DETAILED SYLLABI OF THE

DIFFERENT THEORETICAL & SESSIONAL SUBJECTS

OFFERED IN FIRST SEMESTER

SAFETY, HEALTH & ENVIRONMENTAL MANAGEMENT

Subject Code	Course offered in	Full Marks	Written Test	Internal Assessment	Attendance
IS-101	First Semester	100	75	20	5

		Marks	Hours
Chapter – 1	**Introduction** Management and Management Principles and Types of Management. General principles of Management, Managerial Role, Authority, Responsibility and Power, Span of Management, Delegation and decentralization of authority. Safety, Health and Environment Management, (SHE), Occupational Safety, Health and Environmental Safety Management – Principles & practices. Role of Management in Industrial Safety.	10	8
Chapter – 2	**Planning for Safety** : Planning : Definition, purpose, nature, scope andprocedure. Range of planning, variety of plans. Strategic planning and tools of implementation. Management by objectives and its role in Safety, Health and Environment (SHE). Policy formulation and implementation.	6	6
Chapter - 3	**Organising for Safety** Organising : Definition, need, nature and principles. Organising for Safety, Health and Environment. Organisation Structure, functions and responsibilities. Co-ordination of three component of SHE. Line and Staff Functions for Safety, Health and Environment.	6	6
Chapter – 4	**Directing for Safety** Direction : Definition, process, principles and techniques, Leadership : Role, functions an attributes of a leader, Communication : Purpose, process, types and channels Essential rule in communication. Two ways communication. Barriers in communication, essentials of effective communication. Communication and group dynamics, Team building.	5	5
		10	8
Chapter – 5	**Monitoring for Safety, Health & Environment** Occupational Safety, Health and Environment Management System. Bureau of Indian Standards on Safety and Health : 14489 – 1998 and 15001 – 2000, ILO and EPA Standards Audit and inspection procedures associated with safety, health and environment. Relevance of WTO on SHE. SHE: Element of training cycle.		
Chapter – 6	**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.	10	6

Chapter – 7	**Safety Organization** : Objectives – Safety Policy – An Overview of various safety activities for discovering causes of accidents and controlling them – Division of responsibilities in the organization – Location of safety function - Organization of safety department – Qualification of safety specialist – Functional divisions within the safety department - Role, responsibility, authority and accountability of safety officers – Safety committee, their structures and functions.	5	6
Chapter – 8	**Organisational Behaviour** Human factors contributing to accidents Human Behaviour : Individual differences, behaviour as function of self andsituation, perception of danger and acceptance of risk, knowledge and responsibility vis-à-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.	**5**	**4**
Chapter – 9	**Behavioural Safety Culture & Motivation** Safety Culture of an organization and its components: unsafe human behaviour – safe performance – behavioural safety and risks assessment – Behavioural safety training - behavioural safety programmes.	**8**	**5**
Chapter – 10	**Management information system** Sources of information on Safety, Health and Environment Protection, Compilation and collation of information, Analysis & use of modern methodsof programming, storing and retrieval of MIS for Safety, Health and Environment. QCC HS Computer Software Application and Limitations. Status and future goals of computer utilization in Safety, Health and Environment (SHE) Services in Industries.	**10**	**6**

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SAFETY ENGINEERING

Subject Code	Course offered in	Full Marks	Written Test	Internal Assessment	Attendance
IS-102	First Semester	100	75	20	5

GROUP-A **Marks Allotted: 30**

i) SAFE GUARDING OF MACHINES

Statutory provision related to principles in machine guarding. Type of guards, their design and selection. Guarding of different types of machinery including special precautions of wood working, paper rubber and printing machinery, machine, tools, etc. Built-in-safety devices, maintenance and repairs of guards, incidental safety devices and tools.

… 6 Hrs.

ii) MANUAL HANDLING AND STORAGES OF MATERIALS

Hazards in manual handling. Avoidance of excessive muscular effort. Kinetic methods of correct lifting and handling of materials. Maximum loads that may be carried. Lifting and carrying of object of different shapes, size and weight. Safe use of accessories for manual handling. Storage of materials.

… 6 Hrs.

iii) MECHANICAL HANDLING OF MATERIAS

Lifting machinery (Cranes, Elevators, Conveyors, Dumpers, Pay loaders, etc) – Safety aspects considered during design, construction, and testing of Lifting Machinery - training of operator on safe operation, signaling, inspection and maintenance of Lifting Machinery.

Power trucks and tractors, safety features in design and construction, safe operation, inspection and maintenance.

Lifting tackles: Chain slings, Rope slings, (fibre and wire) rings, hooks, Shackles, Swivels, Eye-bolts – salient safety features. Calculation of Safe Working Load.

… 8 Hrs.

iv) HAND TOOLS AND PORTABLE POWER TOOLS

Main causes of tool accidents – Control of tool accidents – Centralized tool control – Purchase, storage and supply of tools – inspection, maintenance and repair of tools. Detectable causes of tools failure – need for tempering, safe ending and dressing of certain tools – handles of tools – safe use of various tools – types of hand tools used for metal cutting, wood cutting, miscellaneous cutting work – material handling and other hand tools such as Torsion Tools, Shock Tools, Non Sparking Tools – Portable power tools and their selection, inspection, maintenance and repair for safe use.

… 8 Hrs.

GROUP-B **Marks Allotted: 15**

v) ELECTRICAL HAZARDS

Dangers from electricity – Safety limits of amperages – voltages – Safe distance from lines – Capacity and protection of conductors – joints and connection – Means of cutting off power – overload and short circuit protection – Earth fault protection.

Earth., insulation and continuity tests – Protection against over voltage hazards arising out of “borrowed” neutrals - precautions – Portable electrical apparatus – Flame proof – Electrical equipment – Precautions in their selection, installation, maintenance and use – control of hazards to static electricity – Role of Electricians in controlling electrical accidents. Relevant provisions of the Indian Electricity Act and the Rules.

… 5 Hrs.

vi) INDUSTRIAL LIGHTING

Purpose of lighting. Advantage of good illumination. Lighting and Safety. Lighting and the work. Sources and types of artificial lighting. Principles of good illumination. Recommended minimum standards of illumination. Design of lighting installation, maintenance, lighting and colour.

… 2 Hrs.

GROUP-C **Marks Allotted: 30**

vii) SAFETY OF PRESSURE VESSELS

Fired and unfired – Statutory provisions – Testing requirements – Different kinds of testing – Design and construction aspects of safety. Safety in boilers, safety precautions & operation of boilers.

… 4 Hrs.

viii) VENTILATION AND HEAT CONTROL

Purpose of ventilation. Thermal environment and its measurement. Physiology of heat regulation. Thermal comfort. Indices of heat stress. Thermal limits for comfort, efficiency and freedom from health risk. Natural ventilation. Mechanical ventilation. Air conditioning. Process ventilation. Control of heat exposures, control at source, insulation, local exhaust ventilation. Control of radiant heat, dilution ventilation. Local relief.

… 5 Hrs.

ix) MACHINE CONTROL & DISPLAYS

- Location and sequence of operation
- Natural expectation of control movement
- Preventing accidental activation
- Emergency control (creating accident scenarios)
- Foot controls
- Displays – digital, analog, arrays, audio signals, coding, labeling, signs & symbols, warnings. …6 Hrs

x) SAFETY IN INDUSTRIES – Engineering, Jute/Textiles, Agro, Forging & Foundry, Port & Dock. ...10 Hrs

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APPRAISAL, ANALYSIS, INSPECTION & QUALITY CONTROL PROCEDURES

Subject Code	Course offered in	Full Marks	Written Test	Internal Assessment	Attendance
IS-103	First Semester	100	75	20	5

Rationale

For any planned activity there is always a need for appraisal of its effectiveness. It needs certain kind of inspection, analysis and also at time some control measures. This applies to industrial safety plans and programme too. Hence the paper.

Sl. No.	Units	Coverage		Marks
		L	T	
4.1	Plant and equipment safety appraisal and control techniques.	8	2	15
4.2	Hazards identification Techniques	8	2	15
4.3	Accident investigation & Reporting and analysis.	8	2	15
4.4	Measurement and control of performance	10	4	18
4.5	Major Accident Hazards Control	11	1	12
		45	15	75

PLANT AND EQUIPMENT SAFETY APPRAISAL & CONTROL TECHNIQUES

Objectives, Plant safety observation, Plant Safety Inspections. Safety Sampling. Safety Surveys. Job Safety Analysis. Safety Inventory System. Product Safety. Permit to work systems. Safety tag systems. Loss Control: Damage control & system safety.

HAZARD IDENT1FIAT1ON TECHNIQUES

Hazard Analysis: Inductive, deductive. FMEA & CMA. Fault Tree Analysis. Examples of each. Risk Analysis Techniques: HAZAN, HAZOP, Safety Audit. Evaluating risks in chemical process.

ACCIDENT INVESTIGATION REPORTING AND ANALYSIS

Purpose. Identifying the key factors and the causes. Writing reports and report forms. Corrective action. Standard classification of factors associated with accident. Method of collecting and tabulating data. Keeping the records.

MEASUREMENT AND CONTROL OF PREFORMANCE

Lost time accident. Disabling injury. Accidents importable under the factories Act and E.S.I. Act. Frequency rate. Severity rate. Incidence rate per 1000 workers and man days lost. Temporary disablement and permanent disablement. Partial and total disablement. Time charges scheduled in Workmen's Compensation Act and the Indian Standard. Study of appraisal report of the Department of Labour, Government of West Bengal.

Application of digital technology in monitoring safety compliance – usage of artificial intelligence, Robotics, Drones and other applications of Augmented Reality (AR) and Virtual Reality (VR).

Creation of Management Reports from Digital Tools, Dash Boards, Various follow-up mechanisms and enhances accountability through digital applications.

PLANT HOUSEKEEPING

Management responsibility – Safety Engineers stake in good housekeeping- Need for proper planning and follow-up – Need for overall cooperation – Typical accidents due to poor housekeeping – Typical items of unsafe housekeeping - Disposal of scrap and other trade wastes – Prevention of spillage – Marking of gangways and other locations - Use of colour as an aid for good housekeeping – Clean up campaigns – Cleaning methods – Employee assignments – Inspection and Inspection check-list – Results of good housekeeping.

MAJOR ACCIDENT HAZARDS CONTROL

Major Accident Hazards:

Introduction, types and consequences of major accident hazards. Role of management, local authorities and

public.

Emergency preparedness, rehearsal and exercises.

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INDUSTRIAL HYGIENE, OCCUPATIONAL HEALTH & APPLIED ERGONOMICS

Subject Code	Course offered in	Full Marks	Written Test	Internal Assessment	Attendance
IS-104	First Semester	100	75	20	5

GROUP-A (INDUSTRIAL HYGIENE) **Marks Allotted: 20**

Concept, definition and importance of hygiene in industry. Difference between domestic hygiene and industrial hygiene. Physical Hazards – Heat Stress and its control, Ventilation, Noise, Vibration, Improper Illumination, Thermal Radiation – X-Rays – Ultra Violet Radiation – Ionizing and Non-ionizing Radiations – Permissible Industrial Exposure Limits – Effects of Exposure – Preventive and Control measures.

… 8 hrs.

Air Sampling – The concept of Threshold Limits - Acute and Chronic exposure effect – Personal Monitoring – Biological Monitoring and Control Measures – Risk Management at work places – Emergency Control Measures. Awareness for ensuring ideal hygiene.

… 6 hrs.

Noise and Vibration - The effect of noise on man, measurement and evaluation of noise, vibration damping, noise isolation, noise absorption – silencers, practical aspects of control of noise. Case studies on impact of noise from Compressors and Generators. Vibration: Effect, measurement and control.

… 6 hrs.

GROUP-B (OCCUPATIONAL HEALTH) **Marks Allotted: 25**

Meaning of Occupational Health and Occupational health Hazards. Awareness programme, types of occupational health hazards in industries – physical, chemical, biological, mechanical and psychological hazards- Common work related or Occupational Diseases – Occupations involving risk of contacting these diseases – Mode of causation of the diseases and its effect – Diagnostic methods – Methods of prevention – Notifiable occupational diseases – Compensation for Occupational Disease – Evaluation of injuries – Medical Services in an Industrial establishment and its functions – Occupational health service and its activity – Occupational Hazards in Hospital – Action programmes for work related diseases at the National Level – Major Accident Hazards Control – Medical provision – Occupational health audit & survey. Occupational diseases relating to construction work, emergency medical treatment of injuries and rehabilitation at construction site.

… 8 hrs.

PERSONAL PROTECTIVE EQUIPMENT

Introduction and Requirements and assessment of PPE. Type of PPE.

a) **Non-Respiratory Personal Protective Devices**: Head protection - Ear Protection – Face and eye protection – Hand protection – Feet protection – Body protection – supply. Use, care and maintenance of personal protective equipment – Requirements under Factories Acts and Rules.

… 5 hrs.

b) Respiratory Personal Protective Devices: Classification of hazards – Classification of respiratory personal protective devices – Selection of respirators – Instructions and hints in the use of Breathing Apparatus – supply. Use, Care and maintenance of Breathing Apparatus – Training in the use of Breathing Apparatus.

… 5 hrs.

GROUP- C (APPLIED ERGONOMICS) **Marks Allotted: 30**

Definition, Role & Science for considering Ergonomics as a component of SHE.

Industrial Physiology:

- Classification of workload
- Work capacity and man
- Job alignment
- Fatigue and rest allowances
– Physiological list in occupational health assessment
– Ergonomics
– Man-machine differences
- Man-machine interface
- Fitting the man to the job
– Prevention work related limb disorders & repetitive strain injury (RSI). 6 hrs.

Load Carrying:

- Limits to load carrying
- Physiological basis of work
- Muscle system
- Lever system in human body
- Physiological problems measured with load carrying (injuries/fatigue etc.)
- Possible solutions to these problems and general guidelines to avoid such problems. …4 hrs.

Hand Tools and their Use:

- Design of tools in relation to body postures
- Hand tools/power tools/specialized tools body supports/tool supports
- Safety while using tools
- Tool boxes/Kits
- Tool maintenance/Training in usage. …4 hrs.

Work Station Design:

- Introduction to Anthropometrics
- Concepts of percentiles (5^{th}, 50^{th} , 95^{th}), averages and how and where to apply these
- Working heights – standing, sitting, semi-standing (High stools)
- Correct postures – Health problems related to wrong postures, back pain etc., fatigue due to sitting. …8 hrs.

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INDUSTRIAL HYGIENE & OCCUPATION HEALTH LAB.

Subject Code	Course offered in	Full Marks	Internal Assessment	External Assessment
IS-105	First Semester	100	50	50

INDUSTRIAL HYGIENE

Marks Allotted: 50
Total Periods: 20

Name of the Experiment	Equipments/Glasswares to be used
1. Demonstration and calibration of Air Sampling Equipment	Personal Sampler, High X Volume Sampler, Instantaneous Gas Detector. Midger Impinger Tubes, Rotameter, Wet Gas Flow Meter, Soap Bubble, Flow–rate Meter, Spectrophotometer, Atomic Absorption

	Spectrometer, Gas Liquid Chromatograph, Phase Contrast Microscope.
2. Sampling and Estimation of gases in Work Environment by Calorimetric Method.	
a) Oxides of Nitrogen	Personal Sampler, All Glass Bubbler, Rotameter, Spectrophotometer.
b) Sulphur dioxides	–do–
c) Ammonia	–do–
d) Chlorine	–do–
3. Sampling and Estimation of solvent vapours in Work Environment.	
a) Benzene Sampling by Activated Charcoal and Analysis by Gas Liquid Chromatograph.	Low–Flow Personal Sampler, Rotameter, Activated Charcoal Tube, Gas Liquid Chromatgraph.
b) Carbon disulphide Sampling by Aspirator Bottle and Analysis by Calorimetric Method.	Aspirator Bottle, All Glass Impinger Tubes.
4. Sampling and Analysis of Mercury	Personal Sampler, All Glass Impinger Tubes, Rotameter Mercury Analyser.
5. Sampling and Estimation of dust Gravimetric Method	Personal Sampler, Rotameter, Filter Holders, Electronic Balance.

OCCUPATIONAL HEALTH

Marks Allotted: 45
Total Periods: 25

1. Lung Function Test on Medspirer.
2. Ear Testing on audiometer & demonstration of various methods of audiometer, Bakery Audiometer, BA–3 Arphi.
3. Study of notifiable diseases by use of models.
4. Study of various models of lungs (section of lungs)
5. Demonstration of Personal Protective Equipment such as Noise Mask, various types of Safety Goggles, etc.
6. Explanation on the charts of Industrial noise, Notifiable diseases, Physical health hazards, chemical health hazards, Industrial dermatisis, Prevention and Control.
7. Explanation of various notifiable occupational diseases with photographic models.
8. Explain of the charts of control of noise in industry, noise levels in some industries and permissible levels of exposure to noise in industry.

TERM WORK

Subject Code	Course offered in	Full Marks	Internal Assessment	External Assessment
IS-108	First Semester	50	25	25

Total Periods: 45

Q. No. 1, 2 & 3 are compulsory and any two from the rest of works:

1. Hazard identification
2. Accident investigation and reporting
3. Measuring safety performance
4. Design of need based training programme to observe National Safety Day and Safety Awareness
5. Study of safety organisation and management
6. Study of employee's participation in safety
7. Safe guarding of machinery
8. Material handling – role and precaution to safety
9. Working at height – basic training to operator / worker in relation to safety
10. Design of work place having basic feature on safety
11. Ideal housekeeping observing all safety norms
12. Industrial lighting and illumination – concern of safety
13. Ventilation (for heat control) in industry
14. Electrical hazards
15. Noise control
16. Job safety analysis
17. Fault tree analysis
18. Study of cases under Factories Act