B.Sc. in Fire & Industrial Safety

45 hrs	V SEMESTER	Week : 3 hrs
PAPER I	DSC C - 25 – INDUSTRIAL HYGIENE AND OCCUPATIONAL HEALTH	Credits: 3

Unit 1: INDUSTRIALHYGIENE –PHYSICALHAZARDS 9hrs

Noise, compensation aspects, noise exposure regulation, properties of sound, occupational damage, risk factors, sound measuring instruments, octave band analyzer, noise networks, noise surveys, noise control program, industrial audiometry, hearing conservation programs vibration types, effects, instruments, surveying procedure, permissible exposure limit.
Ionizing radiation, types, effects, monitoring instruments, control programs, OSHA standard non-ionizing radiations, effects, types, radar hazards, microwaves and radio-waves, lasers, TLV- cold environments, hypothermia, wind chill index, control measures-hot environments, thermal comfort, heat stress indices, acclimatization, estimation and control

Unit 2: INDUSTRIALHYGIENE -CHEMICAL HAZARDS 9hrs

Recognition of chemical hazards-dust, fumes, mist, vapour, fog, gases, types, concentration, Exposure vs. dose, TV - Methods of Evaluation, process or operation description, Field Survey, Sampling methodology, Industrial Hygiene calculations, Comparison with OSHAS Standard.

Air Sampling instruments, Types, Measurement Procedures, Instruments Procedures, Gas and Vapour monitors, dust sample collection devices, personal sampling Methods of Control - Engineering Control, Design maintenance considerations, design specifications - General Control Methods - training and education

Unit 3: BIOLOGICAL AND ERGONOMICAL HAZARDS 9hrs

Classification of Bio hazardous agents -bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases - Biohazard control program, employee health program-laboratory safety program-animal care and handling-biological Safety cabinets - building design Work Related Musculoskeletal Disorders -carpal tunnel syndrome CTS- Tendon pain disorders of the neck- back injuries.

Unit 4: OCCUPATIONAL HEALTH AND TOXICOLOGY **9hrs**

Concept and spectrum of health-functional units and activities of occupational health services, pre-employment and post-employment medical examinations - occupational related diseases, levels of prevention of diseases, notifiable occupational diseases such as silicosis, asbestosis, pneumoconiosis, siderosis, anthracosis, aluminosis and anthrax, lead-nickel, chromium and manganese toxicity, gas poisoning (such as CO, ammonia, coal and dust etc) their effects and prevention - cardio pulmonary resuscitation, audiometric tests, eye tests, vital function tests. Industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects, carcinogens entry into human systems

Unit 5: OCCUPATIONAL PHYSIOLOGY **9hrs**

Man as a system component - allocation of functions - efficiency - occupational work capacity - aerobic and anaerobic work - evaluation of physiological requirements of jobs - parameters of measurements - categorization of job heaviness - work organization - stress - strain - fatigue - rest pauses - shift work - personal hygiene.

REFERENCE BOOKS :

1) Industrial safety and environment, Anupama prashar, Pratibha Bansal, Kataria publications.
2) Safety health and environment thandbook, Narayanan, Mc Grawhill education.
3) Principles of Ocupational Health and Hygiene, an introduction Edited by Sue Reed, Dino Pisaniello, Geza Benke and Kerrie Burton.
4) Fundamentals of industrial hygiene, Barbara A.plog, National Safety Council ; 6thEdition.

45 hrs	V SEMESTER	Week : 3 hrs
PAPER II	DSC C 26 – TRANSPORTATION SAFETY	Credits: 3

UNIT 1: DRIVER SAFETY **9hrs**

Safety program for drivers, Defensive (Safe) Driving, selection of drivers, driver training, driving test, driver's responsibility, accident reporting and investigation procedures, fleet accident frequency, safe driving incentives, motor vehicle transport workers act. Drive relaxation and rest pauses, speed and fuel conservation, emergency planning and HAZ mat codes.

UNIT 2 : ROAD TRANSPORT **9hrs**

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, checklist, motor vehicles act, motor vehicle insurance and surveys.

UNIT 3 : HAZARDOUS GOODS TRANSPORTATION **9hrs**

Driver training on emergency information panel (EIP) and Transport emergency card (TREM), parking of tanker on the highways, responsibilities of diver, speedof the vehicle, Warning symbols, design of the tanker lorries, inspection and maintenance of vehicles, check list, loading and decanting procedures.

Unit 4 : ROAD AND TRAFFIC SAFETY **9hrs**

Fundamental Traffic rules, The problem of traffic safety, accident statistics and trend, Safety Measures-Administrative, Engineering, Enforcement and Educational Measures, Driving for less pollution, Indian standards, Motor vehicle act-1988, Central motor vehicle rule-1989 (Transportation of hazardous goods and Chemicals).

Unit 5 : WORKSHOP SAFETY **9hrs**

Transport precautions, safety on mechanical and manual handling, mechanical handling equipment operations, and safe driving movement of cranes, conveyors etc., servicing and maintenance equipment, wash rack operation, battery changing, gasoline handling, other safe practices, off the road motorized equipment.

REFERENCE BOOKS:

1. Transport Planning and Traffic Safety-Author Dinesh Mohan,
2. Transportation Engineering -Akash,
3. Highway and Traffic Engineering -Subhash C Saxena.
4. Hazardous Materials Transportation- Rajan Betta.
5. Fundamentals of industrial safety and health, volume land 2 by Dr. KU Mistry.

45 hrs	V SEMESTER	Week : 3 hrs
PAPER III	DSC C 27 -SAFETY IN TEXTILE INDUSTRY	Credits: 3

Unit 1 : INTRODUCTION **9hrs**

Need of safety in textile industry, types of textile industry, Composite flow chart, Manufacturing process- spinning, drawing, ginning, weaving, carding, bale opening and scotching process, pressing and baling, finishing process, short and long staple fibres, viscose rayon and synthetic fibre, spun and filament yarn, jute spinning and jute fabric manufacture. Introduction of process, opening and blow room machine, carding machine, silver and ribbon lap machines, combers and drawing frames, roving frames, ring frames, doubling machines, wrapping machines.

Unit 2: TEXTILE PROCESS HAZARDS **9hrs**

General precautions of process, bleaching process, processing machine, dyeing and printing machine, Mechanical finishing operations, washing machine, washing tanks, hydro extractors, jigger machines, calendar machines, drum washer, carbonizing, shearing and cutting, firing, construction of building, cotton mixing, sizing machines, looms, Loom shed, yarn singeing machine, Transports of size.

Unit 3: WASTE TREATMENT AND DISPOSAL IN TEXTILE INDUSTRY **9hrs**

Introduction of waste treatment and disposal, effect of textile effluents:- (on water,on land, on air), reduction of pollution load, waste segregation, recovery and re- use, substitution of low pollution load substances, use of chemicals, process changers, economical water use treatment method (primary secondary tertiary) tolerance limit, process house effulgent characteristics.

Unit 4: HEALTH HAZARDS AND WELFARE **9hrs**

Health hazard in textile industry due to dust, noise, occupational diseases and Precautionary measures, health and welfare provision in textile industry.

Unit 5: SAFETY STATUTES **9hrs**

Statutory provisions of factories act and rules applicable to textile industry, Indian Standards.

REFERENCE BOOKS:

1. Fundamentals of industrial safety and health, volume 1 and 2 by Dr. KU Mistry.
2. Industrial Safety Management by Deshmuk and L M McGraw Hill.
3. Textile Science by E P G Gohl.
4. Industrial safety handbook. Dr Anupama

45 hrs	V SEMESTER	Week : 3 hrs
PAPER VI	DSC C-28 INDUSTRIAL NOISE AND VIBRATION CONTROL	Credits: 2

Unit-1 : INTRODUCTION **9hrs**

Generation, Perception; Nature, Characteristics & Types of Sound / Noise; Noise ratings and standards for various sources like industrial, construction, traffic, aircraft community etc.; Nature & Types of Vibration.

Unit-2 : EFFECTS AND HAZARDS **9hrs**

Auditory Effects / Hearing Loss; Non Auditory Effects-Speech or Hearing Interference & Masking; Annoyance, Distraction; Physiological Effects, Behavioural Effects; Impact Case Studies; Effect of Vibration on Human Body; Machines & Structure.

Unit-3 : MEASUREMENT AND EVALUATION **9hrs**

Sources of Industrial Noise; Need of Noise Measurement; Methods of Measurements-Measurement Report, Noise Dose, Discretely varying Noise levels; Permissible limits of Noise & Evaluation; Vibration Equipments & Measurements- Root Mean Square (RMS) acceleration.

Unit-4 : CONTROL METHODS **9hrs**

Control at the source; Substitution of less Noisy process; Segregation & Isolation; Enclosure of noise source; Sound Absorption & Silencers; Sound Proofing; Ear protection, Rotational of personnel, Antiphase System, other control measures; Vibration Damping; Technical measures; Prophylactic & therapeutic measures.

Unit-5 : ENERGY TRANSFERRING AND DISSIPATING **9hrs**

Source: Structure borne and flow excited; Vibration isolation and absorption; Spring and damping materials; Dynamic absorbers, Mufflers and silencers; Path: Close filter and loosely covered enclosures; Acoustic treatment and materials; Design of rooms / industrial halls/ auditorium for minimum noise; Receiver: Measure to control at the receiver end; use of enclosures, ear muffs and other protective devices.

REFERENCES BOOKS:

1. Irwin, J.D and Graf, E. R, "Noise and Vibration Control", Prentice Hall Inc. New Jercy, 1979.
2. White R. G. Walker J. G, "Noise and Vibration", John Wiley and sons New York, 1982.
3. Dr. K U Mistry, "Fundamentals of industrial safety and health", SiddharthPrakashan Publisher.
4. R.K.Jain, Sunil S.Rao, "Industrial Safety, Health and Environment Management Systems", Khanna Publishers.

45 hrs	V SEMESTER	Week : 3 hrs
PAPER V	DSC C – 29 FOOD SAFETY	Credits: 3

UNIT-1: INTRODUCTION **9hrs**

Concept and meaning of Food Safety, food adulteration, food hazards, Exposure, estimation, toxicological requirements, and risk analysis. Safety aspects of water and beverages, Safety assessment of food contaminants and pesticide residues.

UNIT-2: LAWS AND REGULATIONS **9hrs**

Food laws and regulations – National (FSSAI) and international (FAO) food laws, newer approaches to food safety. PFA, FPO, Food Safety and Standards Bill 2005, International Laws and Agreements - FAO, WHO, Codex Alimentarius, Governing bodies,

UNIT-3 : SAFETY DURING PROCESSING **9hrs**

HACCP: Desirable safety features of some food processing equipment; Personal protective equipment; Safety from adulteration of food.

UNIT-4 : HYGIENE AND SANITATION IN FOOD INDUSTRY **9hrs**

Hygiene and sanitation requirement in food processing and fermentation industries; Cleaning, sanitizing and pest control in food processing; storage and service areas.

UNIT-5 MAINTENANCE& SAFETY **9hrs**

Role of maintenance staff and plant operators; Preventive maintenance; Guidelines for good maintenance & safety precautions; Lubrication & lubricants; Work place improvement through '5S'.

References Books:

1. Food Safety and Toxicity, De Vries, CRC Press, 1996
2. Hygiene in Food Processing: Principles and Practices, H. L. M. Lelieveldet.al ,Woodhead Publishing series, 2003.
3. Food Safety Handbook, Author(s): Ronald H. Schmidt, Gary E. Rodrick, published 2003 John Wiley & Sons, Inc., Print ISBN: 9780471210641.
4. The Food Safety Hazard Guidebook, Lawley, R., Curtis L. and Davis, J, RSC publishing, 2015
5. Plant sanitation for Food processing and Food service, Y. H. Hui, CRC Press, 2 nd Edition.2015

45 hrs	V SEMESTER	Week : 4 hrs
PAPER VI	DSC C-30 APPRAISAL, ANALYSIS, INSPECTION & CONTROL PROCEDURE	Credits: 4

UNIT-1 PLANT & EQUIPMENT SAFETY APPRAISAL & CONTROL TECHNIQUES 9hrs

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

UNIT-2 HAZARD IDENTIFICATION & RISK ASSESSMENT TECHNIQUES 9hrs

Hazard Analysis, Inductive and Deductive, FMEA, CMA, Fault Tree Analysis, Maximum Credible Accident Analysis, Examples of each, Safety Audit, Evaluating risks, Measure and Control of performance.

UNIT-3 MAJOR ACCIDENT HAZARD CONTROL 9hrs

CIMAH Rules, Safety Case, Safety Report, Introduction, Types and consequences of Major Industrial Hazards, Role of Management, Local Authorities and Public. Hazard Analysis, Risk Analysis Techniques, HAZAN, Hazard and Operability (HAZOP) Study.

UNIT-4 ACCIDENT REPORTING & INVESTIGATION PROCEDURES 9hrs

Identifying the key factors and the causes of accident, Reportable and non- reportable accidents, Accidents reportable under the factories Act, Writing reports and report forms, Investigators Kit, Methods of collecting evidences and tabulating data, Keeping the records, Root cause analysis, Fish Bone analysis, Corrective action.

UNIT-5 MEASUREMENT OF SAFETY PERFORMANCE 9 hrs

Terminology, Assessment of Work Injury, Accident incidents, Frequency rate, Severity rate, Incidence rate and Statistical Periods, Reactive and Proactive monitoring techniques, Indian Standard No.3786, Lead and Lag Indicators.

References books:

1. Dr. K U Mistry, "Fundamentals of industrial safety and health", SiddharthPrakashan Publisher.
2. R.K.Jain, Sunil S.Rao, "Industrial Safety, Health and Environment Management Systems", Khanna Publishers.
3. B S Dhillon "Safety and Human error in engineering systems", CRC Press.
4. Deshmukh, "Industrial safety management, Hazard identification and risk control", McGraw Hill education.
5. R B Choudary, G.R.N Tagore, "Plant layout and materials handling", Khanna publishers.
6. W. David Yates, "Safety professional's reference and study guide", CRC press.

60 hrs	V SEMESTER	WEEK : 4 hrs
PAPER VII	**DSC C 31P–FIRSTAID LAB**	**CREDITS: 2**
Sl No	**Experiment Title**	
1.	Bandaging Techniques	
2.	Fracture Immobilization	
3.	Eye Injury First Aid	
4.	Bleeding Control Techniques	
5.	Treatment of Burns	
6.	Snake Bite and Poisoning First Aid	
7.	Transportation of Injured Persons	
8.	Shock Management	
9.	Artificial Respiration Methods	
10.	Demonstration of CPR	

60 hrs	V SEMESTER	Week : 4 hrs
PAPER VIII	DSC C 32 P -ROAD SAFETY LAB	Credits: 2
Sl No	Experiment Title	
1.	Identification of Traffic Signs and Signal Operations	
2.	Helmet and Seatbelt Safety	
3.	Study of Road Markings	
4.	Speed and Braking Distance Analysis	
5.	Pedestrian Safety Demonstration	
6.	Night Driving Safety Study	
7.	Vehicle Safety Inspection	
8.	Road Accident Hazard Identification	
9.	Emergency Response During Road Accidents	
10.	Defensive Driving Principles	

60 hrs	V SEMESTER	Week : 4 hrs
PAPER IX	**DSC C 33 P - PROJECT WORK**	**Credits: 2**
1.	Students in consultation with the guide shall carry out literature survey/ visit industries to finalize the topic of the Project. The topic of project must be related to Environment, Health or Safety based. Subsequently, the students shall collect the material required for the selected project, Calculate the budget of the Project model, prepare synopsis and narrate the methodology to carry out the project work.	
2.	**Each Batch, under the guidance of a Faculty, is required to** •Present the seminar on the selected project orally and/or through power point slides. •Answer the queries and involve in debate/discussion. •Submit two copies of the typed Project report. Certificate, Acknowledgement. declaration , Introduction to reference. •The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.	

45 hrs	V SEMESTER	Week : 3 hrs
PAPER X	SEC -01 ENVIRONMENTAL ASPECTS OF INDUSTRIES	Credits: 2

UNIT-1 MINING INDUSTRY **9hrs**

Mineral production, history of environmental problems. Mining Methods- Opencast and underground mining. Unit operations: Site clearance, drilling, blasting, transportation, reclamation, mine closure, etc. Mineral beneficiation and their environmental impacts.

UNIT-2 METALLURGICAL INDUSTRY **9hrs**

Unit operations, sources and management of pollution in integrated steel plants, Direct reduced iron (DRI) plants, Aluminium Plants, Copper, Lead, etc. Metallurgical Plant Location and Layout.

UNIT-3 THERMAL POWER PLANTS **9hrs**

Introduction: site selection, layout and unit operations; Fuel and fuel handling -types of fuels, solid, liquid and gaseous. Fuel burning equipment; Pollution control devices- ash handling, management and its utilization. Environmental management for captive power plants.

UNIT-4 PETROLEUM INDUSTRY **9hrs**

Production and consumption of the oil and gas, unit operations involved in exploration and production of petroleum and natural gas; Major environmental problems in On-Shore and off-shore exploration

UNIT-5 CHEMICAL INDUSTRY **9hrs**

Petrochemical, Paint, Chemical Fertilizer, Pesticides, Distilleries, Pharmaceuticals, Pulp & Paper, Sugar Industries, etc.

References Books:

1. R.C Gupta, "Energy and Environmental Management in Metallurgical Industries", PHI Learning Pvt. Ltd.
2. CG Down & J Stocks, "Environmental Impact of Mining", Applied Sc. Pub, London, 1978.
3. S.C.Bhatia, "Environmental Pollution and Control in Chemical Process Industries", Khanna Publishers, New Delhi.
4. Dr. K U Mistry, "Fundamentals of industrial safety and health", SiddharthPrakashan Publisher.

45 hrs	VI SEMESTER	Week : 3 hrs
PAPER I	DSC C -34 Health and Safety Assessment Series (OHSAS 18001 and ISO 45001)	Credits: 3

UNIT-1 :OHSAS STANDARD **9hrs**

Introduction, Development of OHSAS standard, Structure and features of OSHAS 18001, Benefits of certification, certification procedure, specification and scope, correspondence between OHSAS 18001, ISO 45001 and ISO 9001:1994, Guidelines (18002:2000) for implementing OHSAS 18001.

UNIT-2 : OHSAS 18001 POLICY AND PLANNING **9hrs**

Developing OH and S policy, Guidelines, procedure, Content of OH and S policy, General principle, strategy and planning, specific goals, compliance, methodology. Analysis and identify the priorities, objective and Targets, Development of action plan, benefits and costs.

UNIT-3 : IMPLEMENTATION AND OPERATION **9hrs**

Guidelines for structure and Responsibilities, Top Management, middle level management, coordinator and employees, Developing procedures, identifying training needs, providing training, documentation of training, Training methodology consultation and communications.

UNIT-4: CHECKING AND REVIEW **9hrs**

Checking and Review; performance measurement and monitoring, Proactive and Reactive monitoring, measurement techniques, inspections, measuring equipment, Accidents reports, Process and procedures, recording, investigation corrective action and follow up, records.

UNIT-5 : ISO 45001 **9hrs**

ISO 45001, specifications, objectives, steps in ISO 45001, Implementation plan, Registration, Importance of ISO 14000 to the Management. Auditing IS 45001-General principles of Environmental Audit, Auditor, steps in audit, Audit plan.

Reference Books:

1. "ISO 45001, Practical Tool for Self-Assessment",
2. Dr. K U Mistry, "Fundamentals of industrial safety and health", SiddharthPrakashan Publisher.
3. "ISO 45001, The complete Guide , Mohammed Asif Ali Khan

45 hrs	VI SEMESTER	Week : 3hrs
PAPER II	DSC C – 35 DISASTER MANAGEMENT	Credits: 3

UNIT-1 PHILOSOPHY OF DISASTER MANAGEMENT **9hrs**

Introduction to Disaster mitigation-Hydrological, Coastal and Marine Disasters, Atmospheric disaster, Geological & meteorological phenomena, Mass Movement and Land Disasters, Forest disasters, Wind and water disasters, deforestation.

UNIT-2 TECHNOLOGICAL DISASTERS **9hrs**

Emergencies and control measures, APELL, Onsite and Offsite emergencies, Crisis management group, Emergency centers and their functions throughout the country,, Monitoring devices for detection of gases in the atmosphere.

UNIT-3 SUSTAINABLE DEVELOPMENT **9hrs**

Bio Diversity, Atmospheric pollution, Global warming and Ozone Depletion, ODS banking and phasing out, Sea level rise, climate changes, Eco friendly products, Green movements, Green philosophy, Environmental Impact Assessment.

UNIT-4 OFFSHORE AND ONSHORE DRILLING **9hrs**

Control of fires, Marine pollution and control, Toxic, hazardous & Nuclear wastes, state of India's and Global environmental issues, complex emergencies, Earthquake disasters, extreme event analysis, proof and limits.

UNIT-5 ENVIRONMENTAL EDUCATION **9hrs**

Population and community ecology, Natural resources conservation, Environmental protection and law, Risk assessment for different disaster types, Assessment data use, destructive capacity, risk adjustment, choice, loss acceptance, disaster aid, objectives and standards, preparedness, forecasting and warning, land use planning.

References Books:

1. Dr. K U Mistry, "Fundamentals of industrial safety and health", SiddharthPrakashan Publisher.
2. Gilbert, "Introduction to Environmental Engineering and Science", M. Masters.
3. Miller, "Environmental Science", G. Tylor
4. Miller, "Environmental Science sustaining the earth",
5. G. Tylor.R.K.Jain, Sunil S.Rao, "Industrial Safety, Health and Environment Management Systems", Khanna Publishers.

45 hrs	VI SEMESTER	Week : 3 hrs
PAPER III	DSC C – 36 SAFETY IN MINES	Credits: 3

UNIT-1 : OPENCAST MINES **9hrs**

Causes and prevention of accident from: Heavy machinery, belt and bucket conveyors, drilling, hand tools, pneumatic systems, pumping, water, dust, electrical systems, fire prevention, working condition, safe transportation, handling of explosives.

UNIT-2 : UNDERGROUND MINES **9hrs**

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

UNIT-3 : TUNNELING **9hrs**

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

UNIT-4 : RISK ASSESSMENT **9hrs**

Basic concepts of risk, reliability and hazard potential, elements of risk assessment, statistical methods, control charts, appraisal of advanced techniques, fault tree analysis, failure mode and effect analysis, fuzzy model for risk assessment.

UNIT-5 ACCIDENT ANALYSIS AND MANAGEMENT **9hrs**

Accidents classification and analysis, fatal, serious, minor and reportable accidents, Safety audits, Recent development of safety engineering approaches for mines, Frequency rates, Accident occurrence, investigation, Cost of accident, Emergency preparedness.

References Books:

1. Michael Karmis ed., “Mine Health and Safety Management”, SME, Littleton, Co.2001.
2. Dr. K U Mistry, “Fundamentals of industrial safety and health”, SiddharthPrakashan Publisher.
3. Kejiriwal, B.K., GyanPrakashan, “Safety in Mines”, Dhanbad, 2001.
4. OR Lovely Prakashan,”DGMS Circulars-Ministry of Labour, Government of India press”, DHANBAD, 2002.
5. R.K.Jain, Sunil S.Rao, “Industrial Safety, Health and Environment Management Systems”, Khanna Publishers.

45 hrs	VI SEMESTER	Week : 3hrs
PAPER IV	DSC C – 37 ENERGETIC MATERIALS SAFETY AND SENSITIVITY ANALYSIS	Credits: 3

UNIT 1: FUNDAMENTALS OF ENERGETIC MATERIALS **9hrs**

Introduction to energetic materials, Classification of explosives, propellants, and pyrotechnics, Physical and chemical characteristics, Combustion and explosion phenomena, Deflagration and detonation processes, Shock wave propagation, Heat of reaction, formation, and cooling, Sensitivity characteristics of energetic materials

UNIT 2 : MECHANICAL SENSITIVITY TESTING OF ENERGETIC MATERIALS **9hrs**

Principles of explosive testing, Deflagration and detonation tests ,Ignition and minimum ignition energy tests, Impact sensitivity testing (BAM method), Friction sensitivity testing (BAM method), Shock sensitivity testing, Card gap test, Interpretation of sensitivity test results

UNIT 3:THERMAL ANALYSIS AND INSTRUMENTATION **9hrs**

Thermal behaviour of energetic materials , Principles of thermal analysis , Thermo calorimetry techniques, Differential Scanning Calorimetry (DSC), Thermo gravimetric Analysis (TGA),Accelerating Rate Calorimeter (ARC), Operating principles and control parameters, Industrial applications and advantages of thermal analysis technique

UNIT 4: KINETICS AND STABILITY OF ENERGETIC MATERIALS **9hrs**

Reaction kinetics of explosives , Activation energy and reaction rate, Thermal decomposition kinetics, Determination of kinetic parameters, Kinetic analysis using:, DSC, TGA, Differential thermal analysis, ARC techniques, Stability assessment of energetic materials

UNIT 5: EVALUATION OF EXPLOSIVE PROPERTIES AND HAZARD ASSESSMENT **9hrs**

Theoretical evaluation of explosive properties, Oxygen balance calculations, Ignition mechanisms of energetic materials, Initiation methods , Heat, Friction, Impact/Percussion, Electrical energy, Flash and coherent light, Hazard assessment and safety considerations in handling energetic materials

Reference Books :

1. Principles of thermal analysis and calorimetry P J Haines
2. Test Methods for Explosives Mohamed Suceska
3. Guidelines for chemical reactivity evaluation and application to process design-American institute of chemical Engineers

45 hrs	VI SEMESTER	Week : 3hrs
PAPER V	DSCC – 38 SAFETY ENGINEERINGIN COMBUSTIBLE DUST & METAL POWDER	Credits: 3

UNIT 1: FUNDAMENTALS OF POWDERS & BULK SOLIDS **9hrs**

Powder classification – Physical, chemical, morphological properties
Metal powders vs Non-metallic powders – Iron, Al, Ti, polymers, food, pharma dusts
Bulk solids handling – Manual, mechanical, pneumatic, automatic methods
Key hazards – Pyrophoricity, toxicity, charge generation, charging of powders
Powder characterization – Particle size, shape, surface area, density, porosity, flow rate, angle of repose – Testing methods

UNIT 2: METAL POWDER PRODUCTION & SPECIAL HAZARDS **9hrs**

Production methods – Atomization, milling, electro-deposition, spray drying
Screening, cleaning & conditioning of reactive metals
Explosivity & pyrophoricity of Al, Mg, Ti, Zr powders – Case studies
Applications with high risk – Fuels, solid propellants, explosives, pyrotechnics
Nano-powders – Enhanced hazard profile

UNIT 3: DUST EXPLOSION SCIENCE & PREVENTION **9hrs**

Dust explosion pentagon – Industrial dust explosion accidents analysis
Explosibility parameters – MEC, MIE, Pmax, Kst, LOC, MIT – SignificanceTest methods – Hartmann tube, 20-L sphere, Godbert-Greenwald furnace, MIKE-3Explosibility classification – St1, St2, St3 + Hybrid mixturesIgnition sources in industry – Hot surface, flame, electrostatic, mechanical sparkPrevention vs Protection – Inerting, venting, suppression, isolation, containment – Vent sizing basics

UNIT 4: POWDER HANDLING EQUIPMENT & ELECTROSTATIC HAZARDS **9hrs**

Equipment hazards – Mills, conveyors, bucket elevators, cyclones, bag filters, silos, spray driers, hoppers ,Electrostatics fundamentals – Charge generation, accumulation, relaxation in powders

Types of discharge – Corona, brush, propagating brush, bulk surface, lightning-like
Hazards in operations – Pneumatic conveying, powder coating, electroplating, bag emptyingBonding, grounding & charge control – NFPA 77 concepts

UNIT 5: DUST RISK ASSESSMENT, CONTROL & REGULATIONS **9hrs**

Quantitative risk assessment – Dust sampling, area monitoring, personal exposure
Engineering controls – LEV, dust collection, explosion venting, suppression, isolation
Administrative controls – Housekeeping NFPA 654, hot work permits, training
PPE & respiratory protection – NIOSH guide for particulates, silica, asbestos
Legal framework – OSHA Combustible Dust NEP, NFPA 652/654/484, ATEX/DSEAR
Case studies – Coal mine dust, pharma explosion, Al powder incident

Reference Books :

1. Major hazard control ILO Geneva 1987
2. ASM Metals hand book, Ninth edition, Vol.7. powder metallurgy
3. Hazard recognition and prevention in the work place airborne dust vol.1 & 3 SRMC ,Chennai 4/5 sep 2000

45 hrs	VI SEMESTER	Week : 3 hrs
PAPER VI	DSC C- 39 SAFETY IN ON AND OFF SHORE DRILLING	Credits: 3

UNIT-1 : INTRODUCTION **9hrs**

Petroleum and its products are complex hydrocarbon mixtures with fire, explosion and health hazards. This unit covers crude oil composition, properties of fuels, solvents, lubricating oils, wax and grease. Key safety parameters like flash point, fire point, UEL/LEL and auto-ignition temperature are explained. Toxicity of benzene, H2S and other compounds is discussed. Products are classified as Class A, B, C under Petroleum Act 1934 for storage and handling rules.

UNIT-2 : ON AND OFF SHORE OIL OPERATION **9hrs**

This unit compares onshore wells with offshore platforms like jack-up, semi-submersible and FPSO. Construction of platform jacket, deck and pipeline laying hazards are covered. Maintenance and repair activities include hot work, diving, scaffolding and confined space entry risks. Unique offshore hazards like helicopter operations, dropped objects, sea motion and limited escape routes are highlighted. Safety measures include permit-to-work, emergency evacuation and muster systems.

UNIT-3 : DRILLING OIL **9hrs**

Drilling is the most hazardous phase due to high pressure and depth. This unit explains rotary and directional drilling techniques with equipment like derrick, mud pumps, Kelly and BOP. Work positions, 12-hr shifts, noise, vibration and weather create fatigue risks. Main hazards are blowout/kick, stuck pipe, drill string failure and H2S exposure. Proper lighting reduces human error. Well control and kick detection methods are critical for preventing disasters like Deepwater Horizon.

UNIT-4: EXTRACTION AND TRANSPORT BY SEA **9hrs**

After drilling, crude is extracted using primary/secondary recovery and processed at platform. This unit covers separators, flowlines and manifold operations. Marine transportation uses VLCC and double-hull tankers to reduce spill risk. Hazards during crude loading/unloading include static electricity, overfill and vapor explosion. Inert gas systems are used to keep oxygen below LOC. Oil spills cause fire, explosion and marine pollution as seen in Exxon Valdez case.

UNIT-5 : STORAGE & TRANSPORTATION **9hrs**

Petroleum products are stored in fixed roof, floating roof and spherical tanks. Hazards include breathing loss, rim seal fire, tank overfill and static ignition. Precautions like bonding, grounding, flame arrestors and level alarms are mandatory. Road and rail tanker transport has accident, leakage and fire risks. Tank cleaning is high-risk due to H2S, oxygen

deficiency and sludge. Gas freeing, ventilation and confined space permits are essential before entry.

References Books:

1. Dr. K U Mistry, "Fundamentals of industrial safety and health", SiddharthPrakashan Publisher.
2. R.K.Jain, Sunil S.Rao, "Industrial Safety, Health and Environment Management Systems", Khanna Publishers.
3. Encyclopedia of Occupational Health and Safety, Vol. II, International Labour Organisation, Geneva, 1985 & I.

60 hrs	VI SEMESTER	Week : 4 hrs
PAPER VII	DSC C- 40 P - ISO 45001 CLAUSES	Credits: 2
Sl No	EXPERIMENT TITLE	
1.	EXPERIMENT 1: SCOPE	
2.	EXPERIMENT 2: NORMATIVE REFERENCES	
3.	EXPERIMENT 3: TERMS AND DEFINITIONS	
4.	EXPERIMENT 4: CONTEXT OF THE ORGANIZATION	
5.	EXPERIMENT 5: LEADERSHIP	
6.	EXPERIMENT 6: PLANNING	
7.	EXPERIMENT 7: SUPPORT	
8.	Experiment 8: Operation	
9.	EXPERIMENT 9: PERFORMANCE EVALUATION	
10.	EXPERIMENT 10: IMPROVEMENT	

60 hrs	VI SEMESTER	Week : 4 hrs
PAPER VIII	DSC C - 41 P - Occupational Health & Safety Audit Lab	Credits: 2
Sl No	Experiment Title	
1.	**MANAGEMENT SYSTEM & OH&S POLICY EVALUATION** **IS 14489:2018 Element:** Clause 3 & Annex A	
2.	**PRE-AUDIT PLANNING & DOCUMENTATION REVIEW** **IS 14489:2018 Element:** Clause 4	
3.	**AUDIT OF PLANT LAYOUT, DESIGN, AND PHYSICAL HAZARDS** **IS 14489:2018 Element:** Annex A	
4.	**MACHINE GUARDING & MECHANICAL INTEGRITY AUDIT** **IS 14489:2018 Element:** Annex A	
5.	**ELECTRICAL SAFEGUARDING & EARTH SYSTEM INSPECTION** **IS 14489:2018 Element:** Annex A	
6.	**INDUSTRIAL HYGIENE & WORK ENVIRONMENT MONITORING AUDIT** IS 14489:2018 Element: Annex A	
7.	**SAFE OPERATING PROCEDURES (SOP) & WORK PERMIT AUDIT** **IS 14489:2018 Element:** Annex A	
8.	**EMERGENCY PREPAREDNESS & FIRE FIGHTING SYSTEMS AUDIT** **IS 14489:2018 Element:** Annex A	
9.	**ACCIDENT/INCIDENT REPORTING, ANALYSIS & RCA AUDIT** **IS 14489:2018 Element:** Annex A	
10.	**FINAL AUDIT REPORTING & CLOSING MEETING PROTOCOL** **IS 14489:**2018 Element: Clause 4.5 & Annex	

60 hrs	VI SEMESTER	4 Weeks
PAPER IX	**DSC C - 42P - INTERNSHIP**	**Credits: 2**
1-Month Industry Internship Plan for Students Subject: Industrial Safety Duration: 4 Weeks | 30 Days		
1.	**Week 1** - Orientation & Observation	
2.	**Week 2 -** Department-wise Study	
3.	**Week 3 – Assignment**	
4.	**Week 4 -** Reporting & Completion	
5.	**Final Report Must Include for Safety Subject :** • Company Certificate • Company safety policy + emergency plan • Fire protection system details • Hazard list of 1 department + controls • Case study of 1 near-miss/accident if allowed • Your suggestions for safety improvement – 3 to 5 points	

45 hrs	VI SEMESTER	Week : 3 hrs
PAPER X	Compulsory Paper- SEC-02 HUMAN FACTORS	Credits: 2

UNIT-1: HUMAN ANATOMY **9hrs**

Anatomy, Posture and Body Mechanics: Some basic body mechanics, anatomy of the spine and pelvis related to posture, posture stability and posture adaptation, low back pain, risk factors for musculoskeletal disorders in the workplace, Behavioural aspects of posture, effectiveness and cost effectiveness.

UNIT-2: HUMAN BEHAVIOR **9hrs**

Individual differences, Factors contributing to personality, Influence of difference on safety, Motivation, Job satisfaction, Frustration and Conflicts, Reaction to frustration, Emotion, Attitudes-Determination of attitudes, Changing attitudes, Principles of Learning, Forgetting.

UNIT-3 : ANTHROPOMETRY AND WORK DESIGN **9hrs**

Designing for a population of users, percentile, sources of human variability, anthropometry, principals of application in ergonomics and design, design for everyone, anthropometry and personal space, effectiveness and cost effectiveness, ergonomics approach to work station design for standing & seated workers.

UNIT-4 : MAN MACHINE SYSTEM AND REPETITIVE WORKS **9hrs**

Applications of human factors, man as a sensor, man as information processor, man as controller – Man vs Machine. Interventions in Repetitive works, measures for preventing musculoskeletal disorders (WMSDs), reduction and controlling, training

UNIT-5 : DISPLAY, CONTROLS AND VIRTUAL ENVIRONMENTS **9hrs**

General information, processing model of the users, cognitive system, problem solving, effectiveness, Visual displays, auditory displays, combining displays and controls- virtual (synthetic) environments.

References Books:

1. E.J. McCormick “Human Factors in Engineering and Design”, Tata McGraw-Hill.
2. M.S. Sanders, “Human factors in engineering & design”, Tata McGraw-Hill.
3. Accident Prevention Manual for Industrial Operations, NSC, Chicago, 1982.
4. Ergonomic design for organizational effectiveness, Michael O’Neill
5. Fitting the task to the human, Fifth edition,K.H.E.Kroemer and E.Grandjean