

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



UNIVERSITY OF KHARTOUM

Faculty of Engineering

Postgraduate Programs

Proposal:

Diploma/M.Sc. In Health, Safety and Environment (HSE)

Engineering

(by Courses)

(HSE)

December 2016

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Proposal:

Diploma/M.Sc. in Health, Safety and Environment (HSE) Engineering

(by Courses)

1. Introduction:

The Faculty of Engineering – Khartoum University is offering a postgraduate program leading to the degree of Master in health, safety and environment (HSE) through the application of knowledge of Mathematics, Science, Engineering fundamentals and an engineering specialization for hazard identification, risk assessment and control of occupational hazards and to design, establish, implement maintain and continually improve an occupation health and management system to improve safety.

The program will study and conduct investigations on unwanted incidents using root cause analysis and generate corrective and preventive action to prevent recurrence and occurrence of such incidents. In addition to designing of complex man machine systems using human factors engineering tools so as to achieve comfort, worker satisfaction, efficiency, error free and safe workplace environment.

One of the major objectives of the program is to communicate effectively on health, safety and environment matters among the employees and with society at large and to demonstrate understanding of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to occupation health and safety practices.

2. Degree title

Diploma/M.Sc. in Health, Safety and Environment (HSE) Engineering (by Courses)

3. Rationale:

HSE at Khartoum University is based on the rationale that a competent safety engineer is important in rendering expertise to the Industrial and Social needs at National and Global level. As a student on the M.Sc. of HSE courses, you will gain the skills and knowledge to be a 21st century engineer who can meet the Health, Safety and Environmental challenges of industry and society.

4. Objective

The objectives of the program are as follows:

1. Possess a mastery of Health safety and environment knowledge and safety management skills, to reach higher levels in their profession.
2. Effectively communicate information on Health safety and environment facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering activities.
3. Demonstrate professional and ethical attitude with awareness of current legal issues by rendering expertise to wide range of industries.
4. To have a global awareness of HSE issues and use appropriate technologies to solve them.

5. Learning Outcomes:

The Learning Outcomes in the proposed program can be stated as:

1. Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization for hazard identification, risk assessment and control of occupational hazards.
2. Design, Establish Implement, Maintain to improve an occupational health and management.
3. Conduct investigations on unwanted incidents using root cause analysis and generate corrective and preventive action to prevent recurrence and occurrence of such incidents.
4. Design complex man machine systems using human factors engineering tools so as to achieve comfort, worker satisfaction, efficiency, error free and safe workplace environment.
5. Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings so as to provide practical solutions to safety problems.
6. Communicate effectively on health and safety matters among the employees and with society at large.
7. Demonstrate the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to occupational health and safety practices.
8. Understand and commit to comply with legal requirements, professional ethics, responsibilities and general norms of engineering practice.
9. Understand the impact of health, safety and environment solutions on productivity, quality and society at large.
10. Understand the uses of state-of-art occupational health and safety practices in controlling risks of complex engineering activities and understand their limitations.

6. Admission Requirements

- The applicant must satisfy the general rules of registration as specified by the Graduate College of the University.
- The applicant must be holding an honors Degree in Engineering of the University of Khartoum, or its equivalent.

7. Registration Requirements

As per academic Regulations for Postgraduate Studies 2011 (section 4.2), the student must first register for the diploma/Master Program and then pursue the Master degree at the end of the second semester based on his/her academic performance.

8. Teaching Staff and Facilities

8.1 Teaching Staff:

The courses will be taught by faculty of engineering members of relevant departments who hold at least a **PhD** in their respective areas. In addition staff from other faculties in the University will be highly considered if necessary.

8.2 Facilities:

The faculty is equipped with excellent teaching and learning facilities including well equipped classroom and laboratories at different departments along with analytical laboratories procured recently through the faculty of engineering development project.

9. Program Duration and Structure

The study program comprises as illustrated in Table (1):

- A group of **Ten core** courses (see section 11.1) to be covered in the first two semesters, equivalent to 24 credit hours. By the end of the first two semesters those who scored an average of 60% or more will proceed for the Master stage as detailed in the examination rules below.
- Three **elective** courses to be covered in the third semester equivalent to nine credit hours will be selected from a group of elective courses (See section 11.2.1).

- A research paper of three credit hours to be started within the third semester guided and supervised by staff member then to submit a report within 45 days after the end of the third semester examinations.

Table (1): Distribution of the Diploma/Master Program Credit Hours over Semesters

Semester	Credit hours of Program Stages	
	Diploma Stage	M.Sc. Stage
1	12	12
2	12	12
3	Not Applicable	12*
Total credit hours	24	36

**Including 3Credit hours for the research paper*

10: Examination Rules

In addition to the general examination regulations of the Graduate College and Faculty of Engineering in University of Khartoum, the student is subjected to the followings rules:

- 10.1 At the end of each semester, the student sits for examinations in the courses completed in that semester.
- 10.2 To pass the exam, in any course, the student must score not less than 50% of its marks.
- 10.3 A student of Diploma stage (the first two semesters) shall sit for supplementary examinations if fails in not more than three courses of the stage, provided achieving not less than 50% average in aggregate of all courses in the stage.
- 10.4 Any student of the Diploma stage who fails in more than three courses of the stage or any of its supplementary exams or achieves less than 50% average in aggregate of all examined courses in the stage shall be withdrawn from the study.
- 10.5 A student of the Diploma stage who scores average 50% or above, but less than 60%, in aggregate of all courses exam marks will graduate with a “Diploma in Health, Safety and Environment (HSE) Engineering”.
- 10.6 Supplementary and substitute examinations are held once a year for each stage of the program.

- 10.7 A student must attain not less than 60% average in aggregate of exam marks of all courses in the stage, in order to proceed studying for the M.Sc. stage, if wishes.
- 10.8 A student who scores average 60% or above, but does not wish to continue to for the master will be granted a “Diploma in Health, Safety and Environment (HSE) Engineering”, and will not be allowed to continue for the master later.
- 10.9 A student of the M.Sc. stage who fails in not more than two courses of the stage shall sit for supplementary examination(s).
- 10.10 A student of the M.Sc. stage who fails in more than two courses or any supplementary examination will graduate with a “Diploma in Health, Safety and Environment (HSE) Engineering”.
- 10.11 The “research paper” must be submitted within 45 day after the end of taught courses examinations in the M.Sc. Stage, any delay from this date will be classified as failure.

11: Courses Outline

11.1 Core Courses

1. First Semester

Code	Subject	Credit Hours
HSE6113	Principles of Safety Management	3
HSE6122	Environmental Safety	2
HSE6132	Occupational Health & Industrial Hygiene	2
HSE6142	Safety, Health and Environment (HSE) Legal Aspects	2
HSE6153	Hazards Analysis techniques	3
Total		12

2. Second Semester

Code	Subject	Credit Hours
HSE6213	Fire Engineering and Explosion Control	3
HSE6222	Electrical Safety	2
HSE6232	Safety in Construction	2
HSE6242	Quality Engineering	2
HSE6253	Safety in Process Industries	3
Total		12

11.2 Elective Courses

3 Third Semester

Selection of **3** electives from the following options

code	Subjects	Credit hours
Option A		
HSE7113	Work Study and Ergonomics	3
HSE7123	Disaster Management	3
HSE7133	Safety in Powder Handling	3
HSE7143	Plant Layout and Materials Handling	3
HSE7153	Design of Industrial Ventilation System	3
HSE7163	Transport Safety	3
HSE7173	Safety in Petrochemical Industries	3
HSE7183	Environmental Impact Assessment	3
HSE7193	Vibration and Noise Control	3
HSE7203	Safety in Mines	3
HSE 7213	Reliability Engineering	3

Research Paper (3 credit hours)

HSE7213	Research paper	3
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12: Courses Description

12.1. Core Courses:

HSE611: Principals of Safety Management (3 credit hours)

COURSE OBJECTIVES:

- To achieve an understanding of principles of safety management.
- To enable students to conduct safety audit and write audit reports effectively in auditing situations.
- To have knowledge about sources of information for safety promotion and training.
- To familiarize students with evaluation of safety performance.

COURSE OUTCOMES:

The students will be able to ::

- To estimate the accident cost using supervisors report and data.
- To evaluate the safety performance of an organization from accident records.
- To identify various agencies, support institutions and government organizations involved in safety training and promotion.

COURSE CONTENTS

History of Safety movement –Evolution of modern safety concept- general concepts of management – planning for safety for optimization of productivity. Identification of unsafe acts of workers and unsafe conditions .Concepts of an accident, near miss incident, reportable and non-reportable accidents, accident investigation and analysis – records for accidents, , documentation of accidents – unsafe act and condition – domino sequence – supervisory role – role of safety committee –cost of accident.

HSE612: Environmental Safety (2 credit hours)

COURSE OBJECTIVES:

To provide in depth knowledge in Principles of Environmental safety and its applications in various fields.

COURSE OUTCOMES:

The students will be able to

- Explain the ways in which environmental health problems have arisen due to air and water pollution.
- Illustrate the role of hazardous waste management and use of critical thinking to identify and assess environmental health risks.

Course contents

- Classification and properties of air pollutants – Pollution sources – Effects of air pollutants on human beings, Animals, Plants and Materials ultra violet radiation, infrared radiation, radiation from sun-hazards due to depletion of ozone - deforestation-ozone holes-automobile exhausts-chemical factory stack emissions-CFC.
 - different industrial effluents and their treatment and disposal Environmental impact assessment (EIA)-scope, guidelines, activities and methodologies;
 - Pollution control in process industries like cement, petroleum-petroleum products tanneries-thermal power plants – dyeing and pigment industries .

HSE613: Occupational Health & Industrial Hygiene (2 credit hours)

COURSE OBJECTIVES:

- To enable students to compare the hazards with the permissible levels.
- To have knowledge about types of hazards arising out of physical, chemical and biological agents.

COURSE OUTCOMES:

The students will be able:

- To identify various types of hazards arising out of physical, chemical and biological agents in a process.
- To identify notifiable occupational diseases arising out of Occupation and suggest methods for the prevention of such diseases.

COURSE CONTENTS:

physical hazards--noise, vibration, and radiations, effects ,cold environments, hypothermia, wind chill index, control measures of hot environments, heat stress indices, acclimatization, estimation and control.

chemical hazards--recognition of chemical hazards. -dust, fumes, mist, vapour, fog, gases, types, concentration, exposure vs. dose, tlv

biological and ergonomical hazards --classification of bio-hazardous, infectious diseases . building design. work related musculoskeletal disorders –carpal tunnel syndrome cts- tendon pain disorders of the neck- back injuries.

occupational health, physiology and toxicology--concept and spectrum of health pre-employment and post-employment medical examinations – occupational related diseases. occupational work capacity, evaluation of physiological requirements of jobs — stress – strain – fatigue – rest pauses – shift work – personal hygiene. lead-nickel, chromium and manganese toxicity, gas poisoning (such as co, .

HSE 6142 : HEALTH, SAFETY AND ENVIRONMENT(HSE) LEGAL ASPECTS (2 credit hours)

COURSE OBJECTIVES:

To provide wide exposure to the students about various legislations applicable to an industrial unit.

COURSE OUTCOMES:

The students will be able

- To list out important legislations related to health , Safety and Environment.
- To understand the health and welfare provisions given in the field.
- To prepare onsite and offsite emergency plan.

COURSE OUTCOMES:

- General powers of the central government, prevention, control and abatement of environmental pollution-Biomedical , prevention and control of air pollution and water pollution .
- manufacture, storage & import of hazardous chemical rules .Sudanese rules and regulations on HSE, Boiler Act, static and mobile pressure vessel rules ,, motor vehicle rules, the Mines and Minerals Act, , workman compensation act, rules – electricity act and rules – hazardous wastes (management and handling) rules, the building and other construction workers act., Petroleum rules, Gas cylinder rules-Explosives Act -Pesticides Act –.international acts and standards om HSE.

HSE6153: Hazard Analysis Techniques (3 credit hours)**Course objectives:**

- To provide knowledge on risk, hazard and their assessment techniques in Industry
- To understand the principles of operation of various equipment for safety application
- To conduct a risk assessment technique in Industries.

Course outcome:

- This course would make familiarizing of basic concepts in risk and hazard
- Course would equip the students effectively to employ hazard analysis techniques in Industry and helpful to prevent the accidents in Industry

COURSE CONTENTS

hazard, risk issues and hazard assessment ---introduction, hazard, hazard monitoring-risk issue, , social benefits vs technological risk, approaches for establishing risk acceptance levels, risk estimation. risk communication, checklist analysis, what-if analysis, safety review, preliminary hazard analysis(pha), human error analysis, hazard operability studies(hazop),safety warning systems.

instrumentation in safety applications-----applications of advanced equipment's and instruments, risk analysis quantification and softwares----fault tree analysis and event tree analysis, logic symbols, methodology, minimal cut set ranking - fire explosion and toxicity index(feti), various indices – hazard analysis(hazan)- failure mode and effect analysis(fmea)-

consequences analysis ---logics of consequences analysis- estimation- hazard identification based on the properties of chemicals- chemical inventory analysis- identification of hazardous processes-, bleve,

credibility of risk assessment techniques --past accident analysis as information sources for hazard analysis and consequences analysis of chemical accident

HSE6213: Fire Engineering and Explosion Control (3 credit hours)**COURSE OBJECTIVES:**

- To provide an in depth knowledge about the science of fire and its causes,
- To know the various fire prevention systems and protective equip-ments.
- To understand the science of explosion and its prevention tech-niques.
- To understand the various fire prevention techniques to be followed in a building.

COURSE OUTCOMES:

- To make familiar about basic concepts of fire and explosion science.
- To know the different source of ignition and their prevention techniques.
- To understand the operation of various types of firefighting equipment's.
- To understand the causes and prevention of explosion.

COURSE CONTENTS

PHYSICS AND CHEMISTRY OF FIRE---Fire properties toxicity of products of combustion - theory of combustion and explosion – vapour clouds – flash fire – jet fires – pool fires – unconfined vapour cloud explosion, shock waves - auto-ignition – boiling liquid expanding vapour explosion .

fire prevention and protection ---sources of ignition – fire triangle – principles of fire extinguishing – active and passive fire protection systems – various classes of fires ,types of fire extinguishers – fire stoppers – hydrant pipes – hoses – monitors – fire watchers – lay out of stand pipes – fire station-fire alarms and sirens .

industrial fire protection systems----sprinkler-hydrants-stand pipes – special fire suppression systems like deluge and emulsifier– alarm and detection systems. other suppression systems – co2 system, foam system, dry chemical powder (dcp) system, halon system .

building fire safety----objectives of fire safe building design, fire load, fire resistant material and fire testing – structural fire protection – structural integrity – concept of egress design - exit – width calculations - fire certificates – fire safety requirements for high rise buildings.

explosion protecting systems ---principles of explosion-detonation and blast waves-explosion parameters – explosion protection,

HSE6222: Electrical Safety (2 credit hours)**COURSE OBJECTIVES:**

- To provide knowledge on basics of electrical fire and statutory re-quirements for electrical safety
- To understand the causes of accidents due to electrical hazards
- To know the various protection systems in Industries from electri-cal hazards

COURSE OUTCOMES:

- Course would be helpful to understand the electrical hazards in Industries.
- Students would be able to understand the operation of various protection systems from electrical hazards and Recognize different hazardous zones in Industries
- Students would be able to gain knowledge on selection of suitable electrical equipment in different hazardous zone.

COURSE CONTENTS

Introduction –Working principles of electrical equipment- first aid-cardio pulmonary resuscitation(CPR).

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-

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. --classification of hazardous zones.

HSE6232: Safety in Construction (2 credit hours)**COURSE OBJECTIVES :**

- To know causes of accidents related to construction activities and human factors associated with these accident
- To have the knowledge in hazards of construction and their prevention methods
- To know the working principles of various construction machinery
- To gain knowledge in health hazards and safety in demolition work

COURSE OUTCOMES :

Upon completion of the course the students will be able

- To identify types and causes of accidents, and designing aids for safe construction
- To understand the hazards during construction of power plant , road works and high rise buildings.
- To understand the safety procedure for working at heights during construction.

- To have knowledge in selection, operation, inspection and testing of various construction machinery
- To list out construction regulations and Sudanese standards for construction and demolition work .

COURSE CONTENTS

accidents causes and management systems ---problems impeding safety in construction industry- causes of fatal accidents, types and causes of accidents related to various construction activities, human factors associated with these accident – construction regulations, contractual clauses – design aids for safe construction – permits to work - compensation – recording of accidents and safety measures – education and training .

Hazards of construction and prevention--excavations,– scaffolding , scaffold inspection checklist – false work – erection of structural frame work, dismantling – tunneling – blasting, pre blast and post blast inspection – confined spaces – working on contaminated sites – work over water - road works – power plant constructions – construction of high rise buildings .

working at heights ----fall protection in construction– safe use of ladders- scaffoldings , requirement for safe work platforms, stairways, gangways and ramps , accident case studies .

construction machinery ---selection, operation, inspection and testing of hoisting cranes, mobile cranes, tower cranes, crane inspection checklist - use of conveyors - concrete mixers, concrete vibrators – safety in earth moving equipment, excavators, dozers, loaders, dumpers, welding machines, use of portable electrical tools, drills, grinding tools, manual handling scaffolding, hoisting cranes — manual handling .

Safety in demolition work ---safety in demolition work, manual, mechanical, using explosive - keys to safe demolition, pre survey inspection.

HSE6242: Quality Engineering (2 credit hours)

COURSE OBJECTIVES:

- To know the quality engineering concepts in product design and development processes
- To know the control and process parameters' characteristics with feedback system
- To know the methods for production and diagnosis process improvements
- To have knowledge on ISO quality systems and types of quality tools such as failure and effect analysis.

COURSE OUTCOMES:

- Students can understand the loss function derivation and quality engineering in product design and development processes
- The students will be able to improve the production and process diagnosis and production process.
- The students will be able to gain knowledge in ISO quality management systems.
- The students will be able to list the roles and responsibilities of leaders.

COURSE CONTENTS

Introduction to quality engineering and loss function--quality value and engineering- overall quality system-quality engineering in product design - quality engineering in design of production processes On-line quality control --- on-line feedback quality control variable characteristics-control with measurement interval- one unit, multiple units-control systems for lot and batch production. on-line quality control attributes and methods for process improvements quality engineering and tpm preventive maintenance schedules- pm schedules for functional characteristics- pm schedules for large scale systems. quality tools-- fault tree analysis, event tree analysis, failure mode and effect analysis. ISO quality systems. SIX SIGMA AND ITS IMPLEMENTATION Introduction- definition-methodology - six sigma tools – sustaining six sigma

HSE6253: SAFETY IN PROCESS INDUSTRIES (3 credit hours)**COURSE OBJECTIVE**

- To provide knowledge on design features for a process industry and safety in the operation of various equipment in industry.
- To understand the various hazards and prevention in commissioning stage of industry.
- To recognise and identify the safe operation of equipment in process industry.
- To plan and trained for emergency planning in a process industry.
- To get fundamental knowledge on safe storage of chemicals.

COURSE OUTCOMES:

- Course would be helpful to understand the design of pressure systems.
- Students can prepare the emergency planning for chemical industry problems
- Students would be able to create safe storage systems.

COURSE CONTENTS

safety in process design and pressure system design---design process, conceptual design and detail design, assessment, inherently safer design chemical reactor, types, , assessment, reactor safety, operating conditions, unit operations and equipment's, utilities. plant commissioning and inspection---commissioning phases, , plant inspection, performance monitoring, condition, vibration, corrosion, acoustic emission-pipe line inspection. plant operations --operating discipline, operating procedure and inspection, start up and shut down operation, plant maintenance, modification and emergency planning management of maintenance, , confined spaces, permit system- - hot works- tank cleaning, repair and demolition- 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, vapourizer, 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

12.2 Elective Courses

HSE 7113 WORK STUDY AND ERGONOMICS (3 credit hours)

COURSE OBJECTIVES

- Studying the work procedure and understanding the relationships between the workers and working environments.
- To study the applications of ergonomic principles and physiology of workers.
- To know the concepts of personal protective equipment and its usages .
- To create the knowledge in process and equipment design in safety aspects .

COURSE OUTCOMES :

- Students can have the knowledge in work procedure and applications in hazardous workplaces.
- Students will be able to incorporate human factors in design of Personal protective equipment.
- They know the risk factors, guide lines for safe design of man machine systems considering human factors .

COURSE CONTENTS

- methods and movements at the workplace – substitution with latest devices – robotic concepts – applications in hazardous workplaces – productivity, quality and safety (PQS) .
- Definition Ergonomics – applications of ergonomic principles in the shop floor – work benches – seating arrangements — principles of motion economy – location of controls – display locations – machine foundations – work platforms, fatigue, physical and mental strain – incidents of accident – physiology of workers .
- Concepts of personal protective equipment – types – selection of PPE – invisible protective barriers – procurement, storage, inspection and testing – quality – standards – ergonomic considerations in personal protective equipment design .

HSE7123: Disaster Management (3 credit hours)

COURSE OBJECTIVES:

- To study the disaster types and their control using space technology with case studies.-
- To study about on site and off site emergency plans.
- To study about the marine pollution and earth quake disasters and their effects.

COURSE OUTCOMES:

Upon completion of the course the students will be able

- To explain the philosophy of disaster management and their control using the sophisticated technologies.
- To understand the emergency measures and how to control with monitoring devices.
- To understand earth quake disasters and nuclear wastes disposals.
- To gain knowledge in risk and disaster assessment processes including standards, and national policies .

COURSE CONTENTS

Introduction ---philosophy of disaster management-introduction to disaster atmospheric disasters geological, meteorological phenomena-mass movement and land disasters-forest related disasters-wind and water related disasters, deforestation-use of space technology for control of geological disasters .

Technological disasters --technological disasters-case studies of technology disasters with statistical details-emergencies and control measures
environmental impact assessment -- atmospheric pollution-global warming and ozone depletion- - environmental policies environmental impact assessment-case studies-.

offshore and onshore drilling-control of fires-case studies-marine pollution and control-toxic, hazardous and nuclear wastes- ,environmental education-population and community ecology-natural resources conservation-environmental protection and law-.

HSE7133: Safety in Powder Handling (3 credit hours)

COURSE OBJECTIVES :

- To know powder classification, properties and their handling.
- To know the processing and characterisation of metal powders.
- To gain the knowledge on various test and apparatus applicable in dust explosion
- To study the powder handling and material handling equipment in industries.
- To understand housekeeping procedures and pollution control methodology .

COURSE OUTCOMES :

Upon completion of the course the students

- can have the abilities to understand the classification and to synthesis and characterize the powders
- Can have the knowledge regarding the usage and applications of equipment used to characterize the metal powders
- will be able to understand the various tests and apparatus used in dust explosion evaluation.
- can know how to handle the hazardous materials and the usage of different kind of handling equipment
- can have knowledge about housekeeping, role of workers and evaluation procedures and control measures for particulates .

COURSE CONTENTS

Introduction --powder classification-physical, chemical and other properties-metal powders-- synthesis of nano powders - automatic-charges on powders-charge distribution-charging of powders.

metal powders and characterization --- atomization, types – milling – electro deposition – spray drying, production of iron powder, aluminum powder, titanium – screening and cleaning of metals– toxicity particle size and size distribution – measurement, types and significance – particle shape analysis .

Dust explosion---industrial dust, dust explosion – dust explosion prevention – dust explosion protection – dust explosion venting, vent coefficient, various methods of design – venting of ducts and pipes – dust fire.

Dust handling plants and electro static hazards --- grinding mills, conveyors, bucket elevators, dust separators, dust filters, cyclones, driers, spray driers, silos, grain elevators, typical applications, hazards. electrostatic charges-energy released-type of discharge-sparkcarona-insulating powders-propagating brush discharge-discharge in bulk lightning

hazards in powder coating-electroplating - handling of nano powders in the presence of flammable gases and vapour.

dust evaluation and control ----evaluation, methodology, quantitative, sampling, measurements – control approaches and strategies – control of dust sources, dust transmission – role of workers, ppe and work practice

HSE7143: Plant Layout and Materials Handling (3 credit hours)

COURSE OBJECTIVES

Students will be provided with the knowledge of the process of analyzing and developing information to produce a plant layout based on the locations and working conditions.

- To educate the students about the basic things of work conditions which include ventilation, comfort, lighting and its effect based on various nature of work.
- To provide the skill of handling the Manual material handling and lifting techniques of various shapes of machine and heavy objects
- To give an input of handling the hazardous materials of liquid, solids and cryogenic liquids with proper packing
- The students will be provided with expert knowledge of arriving plant locations and creating the plant layout based on nature of industries and working conditions with better experience in material handling techniques .

COURSE OUTCOMES :

- The students will be able to identify equipment requirements for a specific process and for various locations and working conditions.
- The students will be able to understand the benefit of an efficient material handling system. ☐ The student
- The students will be able to recommend improvements to existing plant layouts based on material handling factors
- The students will be able to integrate concepts and techniques learned through this course in order to design an efficient plant layout .

COURSE CONTENTS

Plant location --selection of plant locations, territorial parameters, considerations of land, water, electricity, location for waste treatment and disposal, further expansions safe location of chemical storages in the form of bullets, spheres, cylinders for lpg, lng, cng, acetylene, ammonia, chlorine – explosives and propellants .

plant layout ---safe layout, equipment layout, safety system, fire hydrant locations, fire service rooms, facilities for safe effluent disposal and treatment tanks, site considerations, approach roads, plant railway lines, security towers. safe layout for process industries,

working conditions --principles of good ventilation, purpose, physiological and comfort level types, local and exhaust ventilation. .

Manual material handling and lifting tackles-

mechanical material handling hoisting apparatus, types - cranes, types, design and construction, guards and limit devices, signals, operating rules, maintenance safety rules, inspection and inspection checklist – conveyors, precautions, types, applications. powered industrial trucks,

HSE7153: Design of Industrial Ventilation System (3 credit hours)

COURSE OBJECTIVES

The course could provide the basic knowledge on principles of ventilation and its applicability in industries.

- To impart the knowledge on various types of ventilating system, the mechanism of ventilation and the relationship between heat generation and ventilation
- To educate the designing of Exhaust system based on various exhaust system taking into consideration of various parameters and validating the same with proper testing methods.
- To provide knowledge on how to select the ventilation system for the specific usage based on industrial experience.

COURSE OUTCOMES:

- The course could provide the students in remembering the basic knowledge and principles of ventilation and exhaust system
- The students could understand the various types of Ventilation systems and the mechanism and testing processes behind each ventilation systems.
- The students could able to apply the acquired knowledge in selection various ventilation systems based upon end use.
- The students could able to analyze the salient feature of various ventilation systems and the role of individual parameters in controlling the efficiency of the ventilation system
- The student could able to design or create the required type of ventilation systems and local exhaust hoods of their choice based on the knowledge acquired by them after knowing the test methods and design procedures.

COURSE CONTENTS

General principles of ventilation --introduction,-supply and exhaust systems-basic definitions-principles of air flow-acceleration of. .

General industrial ventilation --dilution ventilation principles radiant heat control – enclosures and insulation– personal protective equipment’s-protective suits and refrigerated suits .

local exhaust hoods and air cleaning devices

DESIGN and testing of industrial ventilation --exhaust system design procedure-steps-duct segment calculations – distribution of air flow--replacement and recirculated air-distribution – flow rate-air conservation-ventilation aspects of indoor air quality-ventilation system for specific operations --cleaner rooms-filling operations-foundry operations-gas treatment laboratory–welding and cutting – wood working

HSE7163: Transport Safety (3 credit hours)

COURSE OBJECTIVES:

- To provide the students about the various activities/steps to be followed in safe handling the hazardous goods transportation from one location to another location.
- To educate the reasons for the road accident and the roles and responsibilities of a safe Driver and the training needs of the driver.
 - To inculcate the culture of safe driving and fuel conservation along with knowing of basic traffic symbols followed throughout the highways.
- To impart knowledge on maintenance of vehicle and other preventive measure to avoid the accident.
 - To educate the student to visualize the status of road conditions, its characteristics with reference to the speed of the vehicle and to impart knowledge on shop floor maintenance and shop safety.

COURSE OUTCOMES:

- The students will be able to know various safety activities undertaken in transporting of hazardous goods.
- The students could be able to understand the various symbols which are specific to the road safety and able to reduce the accidents occurred in the roads.
- The course could lead the student to apply for the safe transportation of hazardous goods, safe loading and unloading procedure.
 - The students could be able to analyse the causes for the accidents and to suggest preventive measures for the accident.
 - The student could design the shop floor and could handle the various maintenance activities by using various mechanical equipment meant for servicing.

COURSE CONTENTS

transportation of hazardous goods -- 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 .

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.

driver and safety ---driver safety programme – selection of drivers – driver training - driver relaxation and rest pauses – speed and fuel conservation – emergency planning and hazmat codes .

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-trackwarning methods-loading and unloading-moving cars safety practices .

shop floor and repair shop safety ---transport precautions-safety on manual, mechanical handling equipment operations safe driving-movement of cranes-conveyors etc.,

HSE7173: Safety in Petrochemical Industries (3 credit hours)

COURSE OBJECTIVES:

- To provide about the various risks and hazards involved in petrochemical industries and its control measures.
- To impart knowledge on risk analysis, toxic effect and planning for onsite and offsite emergency planning in petrol chemical industries.
- To acquire knowledge on Controlling of safety systems and Relief systems and to acquire knowledge on design activities of safety and relief systems.
- To know fundamentals in identifying the hazards and the controlling measures against leakages, spillage of liquids, solids and gaseous toxic materials.

COURSE OUTCOMES:

- The course could make the students to remember the various terms and terminologies involved in the safety of petrochemical industries.
- The students could be able to understand the various concepts involved in the Risk analysis, hazard assessment, toxicity in petrol chemical industries and able to control the safety and relief systems.

- Knowing the various risk factors and controlling systems the student could be able to apply the various techniques of safety in preventing and mitigating the hazards in petrochemical industries.
- The course could able to make the student to analyse and compare the various safety and relief system and controlling the toxicity and leakages of hazardous gases, liquids and solids.
- The students could design on-site and off-site emergencies plan for all types of emergencies.

COURSE CONTENTS

Risk management --overall risk analysis -methods for determining consequences effects: effect of fire, effect of explosion and toxic effect – disaster management plan – emergency planning – onsite and offsite emergency planning – risk management – gas processing complex, refinery – first aids.

Control of safety systems --concept of risk, selection of design bases for safety systems, guidelines for risk tolerability, potential process safety systems and design solutions

Control of relief system --relief systems: preventive and protective management from fires and explosion-inerting, static electricity passivation, ventilation, and sprinkling, proofing, relief systems toxicology of petro chemical industries ---toxicology: hazards identification-toxicity, fire, static electricity, noise and dust concentration; material safety data sheet, hazards indices-dow and mond indices, hazard operability (hazop) and hazard analysis (hazan).

Controlling of leakages and hazards associated --leaks and leakages: spill and leakage of liquids, vapors, gases and their mixture from storage tanks and equipment. naturally buoyant and dense gas dispersion models; effects of momentum and buoyancy; mitigation measures for leaks and releases. hazards associated with hydrocarbon and other chemical products: crude oil, natural gas, LPG, CNG, LNG, oxygenated hydrocarbons, chlorine, ammonia, hydrogen fluoride

HSE7183 : ENVIRONMENTAL IMPACT ASSESSMENT(3 credit hours)

COURSE OBJECTIVES:

- To provide the in depth knowledge on Environment and Its impact on the surroundings when a major project is being carried out in a location.
- To provide the basic knowledge on Environmental impact assessment (EIA) and its legal requirements.
- To understand about the various terms and terminologies relating to EIA.
- To know the implications of EIA in maintaining the global environmental management plan.

COURSE OUTCOMES:

- Course would make the student in knowing the basic things about Environmental Impact assessment and its relevance to the Legal and regulatory aspects.
- Course would make the student to apply and practice the EIA with the proper guideline and evaluation criteria.
- The students could able to design the concept, implement the process and to excel Environmental Impact assessment procedure in carrying out the major project in their career.

COURSE CONTENTS

Introduction --environmental impact assessment (eia) - environmental impact statement (eis) - environmental risk assessment (era) – Environmental analysis and assessment techniques -- components - screening - setting - analysis - prediction of impacts - mitigation. matrices - networks - checklists. importance assessment techniques - cost benefit analysis - analysis of alternatives - methods for prediction and assessment of impacts - air - water - soil - noise - biological - cultural - social - economic environments. standards and guidelines for evaluation. public participation in environmental decision-making.

Environmental impact assessment evaluation – Environmental management plan -document planning - collection and organization of relevant information - use of visual display materials – team writing - reminder checklists. environmental monitoring - guidelines - policies - planning of monitoring programmes. environmental management plan. post project audit.

case studies --case studies of eia of developmental projects

HSE 7193 : VIBRATION AND NOISE CONTROL (3 credit hours)**COURSE OBJECTIVES :**

- To provide in depth knowledge about the vibration and noise control and to get an exposure about the basic terms and terminologies .
- To analyse and to design the component in such a way that noise and vibration may be controlled by suitable experimental methods .

COURSE OUTCOMES :

- This course would make the student in understanding the basic concepts about the Vibration and Noise and its types.
- The student will be able to create the system with low vibration with hazard control at the source of generation .

COURSE CONTENTS

Basics of vibration -introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and nonlinear vibration, determination of natural frequencies.

Basics of noise--introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, .

Source of noise and control --methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, sound energy absorption, sound transmission through barriers

Vibration control --specification of vibration limits –vibration severity standards- vibration as condition monitoring tool-vibration isolation methods- -dynamic vibration absorber, torsional and pendulum type absorber

Experimental methods in vibration analysis -vibration analysis overview - experimental methods in vibration analysis.-vibration measuring instruments - selection of sensors- accelerometer mountings. –vibration exciters-mechanical, hydraulic, electromagnetic and electrodynamic – frequency measuring instruments-. system identification from frequency response -testing for resonance and mode shapes.

HSE 7203 SAFETY IN MINES (3 credit hours)

COURSE OBJECTIVES :

- To provide in depth knowledge on Safety of mine s of various types
- To study, know and understand about the types of mines and various risk involved in the mining operations.
- To get exposed to various types of accidents happened in mines and how to manage during accidents.
- To analyse the nature of mining activities and developing a safety system to reduce the risk and also to implement the Emergency preparedness in the working environment of mines and to plan for the disaster management .

COURSE OUTCOMES

- This course would make the student familiar with the concept of safety aspects in the mining industries.
- Course would be helpful in understanding the various types of mining activities like open case mines, underground mines and tunnelling.
- The students will understand about the various risks involved in the mining activities and come to know about the various safety activities to be taken to ensure the safety of the workers.

- Students could able to implement the techniques like risk assessment, Disaster management and emergency preparedness with the proper knowledge on accident prevention.
- Course would equip the students to effectively employ their knowledge on accident prevention in mines .

COURSE CONTENTS

Opencast mines --causes and prevention of accident from: heavy machinery, belt and bucket conveyors, drilling, hand tools-pneumatic systems, pumping, water, dust, electrical systems, fire prevention. garage safety – accident reporting system-working condition-safe transportation – handling of explosives

Underground mines ---fall of roof and sides-effect of gases-fire and explosions-water flooding warning sensors-gas detectors-occupational hazards-working conditions-winding and transportation.

Tunnelling --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-noise-electrical hazards-noise and vibration from: pneumatic tools and other machines – ventilation and lighting – personal protective equipment.

Risk assessment -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 – quantitative structure-activity relationship analysis-fuzzy model for risk assessment.

Accident analysis and management -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-measures for improving safety in mines-cost of accident emergency preparedness – disaster management

HSE7213: RELIABILITY ENGINEERING (3 credit hours)

COURSE OUTCOMES:

- To provide in depth knowledge about the concept of reliability and prediction models.
- To learn about various techniques for improving reliability in industries.and To develop knowledge on risk assessment study.

COURSE OUTCOMES:

- This course will familiarize students with the concepts of reliability.
- This course will be helpful to know about various failure modes of equipment and their effects.

- Students would be trained to maintain reliability by reducing failure time in Industry to maintain safety and productivity.
- This course will equip the students to effectively conduct risk assessment study in industries.

COURSE CONTENTS

Reliability concept--reliability function – failure rate – mean time between failures (mtbf) – mean time to failure (mttf) – a priori and a posteriori concept - mortality curve – useful life – availability – maintainability – system effectiveness.

failure data analysis --time to failure distributions – exponential, normal, gamma, weibull - ranking of data – probability plotting techniques – hazard plotting.

reliability prediction models.

Reliability management--reliability testing – reliability growth monitoring – non-parametric methods – reliability and life cycle costs – reliability allocation – replacement model.

Risk assessment----definition and measurement of risk – risk analysis techniques – risk reduction resources – industrial safety and risk assessment

13. Award of the Degree

The University Senate is the entitled to award the degree of M.Sc. or Dip. In Health, Safety and Environment (HSE) upon the recommendation of the Graduate College Council.