation, perception of danger and acceptance of risk, knowledge, and responsibility vis-a-vis safety performance, theories of motivation and their application to safety, role of, supervisors and safety departments in motivation. Conflict & Frustration :Identification of situations leading to conflict and frustration and techniques of management.
12	Management information System : Sources of information on Safety, Health and Environment Protection. Compilation and collation of information, Analysis & use of modern methods of programming, storing and retrieval of MIS for Safety, Health and Environment QCC HS Computer Software Application and Limitations. Status and

Theory – II - Safety Engineering – I

Unit	Contents
1	Machine Operation and Guarding : Principles in machine guarding. Ergonomics of machine guarding. Type of guards, their design and selection. Guarding of different types of machinery including special precautions for wood working, paper, rubber and printing machinery, machine, tools etc. Built-in-safety devices, maintenance and repairs of guards, incidental safety devices and tools.
2	Safety in the use of Machines : Shaping, 2.2 Need for selection and care of cutting tools. Preventive maintenance, periodic checks for safe Operation. Associated hazards and their prevention. Safety in the use of 1) power presses (all types), 2) shearing, 3) bending, 4) rolling, 5) drawing, 6) turning, 7) boring, 8) milling, 9) planning broaching, planting, 10) Grinding, 11) CNCs.
3	Material Handling and Storage of Materials : Manual : Kinetics of manual handling. Maximum loads that could be carried. Lifting and carrying of objects of different shapes, size and weight. Safe use of accessories for manual handling Storage of materials. Safety in stacking and unstacking, floor loading conditions. Layout condition for safety in storage, ergonomics of manual handling and storage. Mechanical : Lifting machinery, lifts and hoists; safety aspects in design and construction, testing, use and care, signaling, inspection and maintenance. Safety in design and construction, operation, inspection and maintenance of industrial trucks, lifting tackles and loose gears, conveyors. Safety features, safe locations, testing, inspection and maintenance of lifting tackles, safe working load for all mechanical material handling equipment. The competent persons in relation to safety legislation - duties and responsibilities.
4	Working at Different Levels : Working at Heights : Incidence of accidents. Safety features associated with design, construction and use of stairways, ramps, working platforms, gangway, ladders of different types, scaffolds of different types including Boatswain's chair and safety harness working on roofs. Other safety requirements while working at heights. Working in Confined Spaces : Working Underground :
5	Hand Tools and Power Tools : Main causes of accidents, prevention and control of accidents. Centralised and personal tool issues System. Purchase, storage and supply of tools. Inspection, maintenance and repair of tools. Detectable causes of tool failures. Tempering, safe end in and dressing of certain tool. Safe use of various types of hand tools used for metal cutting, wood cutting, miscellaneous cutting work, other hand tools such as torsion tools, shock tools, non-sparking tools. Portable power tools and their selection, inspection, maintenance, repair and safe use.
6	Plant Design and Housekeeping : Plant layout, design and safe distance. Need for planning and follow-up. Safety and good house-keeping. Typical accidents due to poor house-keeping. Disposal of scrap and other trade wastes. Prevention of spillage. Marking of aisles space and other locations. Use of colour as an aid for good housekeeping. Housekeeping contest. Cleaning methods. Employee assignment. Inspections and check-lists. Benefits of good housekeeping. Role of preventive maintenance in safety and health. Importance of standards and codes of practice for plant and equipment.
7	Industrial Lighting & Illumination : Purpose of lighting. Benefits of good illumination. Phenomenon of lighting and safety. Lighting and the work. Sources and types of artificial lighting. Principles of good illumination. Recommended optimum standards of illumination. Design of lighting installation. Maintenance. Standards relating to lighting and color.

8	Ventilation and Heat Stress : Purpose of ventilation. Physiology of heat regulation. Thermal environment and its measurement. Thermal comfort. Indices of heat stress. Thermal limits for comfort, efficiency and freedom from health risk. Natural ventilation. Mechanical ventilation. Air conditioning. Control of heat exposures at source, dilution and local ventilation. Recommended values for air changes required for various areas as per Factories Act, 1948 and National Standards. IS:3103- 1975-Code of practice for Industrial Ventilation, National Building Code Part VIII, Building Services.
9	Noise and Vibration : Continues and impulse noise. The effect of noise on man. Measurement and evaluation of noise. Noise isolation. Noise absorption techniques, silencers. Practical aspects of control of noise.
10	CONCEPTS AND STATUTORY REQUIREMENTS Introduction – electrostatics, electromagnetism, stored energy, energy radiation and electromagnetic interference – Working principles of electrical equipment-Indian electricity act and rules-statutory requirements from electrical inspectorate-international standards on electrical safety – first aid-cardio pulmonary resuscitation(CPR)
11	ELECTRICAL HAZARDS Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity. Energy leakage-clearances and insulation-classes of insulation-voltage classifications-excess energy- current surges-Safety in handling of war equipments-over current and short circuit current-heating effects of current-electromagnetic forces-corona effect-static electricity – definition, sources, hazardous conditions, control, electrical causes of fire and explosion-ionization, spark and arcignition energy-national electrical safety code ANSI. Lightning, hazards, lightning arrestor, installation – earthing, specifications, earth resistance, earth pit maintenance.
12	PROTECTION SYSTEMS Fuse, circuit breakers and overload relays – protection against over voltage and under voltage – safe limits of amperage – voltage –safe distance from lines-capacity and protection of conductor-joints-and connections, overload and short circuit protection-no load protection earth fault protection. FRLS insulation-insulation and continuity test-system grounding equipment grounding-earth leakage circuit breaker (ELCB)-cable wires-maintenance of ground-ground fault circuit interrupter-use of low voltage-electrical guards-Personal protective equipment – safety in handling hand held electrical appliances tools and medical equipments. leakage circuit breaker (ELCB)-cable wires-maintenance of ground-ground fault circuit interrupter-use of low voltage-electrical guards-Personal protective equipment – safety in handling hand held electrical appliances tools and medical equipments.
13	SELECTION, INSTALLATION, OPERATION AND MAINTENANCE Role of environment in selection-safety aspects in application - protection and interlock-self diagnostic features and fail safe concepts-lock out and work permit system-discharge rod and earthing devices- safety in the use of portable tools-cabling and cable joints-preventive maintenance.
14	Electrical Hazard Hazards of electrical energy. Safe limits of amperages, voltages. Safe distance from lines. Capacity and protection of conductor. Joints and connections. Means of cutting off power. Overload and short circuit protection. No load protection. Earth fault protection. Earth insulation and continuity tests. Earthing Standards. Protection against surge and voltage fluctuation. Hazards arising out of 'borrowed' neutrals. Others precautions. Types of protection for electrical equipment in hazardous atmosphere. Electrical area classification. Criteria in their selection, installation, maintains and use.
15	Static Electricity : Introduction, Electro-Static charging – where charging can occur contact electrification. Electro Static dischargers (sparks) . Electro Static hazards and their control. Earthing and bonding. Recommended earthing resistance for control of electricity.
16	HAZARDOUS ZONES Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatusincrease safe equipment-their selection for different zones-temperature classification-grouping of gases-use of barriers and isolators-equipment certifying agencies.

17	Lightning Arrestors : Definition, lightning splash, lightning strokes, lightning protection systems. Characterisation Of health effects of lightening stroke (electrical effects, side flashers, thermal effects, mechanical effects. Function of lightning. Where lightning protection is required – System design, material of construction, component of a lightning arrestors, earth terminal / network.
18	Safety Check list for buying new machinery for the plant

Theory – III - Safety Engineering – II

Unit	Contents
1	1.1 Agro-Industry / Sugar Industry. 1.2 Harvesting and activities related to harvesting, such as preparation of crop by cleaning, trimming, grading, drying, decorticating, retting, cooling or bulk packaging. Includes cotton picking.
2	2.1 Manufacture of Basic Metals : Ferrous and Non Ferrous 2.2 Metallurgy : Foundary, Steel Plant. 2.3 Hazards in the Process of melting (furnaces) <i>casting</i> , forging, working on hot rolling and cold rolling, N. D. Test & heat treatment
3	3.1 Automobile Manufacturing activity like pattern making, melting, moulding, machining, forging, chipping, grinding, heat treatment N. D. Test, Pollution control measures.
4	4.1 Textile Industry : 4.2 Introduction to Textile process involving cotton, jute and man made fibre. Significant hazards and preventive measures.
5	5.1 Construction Industry : 5.2 Basic philosophy peculiarities and parameters governing the safety in construction such as site planning and layout, safe access, good housekeeping, safety in the use of construction machinery, signs and indication liaison for safety with local authorities, structural soundness accident and hazards their causes and effects.
6	6.1 (IT Industry) 6.2 Manufacture of Computers, Radio, Television and communication Equipment and Apparatus 6.2.1 Manufacture of electronic valves and tubes and other Electro-Magnetic Devices. 6.3 Safety in semiconductor industry.
7	7.1 Safety in docks 7.2 Handling of cargo 7.3 Container operation 7.4 Lifting appliance 7.5 Responsibility of different agency for safety, health & environment involved in dock work.
8	8.1 Safety in Boilers 8.2 Safety precautions and operations of boilers 8.3 Different type of boilers 8.4 Preservations of boilers when not in use 8.5 Steam pressure, Pressure gauge. 8.6 Treatment of feed water etc.
9	9.1 Environment protection 9.2 Principles & practices for prevention and control of air pollution, water pollution, solid and hazardous waste management. 9.3 Cleaner technologies.
10	10.1 Work Permit Application, Adoption and Enforcement :
11	11.1 Welding, Gas Cutting 11.2 Precautions in welding, gas cutting, brazing, soldering, and other operations.

Theory – IV - Quality Control In Occupational Safety, Health and Environment

Unit	Contents
1	1.1 Plant and Equipment : Safety Appraisal & Control Techniques. 1.2 Plant Safety Rules and Procedure, Safe Operating Systems, Safety Check List, Plant Safety Inspection. Safety Sampling. Safety Surveys. Jobs Safety Analysis. Safety Inventory system. Product Safety. Safety tag system. Total Loss Control & Prevention.
2	2.1 Hazard and Risk Identification Techniques. 2.2 Hazard and Risk Analysis : Quantitative and Qualitative : Failure, Mode and Effect Analysis (FMEA) & Maximum Credible Accident Analysis (MCAA). Fault Tree Analysis, event tree analysis. Example of each. HAZAN, HAZOP, Managerial Oversight Review Technique (MORT), Incident Recall Technique. Critical Incident Review Technique safety integrity levels (SIL) etc.
3	3.1 Accident and Incident Investigation : Reporting and Analysis 3.1.1 Accident and Incident Investigation : Philosophy, purpose, process and types of investigations. Identifying the key factors and the immediate and basic causes. Corrective Action. Agencies investigating accident. Accident reporting : Report forms, writing reports, essential elements. 3.1.2 Accident and Incident Analysis : Standard classification of factors associated with accident. Methods of collating and tabulating data. Record keeping.
4	4.1 Measurement & Evaluation of Performance. 4.2 Definition of Accident, Reportable, Non- Reportable, Fatal, Non-Fatal. 4.3 Near miss accident. Lost time accident. Disabling injury. Accidents reportable under the Factories Act and ESI Act. Frequency Rate, Severity Rate, Incidence Rate, Frequency Severity Index, Safety Score . 4.4 Temporary Disablement and Permanent Disablement Partial and Total Disablement. Time Charges scheduled in Workmen's Compensation Act 1928 and the National and International Standards.
5	5.1 Major Accident Hazards (MAH) Control System 5.2 Major Accident Control : Definition, Major Accident Hazards, Identification and Assessment of MAH Units. Role of Govt., Role of Management, Local Authorities and Public.
6	6.1 Preparation and Assessment of Safety Audit. 6.2 Report as BIS 14489 : 1998, Safety Report, Standards, ILO Code of Practice for Major Accident Control.
7	7.1 Major Accident Control System : Local , State, National and International

Theory – V - Safety, Health and Environmental Legislation

Unit	Contents																		
1	<p>1.1 ILO Convention and Recommendation concerning Occupational Health & Safety</p> <p>1.2 Relevant Conventions and Recommendation of ILO in the furtherance of Safety, Health and Environment (SHE). SHE a human right issue. Trade Policy affecting OHS.</p> <table><tr><th>Year</th><th>Convention</th><th>Recommendation</th></tr><tr><td>1981</td><td>155-OHS</td><td>164-OHS</td></tr><tr><td>1985</td><td>161-OHS</td><td>171-OHS</td></tr><tr><td>1988</td><td>167-Safety & Health in construction</td><td>175-Safety & Health in construction</td></tr><tr><td>1990</td><td>170-Chemicals</td><td>177-Chemicals</td></tr><tr><td>1993</td><td>174-Prevention of major industrial accidents</td><td>181- Prevention of major industrial accidents</td></tr></table>	Year	Convention	Recommendation	1981	155-OHS	164-OHS	1985	161-OHS	171-OHS	1988	167-Safety & Health in construction	175-Safety & Health in construction	1990	170-Chemicals	177-Chemicals	1993	174-Prevention of major industrial accidents	181- Prevention of major industrial accidents
Year	Convention	Recommendation																	
1981	155-OHS	164-OHS																	
1985	161-OHS	171-OHS																	
1988	167-Safety & Health in construction	175-Safety & Health in construction																	
1990	170-Chemicals	177-Chemicals																	
1993	174-Prevention of major industrial accidents	181- Prevention of major industrial accidents																	
2	<p>2.1 The Factories Act, 1948 (Amended) and Rules :</p> <p>2.1.1 Factories Act. Provisions under the Act and Rules made there-under with Amendments Case Laws under the Factories Act.</p>																		
3	<p>3.1 Social Security – Legislations :</p> <p>3.1.1 Workmen's Compensation Act and Rules.</p> <p>3.1.2 ESI Act and Rules. Contract Labour (Abolition and Regulation) Act.</p> <p>3.1.3 Public Liability Insurance Act.</p> <p>3.1.4 Social Accountability 8000 SA-8000.</p>																		
4	<p>4.1 Safety, Health and Environment (SHE) related Important Legislation :</p> <p>Salient feature :</p> <p>4.1.1 Sections pertaining to SHE.</p> <p>4.2 Indian Boilers Act, 1923 with allied Regulations,1961. Indian Electricity Act, 2003 and Rules, Indian Explosives Act,1984 and Rules. Petroleum Act and Rules. Gas Cylinders Rules. Calcium Carbide Rules. The Insecticides Act and Rules.</p> <p>4.3 Radiation Protection Rules. Hazardous Material Transportation Rules.</p> <p>4.4 Static and Mobile (Unfired) Pressure Vessel Rules,1981 as amended in 2000.</p> <p>4.5 The Dock Workers (Safety, Health & Welfare) Act 1996 and Rules and Regulations.</p> <p>4.6 The Building and other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996.</p> <p>4.7 The Building and other Construction Workers (Regulation of Employment and Conditions of Service) Central Rules, 1998.</p> <p>4.8 The Building and other Construction Worker’s Welfare Cess Act, 1996 Cess Rules, 1998.</p>																		
5	<p>5.1 Environment Protection Legislations :</p> <p>5.2 Water (Prevention & Control of Pollution) Act 1974 and Rules. Air (Prevention and Control of Pollution) Act 1981 and1982 and Rules. Motor Vehicles Act, 1988 as amended in 2000, The Central Motor Vehicles Rules, 1989 as amended in 2000, The Maharashtra Motor Vehicles Rules, 1989 and Transport of Hazardous Goods Rules.</p> <p>5.3 Environment Protection Act 1986 (<i>Amended</i>) and Rules. MSIHC Rules. Noise Pollution Act, 1998, Bio-Medical Waste, Hazardous Waste Management Rules.</p> <p>5.4 Chemical accidents (Emergency preparedness, planning and response) Rule 1986.</p> <p>5.5 The batteries management handling rules 2001.</p> <p>5.6 The Central & State board for prevention & control of Air Pollution powers & functions of boards- Prevention of and control of air pollution & control of water pollution- Fund- Accounts and audit, penalties & procedures.</p>																		

Theory – VI - Industrial Hygiene and Occupational Health

Unit	Contents
1	1.1 Industrial Hygiene. 1.2 Definition of Industrial Hygiene, Industrial Hygiene : Control Methods, Substitution, Changing the process, isolation, wet method, local exhaust ventilation, personal hygiene, housekeeping and maintenance, waste disposal, special control measures. 1.3 Introduction to chemical hazards, dangerous properties of chemical, dust, gases, fumes, mist, vapours, smoke and aerosols. 1.4 Route of entry to human system, recognition, evaluation and control of basic hazards, concepts of dose response relationship, bio-chemical action of toxic substances. 1.5 Concept of threshold, limit values, air sampling strategies, personal exposure monitoring. 1.6 Work environment monitoring biological sampling & analysis.
2	2.1 Personal Protective Equipment : 2.1.1 Need for personal protection equipment, selection, applicable standards, supply, use, care & maintenance respiratory and non-respiratory personal protective equipment. 2.1.2 Non-respiratory personal protective devices : Head protection, Ear protection. Face and Eye protection. Hand protection, Foot protection, body protection. 2.1.3 Respiratory personal protective devices : Classification of hazards. Classification of respiratory personal protective devices. Selection of respiratory personal protective devices 2.1.4 Instructions and training in the use, maintenance and care of self containing breathing apparatus. Training in the use of breathing apparatus (open circuits and close unit). 2.2 Testing Procedures and Standards.
3	3.1 Occupational Health : 3.2 Definition : As per WHO.
4	4.1 Common Occupational Disease : 4.1.1 Occupations involving risk of contracting these disease - mode of causation of the diseases and its effects - diagnostic methods. 4.1.2 Biological monitoring - Method of prevention Compensation for occupational diseases. 4.1.3 Evaluation of injuries 4.1.4 Occupational Health Management Services at the work place. 4.1.5 List of notifiable diseases Schedule III of Factories Act - 1948.
5	5.1 Occupational Health Hazards : 3.1.1 Adverse health effects of noise, vibration, cold, heat stress, improper illumination, thermal radiation, ionising and non-ionising radiations. 5.2 Permissible threshold exposure limits - short term and long term effects of exposures – Preventive and control measures.
6	6.1 Common Occupational Diseases as per the Schedule III of the Factories Act. 6.2 Pre-employment, periodic medical examination of workers. Medical surveillance for control of occupational diseases and health records. 6.3 Fundamentals of First-Aid-Burns, Fractures, Suffocation, Toxic Ingestion - Bleeding Wounds and Bandaging, Artificial Respiratory, Techniques.
7	7.1 Physiology and Ergonomics at Work : 7.1.1 Physiology of respiration, cardiac cycle, muscle contraction, nerve conduction system etc. Assessment of Workload based on Human Physiological reactions. Permissible limits of load for manual lifting and carrying. Criteria for fixation limits. 7.1.2 Working posture : Its effect on cardio-vascular and musculo-skeletal system and implications on health. Nutrition and its importance in manual work. Nutritional requirements and nutritional of diet. 7.1.3 Assessment of Work Capacity Fatigue and Rest Allowances. Physiological Test for Assessment of Occupational Health. Nutrition : Nutritional requirements and the Diets for Exercise, Work and Physical Fitness. 7.1.4 Aerobic work capacity (physical work capacity), methods of its determination (use of bicycle, ergometer, treadmill, step-stool ergometer). Factors affecting aerobic capacity and work performance. 7.1.5 Environmental Physiology.

8	<p>8.1 Introduction to Ergonomics, Definition, Aims and Scope, Man-machine (Job), Environment System, Constituents of Ergonomics, Application of Ergonomics in industry for Safety, Health and Environment.</p> <p>8.1.2 Ergonomics of Automation / Assembly, Visual Fatigue, Ergonomics of Rehabilitation while assigning alternate jobs. Anthropometry and fundamental of bio-mechanics : Basic and applied aspects : Anthropometric measurements and their usefulness in industry.</p> <p>8.1.3 Ergonomic Design of Work Station : Concept of workstation and its design. Improving safety and productivity through work station design. Technical and Engineering control measures. Economics consideration.</p>
----------	--

Theory – VII - Safety In Chemical & Petrochemical Industry

Unit	Contents
1	<p>1.1 U.N Classification of Hazardous materials.</p> <p>1.1.1 Safety in chemical industry,</p> <p>1.1.2 Criteria for siting and layout of Chemical and Petrochemical Plants</p> <p>1.1.3 Plant Area classification.</p> <p>1.1.4 Instrumentation for safe plant operations.</p>
2	<p>2.1 Hazard in Unit Processes and Unit Operations,</p> <p>2.1.1 Control, precautions and prevention, specific safety measures for certain chemical industry like fertiliser, insecticide, pesticides-choler-alkali, explosives, polymer plants.</p> <p>2.1.2 Sampling technique for toxic and flammables, pharmaceuticals, petro-chemical etc.</p>
3	3.1 Precautions in the process and operations involving explosives, flammables, toxic substances, dusts, gases, vapour cloud formations and combating.
4	<p>4.1 Receiving, Storing and Handling of chemicals.</p> <p>4.2 Chemicals Compatibility Considerations</p>
5	<p>5.1 Transportation of Hazardous material ./</p> <p>5.2 Safety Precautions for transporting hazardous / toxic / flammable /explosive/ radioactive substances by all modes.</p>
6	6.1 Transfer of chemicals by pipelines within and outside installations, above and under ground and submarines.
7	<p>7.1 Colour coding identification of contents.</p> <p>7.2 Safety Precautions for working on pipelines, safe entry procedures to confined spaces including reaction vessels.</p> <p>7.3 Safe procedure of start up and shut down procedures.</p> <p>7.4 Safety in preventive and emergency maintenance operations.</p>
8	8.1 Use of Material Safety Data Sheets.
9	9.1 Work permit system. Confined space, hot work, working at height.
10	<p>10.1 Fire & Explosion :</p> <p>10.1.1 *Chemistry of fire, Factors contributing towards fire, Classification of fires. Common causes of industrial fires.</p> <p>10.2 Determination of fire load.. Design of building plant, exists, etc. for fire safety and Fire resistance of building materials.</p> <p>10.3 Prevention of fire. Portable extinguishers. Hydrant system, sprinkler system, introduction to. Carbon-di-oxide systems. Foam extinguisher system. Dry chemical Extinguishing systems Halon replacement of fire fighting products.</p> <p>10.4 Fire detection and alarms system.</p> <p>10.5 Special safety precautionary measures for control of fire and explosion in handling / processing flammable liquids, gases, vapors, mists and dusts etc. BLEVE (Boiling liquids expanding vapor Explosion , Vapor Cloud Explosion) including pesticides.</p> <p>10.6 Fire emergency action plan. Deflagration and detonation.</p>
11	<p>11.1 Salient features of fire explosion and toxicity index, Dow, dispersion, Probability analysis, modeling.</p> <p>11.2 Pressure vessels fired and unfired, codes of practices governing their safety.</p>
12	12.1 Assessment of reliability of vessels, test checks
13	13.1 Inspection techniques for plants, reaction vessels, check list for routine inspection, checklist for specific maintenance and break down

14	14.1 Corrosion and erosion, location, causes inspection and prevention
15	PLANT COMMISSIONING Commissioning phases and organization, pre-commissioning documents, process commissioning, commissioning problems, post commissioning.
16	PLANT INSPECTION Documentation Plant inspection, pressure vessel, pressure piping system, non destructive testing, pressure testing, leak testing and monitoring- plant monitoring, performance monitoring, condition, vibration, corrosion, acoustic emission-pipe line inspection.
17	PLANT OPERATIONS Operating discipline, operating procedure and inspection, format, emergency procedures- hand over and permit system- start up and shut down operation, refinery units- operation of fired heaters, driers, storage- operating activities and hazards- trip systems- exposure of personnel.
18	PLANT MAINTENANCE Management of maintenance, hazards- preparation for maintenance, isolation, purging, cleaning, confined spaces, permit system maintenance equipment- hot works- tank cleaning, repair and demolition- online repairs maintenance of protective devices.
19	PLANT MODIFICATION Modification of plant, problems- controls of modifications. operations.
20	PLANT EMERGENCY PLANNING Emergency planning, disaster planning, onsite emergency- offsite emergency, APELL
21	STORAGES General consideration, petroleum product storages, storage tanks and vessel- storages layout- segregation, separating distance, secondary containment- venting and relief, atmospheric vent, pressure, vacuum valves, flame arrestors, fire relief- fire prevention and protection- LPG storages, pressure storages, layout, instrumentation, vaporizer, refrigerated storages- LNG storages, hydrogen storages, toxic storages, chlorine storages, ammonia storages, other chemical storages- underground storages- loading and unloading facilities- drum and cylinder storage- ware house, storage hazard assessment of LPG and LNG.

Practical – I - Safety , Health and Environmental Management

1	Study of organization structure of safety department of chemical / Engineering / Textile / IT / Agro Industry / DOCKS / Transportation / Construction / Aviation Industry.
2	Seminar on Policy formulation of Safety in any Industry.
3	Seminar on Risk Management Plan for Safety
4	Case studies of Strategic Planning.
5	Study of MIS System for Safety, Health and Environment.
6	Failure Mode Analysis.
7	Software usages for :- 1. Accident Analysis 2. Safety Audit Packages. 3. Consequence Analysis (CISCON) 4 Five, Explosion and Toxicity Index (FETI) 5. Reliability Analysis for Mechanical System and Electrical System.

Practical – II - Safety Engineering – I

1	Industrial Lighting & Illumination : 1.1 Measurement of illumination & Photometer level
2	Ventilation and Heat Stress : Measurement of Ventilation (a) Measurement of thermal (i) Dry Bulb Temperature (ii) Wet Bulb Temperature (b) Determination of relative humidity and effective corrective effective.
3	1) Study of Aspirator Hygrometer Parameters. 2) Study of Kata-Thermometer 3) Study of Globe-Thermometer
4	Noise and Vibration : Noise Level Measurement. (a) Measurement of Sound pressure level in dbA and db linear. (b) Frequency analysis of noise.

Practical – III - Industrial Hygiene and Occupational Health

1	Demonstration and Calibration of Air Sampling Equipment
2	Sampling and Estimation of Gases in Work Environment by Colorimetry (a) Oxides of Nitrogen (b) Sulphur Dioxide (c) Ammonia (d) Chlorine
3	Sampling and Estimation of Solvent vapours in work environment. Benzene-Sampling by Activities Charcoal and Analysis by Gas Liquid Chromatograph CS ₂ Sampling by Aspiratory Bottle Analysis by Colorimetric Method.
4	Sampling and Analysis of Mercury
5	Sampling and Estimation of Dust-Gravimetric Method.
6	Personal Protective Equipment
7	OCCUPATIONAL HEALTH : 7.1 Lung Function Test on Medspirator. 7.2. Ear Testing on Audiometer & Demonstration of various models of Audiometer, Bakery Audiometer, BA-3, Arphi. 7.3. Study of Notifiable Diseases by use of models. 7.4. Study of various models of lungs. (Sections of lungs). 7.5. Demonstration of medical laboratory equipment such as tetanus. Vision tester, blood analyser, electrocardiography etc. 7.6. Explanation on the charts of Industrial Noise. Notifiable diseases. Physical Health Hazards. Chemical Health Hazards. Industrial Dermatitis. Prevention and Control. 7.7. Explanation of various notifiable occupational diseases with photographic models. 7.8. Explanation on the charts of control of noise in industry, noise levels in some industries And permissible level of exposure to noise in Industry.
8	Physiology and Ergonomics at Work : 8.1 Evaluation of Environment Stress (Heat) 8.2 Physical Fitness test (PFI Test) 8.3 Respiratory Physiology for evaluation of Pulmonary function impairment 8.4 Anthropometry Practical Measurements of a few body. dimension, its treatment and application

Elective-I - SAFETY IN ENGINEERING INDUSTRY

Unit	Contents
1	1.1 Introduction : 1.1.1 Introduction to various hot and cold processes in Engineering industry including manufacture of various grades of steel.
2	2.1 PRINCIPLES OF MACHINE GUARDING Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard opening. Selection and suitability: lathe-drilling-boring- milling-grinding-shaping-sawing-shearing-presses-forge hammer-flywheels- shafts-couplings-gears-sprockets wheels and chains-pulleys and belts- authorized entry to hazardous installations-benefits of good guarding systems. 2.2 Hot Working 2.2.1 Foundry operation : Flow sheet for foundry operation including use of different types of furnaces in each of the operation. Health hazards and safe methods of operation. Die casting. Fettling operations, Short blasting, sand blasting etc. 2.3 Forging Operation : Hazards in forging operations. Preventive maintenance of forging machines. Safework practices in forging operations. Safety in the use, handling and storage of dies. Safety on die changing. 2.4 Hot Rolling Mills Operation : Hazards in hot rolling operations and their control measures, safety in hot rolling mills
3	3.1 Cold Working : 3.2 Safety in the use of 1) power presses (all types) 2) shearing, 3) bending, 4) rolling, 5) drawing, 6) turning, 7) drilling, 8) boring, 9) milling, shaping 10) planning broaching, 11) grinding, 12) Computerized Numerically Controlled Systems. Need for selection and care of cutting tools. Preventive maintenance, periodic checks for safe operation. Associated hazards and their prevention. 3.3 Safety in the machine tools.
4	4.1 Other Operations : 4.2 Safety precaution in 1) Welding 2) Cutting 3) Brazing, 4) Soldering and Metalising and Chiseling, Blasting Operations. Safety in selection, care and maintenance of the associated equipment and instruments. Safety in finishing operation like a) cleaning b) polishing and c) buffing and their c) related hazards. Safety in maintenance and use of these machines.
5	5.1 Heat Treatment : 5.1.1 Hazards in various heat treatment operations. Control and Prevention.
6	6.1 SAFETY IN FINISHING, INSPECTION AND TESTING Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation. Health and welfare measures in engineering industry-pollution control in engineering industry industrial waste disposal.

Elective-II - SAFETY IN TEXTILE INDUSTRY

Unit	Contents
1	1.1 Introduction of Process Flow Charts of i) Short Staple Spinning, ii) Long staple spinning, iii) Viscose Rayon and Synthetic Fiber, Manufacture, iv) Spun and Filament Yarn to Fabric manufacture, v) Jute Spinning and Jute Fabric Manufacture. Types of Accident guarding of machinery and safety precautions in opening, carding, combing, drawing, flyer frames and ring frames, doubles, rotor spinning, winding, warping, softening/spinning inter-link industry.
2	2.1 Risk and Hazards in Sizing Processing and Looms :
3	3.1 Hazards of Chemicals : 3.2 Safety precautions in chemical processes like bleaching dyeing, printing and effluents in textile / jute processes.
4	4.1 Occupational Health : 4.2 Health Hazards in Textile Industry due to dust, humidity, heat, vibration and noise hazard etc., prevention and control measures, Occupational diseases as per the Legislation, Personal Protective Equipments.

Elective-III - Safety in Transport

Unit	Contents
1	TRANSPORTATION OF HAZARDOUS GOODS Transport emergency card (TREM) – driver training-parking of tankers on the highways-speed of the vehicle – warning symbols – design of the tanker lorries - static electricity-responsibilities of driver – inspection and maintenance of vehicles-check list- loading and decanting procedures – communication.
2	ROAD TRANSPORT Introduction – factors for improving safety on roads – causes of accidents due to drivers and pedestrians-design, selection, operation and maintenance of motor trucks-preventive maintenance- check lists-motor vehicles act – motor vehicle insurance and surveys.
3	DRIVER AND SAFETY Driver safety programme – selection of drivers – driver training-tacho-graph- driving test-driver's responsibility accident reporting and investigation procedures-fleet accident frequency-safe driving incentives-slogans in driver cabin-motor vehicle transport workers act- driver relaxation and rest pauses – speed and fuel conservation – emergency planning and Haz mat codes
4	ROAD SAFETY Road alignment and gradient-reconnaissance-ruling gradient-maximum rise per k.m.-factors influencing alignment like tractive resistance, tractive force, direct alignment, vertical curves-breaking characteristics of vehicle-skidding- restriction of speeds-significance of speeds- Pavement conditions – Sight distance – Safety at intersections – Traffic control lines and guide posts-guard rails and barriers – street lighting and illumination overloading-concentration of driver. Plant railway: Clearance-track-warning methods-loading and unloading-moving cars-safety practices
5	SHOP FLOOR AND REPAIR SHOP SAFETY Transport precautions-safety on manual, mechanical handling equipment operations-safe driving-movement of cranes-conveyors etc., servicing and maintenance equipment-grease rack operation- wash rack operation-battery charging-gasoline handling-other safe practices-off the road motorized equipment.

Elective-IV - SAFETY IN DOCKS

Unit	Contents
1	1.1 History of Safety Legislation : 1.2 Various ILO Conventions and recommendations relating to safety, health and welfare of dock workers.
2	2.1 Dock Safety Statutes in India : 2.2 History of Dock Safety Statutes in India, background of present Dock Safety Statutes Dock Workers (Safety Health & Welfare) Act, 1986 and the Rules and Regulations framed there under. Other Statutes like Marking of Heavy Packages Act, 1951 and the Rules framed thereunder, Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 framed under the Environment (Protection) Act, 1989. Few case laws to interpret the terms used in the dock safety statutes.
3	3.1 Responsibility of different agencies for safety, health and welfare involved in dock work : 3.1.1 Responsibilities of port authorities, Dock Labour Board, Owner of ship, Master and agent of ship, owner of Lifting appliances and loose gear etc. employers of dock workers like stevedores, clearing and forwarding agents, competent persons and dock worker.
4	4.1 Working on board the ship : 4.2 Types of cargo ships, working on board ships, safety in handling of hatch beams, hatch covers including its marking. Mechanical operated hatch covers of different types and its safety features, safety in chipping and painting operations on board ships, safe means of accesses, safety in storage etc., Illumination of decks and in holds and other working places various hazards of working inside the hold of the ship and on decks, and safety precautions needed, safety in use of transport equipment, with internal combustible engines like fork-lift trucks, pay-loaders etc. in the holds
5	5.1 Lifting Appliances : 5.2 Different types of lifting appliances, its construction, maintenance and use, various methods of rigging of derricks, testing, examination and certification of lifting appliances
6	6.1 Loose Gears, Ropes and Chains : 6.2 Use and Care of synthetic and natural fibre rope wire rope chains, different types of slings and loose gears. Methods of testing examination and certification of hooks, shackles, blocks, container spreaders, magnetic lifting devices grabs, wire rope and chains. 6.3 Testing establishments : Details of facilities, approval, duties and responsibilities of competent persons
7	7.1 Handling of Cargo: 7.1.1 Handling of different types of cargo, stacking and unstacking both on board the ship and on shore, loading and unloading of cargo from ship to shore and vice versa, restriction on loading and unloading operations, covered under regulations and port by-laws, modern methods of handling bulk cargo, like mechanical handling plants, pneumatic suction methods, continuous loaders, etc., handling, storage and transportation of dangerous goods, IMO's classification of dangerous goods, identification, labelling and packaging of dangerous goods, introduction to IMDG Coads, IMO's recommendations relating workers by water.
8	8.1 Major Accident Hazards Control in parts : 8.2 Occupiers responsibilities, inspection of hazardous installations in ports, like isolated storages and pipelines. Preparation of on-site emergency plan and safety report, Conduction of mock drills.
9	9.1 Container Operations : International Convention for Safe Containers (CSC) including procedure for testing, examination and inspection of containers. 9.2 Safety in handling, storage and transportation of containers inside the port, safety in freight container terminals, inland container, depots, safety in stuffing and destuffing of containers, safe use of special lift trucks inside containers, examination and inspection of containers, carriage of dangerous goods in containers and maintenance and certification of containers for safe operation.
10	10.1 Transport Equipment : 10.1.1 Safety in the use of the different types of equipment for transporting containers and safety in their use, safety in the use of self loading container vehicles like container side lifter, fork lift truck, pay loaders etc., Safety in dock railways, conveyors and ports

11	11.1 Investigation of Accident and dangerous occurrences and their system of investigation and classification. Few case studies of accidents and dangerous occurrences.
12	12.1 Health and Welfare : 12.2 Occupational diseases, personal protective equipment, health and welfare measures, first-aid facilities and other appropriate measures, hospitals, medical examination of dock workers, clinics, special precautions for specific work environment, canteen facilities.
13	13.1 General : 13.2 Forums for promoting safety and health in ports – Safety Committees and Advisory Committees. Their functions, training of dock workers, responsible persons, authorised person etc. Emergency Action Plants for fire and explosions, collapse of lifting appliances and buildings, sheds etc., Gas leakages and precautions concerning spillage of dangerous goods etc.

Elective-V - SAFETY CONSTRUCTION INDUSTRY

Unit	Contents
1	1.1 Meaning and Scope of Safety in Construction : 1.2 Basic philosophy peculiarities and parameters governing the safety in construction such as site planning and layout, safe access, good housekeeping. 1.3 Safety in the use of construction machinery. 1.4 Seismic structural soundness. Structural safety, accident and hazards their causes and effects.
2	2.1 Safety in Construction Operations : (a) Underground Works : Excavation, drilling and blasting pre-matic, trenching, shoring, type of shoring, strutting, tunnelling, piling and Safety in using and operating machinery and equipment relating to the above works. Foundations : Plant & Machinery and Structure (b) Above Ground Works : Scaffolding, shuttering / form work, ladders, concrete, cofferdams and special operation connected with irrigation work. Safety in use and portion of related machinery and equipments. Safety on working on fragile roof. Working at Heights. (c) Underwater portions : Well sinking, caissons underwater concreting, cofferdams and special operations connected with irrigation work. Safety in use of machinery and equipments related to underwater portions. (d) Movement of Construction Machinery : Heavy/Long Items. Earth Movers equipments Railway wagons, motor trucks, Materials Vehicles etc., Hazardous Materials, Material handling equipments. (e) Special Works : High rise buildings, bridges and tunnels, roads, railways, asphaltting, pneumatic caissons, electrical installations and lifts. (f) Safety in Prevention and Protection at Work Site including the collapsing of the structure. (g) Safety in use of explosives : Open cost machinery, quarrying. Project Management and Constructions in Safety : Introduction, Manpower utilisation, utilization of material, equipment and tools. Temporary installation and structures.
3	3.1 Safety in Demolition Operations : 3.2 Planning and Permit. 3.3 Planning the sequence of demolition. 3.4 Safety Precautions to be taken for and during demolition carrying out repairs, additions and alterations.
4	4.1 Safety with regard to storage, stocking and handling of Materials of Construction: 4.2 Health hazards while handling construction material and chemicals; safety measures with respect to handling of materials such as cement, limes, aggregates, flash, timber, steel, glass, paints, varnishes, petroleum products chemicals used in construction, plastics & PVC material etc.
5	5.1 Accident Prevention : 5.2 Occupational Health Hazards, Occupational diseases relating to construction work. Safety in the use and maintenance of personal protective equipment specific to construction industry, health and welfare measures, emergency medical treatment of injuries and rehabilitation at construction site.

6	6.1 Statutory Obligations : 6.2 Regulation of employment and condition of work in construction. 6.3 Construction Safety Laws, IS AND NB Codes, Local Building and Development Laws, Accident Investigation and reporting, structure stability and precautions to be taken.
7	7.1 Statutory Obligations : 7.2 Regulation of employment and condition of work in construction. 7.3 Construction Safety Laws, IS AND NB Codes, Local Building and Development Laws, Accident Investigation and reporting, structure stability and precautions to be taken. 7.4 The Building and other Construction Workers (Regulation of Employment and Conditions of Service) Central Rules, 1998. 7.5 The Building and other Construction Worker's Welfare Cess Act, 1996 Cess Rules, 1998.
8	8.1 Special precautions for works of Engineering construction like distilling / fractionating columns, chimney, silos-oil and gas installations, transmission/ communication lines, cable car installations, air fields.

Elective-VI - Advanced Safety Management and Engineering

Unit	Contents
1	1.1 Process Design : 1.2 The Components involved in design process. 1.3 General considerations of design Emergency shutdown. 1.4 Operating conditions
2	2.1 Pressure System Design : 2.2 Pressure System Components, 2.3 Fundamentals of pressure vessels design. 2.4 Standards & Codes. 2.5 Over pressure protection. 2.6 Pressure relief and blow down. 2.7 Basic requirements of protection and their practical application Flare Systems.
3	3.1 Control System Design : 3.2 Process and Control System Characteristics. 3.3 Instrument systems for safety and safety features of instruments
4	4.1 Principles of Reliability Engineering : 4.1.1 Principles of Reliability Engineering 4.2 Application of Reliability 4.3 Engineering, Concepts of critical equipments and devices.
5	5.1 Risk 5.2 Acceptable Risk 5.3 Individual and Average Risk 5.4 Computation of Risk. 5.5 Risk Assessment Techniques detailed and quick. 5.6 Engg. Feasibility 5.7 Area classification Safety Integrity Levels (SIL).
6	6.1 Emission and Dispersion 6.2 Liquid discharge 6.3 Gas discharge 6.4 Vapour- liquid discharge
7	7.1 Plant Siting : 7.1.1 Siting Criteria and its evaluation, 7.2 Separation, distance, relevant, statute requirements.
8	8.1 Bulk Storages : 8.2 General considerations 8.3 Types of storages, layout of storages with specific reference to LPG, Chlorines, Ammonia, EO, Oleum, Sulphur Tri.....
9	9.1 Plant Inspection : NDT-testing, significance and limitations. Radiography Ultra-sonics, Magnetic Particle Methods, Eddy-Current Method, Die Penetration test strain Measurement.

10	10.1 Major Industrial Disasters Case Studies.
11	11.1 Transport Safety : 11.1.1 Safety in Transport. 11.2 Emergency Planning in the transport of hazardous chemicals.
12	12.1 Safety Audit, Safety Report : Preparation and Assessment :
13	13.1 EIA, Environment Statement : Definition, Inventory, Preparation and Submission of Report to Competent Authority :
14	14.1 Safety Check list for Preventive and Emergency Maintenance :

Elective-VII - Environmental Management

Unit	Contents
1	1.1 Environmental Policy and Laws 1.2 Environmental Policy Issues and Planning, 1.3 Corporate Environmental Policies, 1.4 Water and Air Acts and Rules, 1.5 Environment (Protection) Act and Rules, Provisions under Factory Act, 1.6 Public Liability Insurance Act, 1.7 Guidelines related to Industrial Siting 1.8 Coastal Zone Development.
2	2.1 Environmental Management Systems 2.2 Environmental Impact Assessment (EIA), 2.3 Process and Methodologies, 2.4 Administrative Procedure for Environmental Clearances 2.5 EMP and DMP needs with HAZAN and HAZOP Studies.
3	3.1 Environmental Economics : 3.2 Rules of Taxation, 3.3 Cess, 3.4 Water Charges, 3.5 Biodiversity Damage Assessment and Price Evaluation.
4	4.1 Global warning History of Earth climate. 4.2 Carbon Emission Atmospheric gases, Green house gases 4.3 Kyoto protocol 4.4 Effects on Human beings, wild life and Natures 4.5 Mitigation measures of Global warming.
5	5.1 Bio Medical waste, plant and IT waste Lead/Battery waste their treatment and disposal.

Elective-VIII - Applied Ergonomics

Unit	Contents
1	1.1 Load Carrying : 1.2 Limits to load carrying. 1.3 Physiological basis of work. 1.4 Muscle System. 1.5 Lever systems in human body. 1.6 Physiological problems associated with load carrying (injuries / fatigue etc.) 1.7 Possible solutions to these problems and general guide lines to avoid such problems
2	2.1 Hand tools and their use : 2.2 Design of tools in relation to body postures 2.3 Hand tools / power tools / specialised tools Body supports / tool supports 2.4 Safety while using tools 2.5 Tool boxes / kits 2.6 Tool maintenance / Training in usage.

3	3.1 Work Station Design : 3.2 Introduction to Anthropometrics. 3.3 Concepts of percentiles (5 th , 50 th , 95 th), averages & how & where to apply these. 3.4 Working heights – standing, sitting, semi standing (high stools) 3.5 Correct postures – Health problems related to wrong postures, back pain etc. fatigue due to sitting. 3.6 Good Chair ? 3.7 Precession tasks vs gross tasks. 3.8 Inspection tasks. 3.9 Key board work station .
4	4.1 Machine Controls and Displays : 4.2 Location & Sequence of operation. 4.3 Natural expectation of control movement. 4.4 Preventing accidental activation. 4.5 Emergency controls (creating accident scenarios). 4.6 Foot controls. 4.7 Displays – digital, analog, arrays, audio signals, coding, labeling, signs & symbols, warnings
5	5.1 Lighting : 5.2 Direct / indirect lighting / shadows Local vs. general Lighting Glare Measurement of light & acceptable / recommended values for lighting.
6	6.1 Heat : 6.2 Protection from heat, protective suits / shoes / masks, ventilation & exhausts. 6.3 Good practices, insulation materials.
7	7.1 Noise : 7.2 Protection from noise, reducing noise levels, good practices, insulation.
8	8.1 Emergencies : 8.2 Fire, Flood, Earthquakes / Emergency Accident Scenarios 8.3 Guidelines for prevention escape routes, exists etc.
9	9.1 General upkeep : 9.2 Create hassle free, injury free environment, proper aisles for men & material movement, stairs, ramps, hand rails, signage.
10	10.1 Welfare : 10.2 Baths, toilets, food, drinking water (minimum facilities and their upkeep) 10.3 Recreations & relaxation / facilities Special needs of women 10.4 Creation of possibility of interaction, idea exchange, easy Communication 10.5 Self – improvement, rewards & motivation.
11	11.1 Consideration for disabled, elderly & women at places : 11.2 Wheel chair movement. 11.3 Use of crutches – Ramps etc. 11.4 Signage for visually impaired/hearing impaired. Supports while walking / sitting / working

Tools and Equipments Required:

1. Aspirator Hygrometer
2. Kata-Thermometer
3. Globe-Thermometer
4. Sound Level Meter
5. Octave filter set
6. Personal Sampler. High x Volume Sampler. Instantaneous Gas Delegator. Midget Impinger Tubes.
7. Rotameter. WetGas Brow Meter. Spectrophotometer.
8. Automic Absorption Spectrometer.
9. Gas Liquid Chromatograph.
10. Phase Contrast Microscope.
11. Personal, Sampler. All Glass Bubbler.

12. Rotameter.
13. Spectrophotometer, Drager Demonstration.
14. Low flow Personal Sampler.
15. Charcoal Tubes Gas Liquid Chromatograph.
16. Aspirator Bottle.
17. All glass Impinger tubes.
18. All glass Impinger Tubes Rota-meter. Mercury Analyser.
19. Bottle Holders, Electronic Balance.
20. Respiratory and Non-respiratory demonstration of testing kit.
21. Thermal Kit Containing
 - i) Sling Psychrometer
 - ii) Kata Thermometer (of different range)
 - iii) Globe Thermometer (OC to OC)
 - iv) Stop-watch
 - v) AirVelo-Charts Psychrometric Chart.
 - vi) ET/CET Chart.
22. Step Test Stool. (HT 46 CM)
23. Metronome.
24. Stop-Watches-2 Nos.
25. Spirometer, Peak Flow Meter
26. Anthropometer
27. Calipers
28. Skin Fold Caliper
29. Weighing Machine
30. Computer Systems as required
31. Software as required
32. Video Projector
33. Fire Extinguisher.
34. First AID Box
35. Software for :-
 1. Accident Analysis
 2. Safety Audit Packages
 3. Consequence Analysis (CISCON)
 4. Fire, Explosion and Toxicity Index (FETI)
 5. Reliability Analysis for Mechanical System and Electrical System
36. Road safety signals and symbols.

Note:- Above tools and equipments should be available either in industry with whom institute signs MOU for practical training or in institute.
