Vision
Provide the knowledge and prosperity through high quality education to the next generation of visionaries and prepare the students for leadership and management role in diverse careers.

Mission
- To render the highest quality of education through teaching and research excellence, with the state-of-the-art educational facilities and innovative programs.
- To provide the students with the knowledge and skills needed to succeed and become leaders of tomorrow.
- To provide the students with multidisciplinary approach to tackle the socio-economic problems.
- To encourage the students for advanced study and research in the field of upstream and downstream sectors in petroleum industry, safety, occupational health and environmental management.
1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

1. To provide students with a good understanding of philosophy and integrated approach to managing safety, industrial hygiene and environment.

2. To inculcate the students in hazardous identification techniques, reliability analysis of the process system, event trees & fault trees analysis, hazards and operability analysis (HAZOP).

3. To introduce students to recent developments in analytical techniques, such as computer modeling of risk, reliability and safety problems.

4. To inculcate students in professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to think and act an individual safety consultant.

5. To impart the students with the understanding the professional practice of industrial safety & industrial acts.

2. PROGRAMME OUTCOMES (POs):

On successful completion of the Programme,

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<tr>
<th>PO</th>
<th>Graduate Attribute</th>
<th>Programme Outcome</th>
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<tbody>
<tr>
<td>1</td>
<td>Safety knowledge</td>
<td>Apply knowledge of basics of hazards and its types to assess the risk.</td>
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<tr>
<td>2</td>
<td>Problem Analysis</td>
<td>Identify, formulate and solve the current problems related to industrial safety.</td>
</tr>
<tr>
<td>3</td>
<td>Design / Development of solutions</td>
<td>Evaluate existing system / design safety models identify the problems, evaluate and implement the remedial measures in the industries.</td>
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<tr>
<td>4</td>
<td>Conduct investigations of complex problems</td>
<td>Conduct detailed audit, collect data and analyze accident investigation report.</td>
</tr>
<tr>
<td>5</td>
<td>Modern tool usage</td>
<td>Apply various hazard assessment tools and techniques to identify the hazard estimate risk and reduce the accident occurrence to improve the safety levels.</td>
</tr>
<tr>
<td>6</td>
<td>The Engineer and Society</td>
<td>Adequate knowledge about technical aspects with safety legislation to uphold professional and social obligations.</td>
</tr>
<tr>
<td>7</td>
<td>Environment and sustainability</td>
<td>Uphold environment legislation and developing sustainable work environment.</td>
</tr>
<tr>
<td>8</td>
<td>Ethics</td>
<td>Cultivate and uphold ethical practices in workplace and society.</td>
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</table>
9. **Individual and team work**  
Develop documentation individually in an effectively manners and work efficiently in team environment.

10. **Communication**  
Develop communication skills to manage workers and management.

11. **Project management and finance**  
Effective knowledge of safety management aspect helps in efficient project management and reduces budgetary overshoot.

12. **Life-long learning**  
Continue knowledge updating and develop holistically as a learner to become leader of tomorrow.

### 3. MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVE WITH PROGRAMME OUTCOMES

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### 4. MAPPING OF COURSE OUTCOMES AND PROGRAMME OUTCOMES

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**YEAR 2**

**SEMESTER 3**
1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
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**PRACTICALS**

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## SEMESTER – II

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**PROGRAME CORE COURSES (PCC)**

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## PROGRAME ELECTIVES COURSES (PEC)

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**RESEARCH METHODOLOGY AND IPR COURSES (RMC)**

**OPEN ELECTIVE COURSES [OEC]**

*(Out of 6 Courses one Course must be selected)*

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AUDIT COURSES (AC)
Registration for any of these courses is optional to students

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EMPLOYABILITY ENHANCEMENT COURSES (EEC)

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OBJECTIVES

- To gain knowledge on PHA, HAZOP studies.
- To learn about BAM testing and thermal analysis.
- To learn about HAZAN, FMEA, FET index.
- To gain knowledge on CPQRA, CAMEO.
- To learn about intermediate, risk on CPQRA.

UNIT I HAZARD, RISK ISSUES AND HAZARD ASSESSMENT 8
Introduction, hazard, hazard monitoring-risk issue - Hazard assessment, procedure, methodology; safety audit, checklist analysis, what-if analysis, safety review, preliminary hazard analysis (PHA), hazard operability studies (HAZOP).

UNIT II THERMAL AND MECHANICAL HAZARD ASSESSMENT 8
Applications of Advanced Equipment's and Instruments, Thermo Calorimetry, Differential Scanning Calorimeter (DSC), Thermo Gravimetric Analyzer (TGA), Accelerated Rate Calorimeter (ARC), Principles of operations, Controlling parameters, Applications, advantages. Explosive Testing, Deflagration Test, Detonation Test, Ignition Test, Minimum ignition energy Test, Sensitiveness Test, Impact Sensitiveness Test (BAM) and Friction Sensitiveness Test (BAM), Shock Sensitiveness Test, Card Gap Test.

UNIT III RISK QUANTIFICATION AND SOFTWARES 9
Fault Tree Analysis and Event Tree Analysis, Logic symbols, methodology, minimal cut set ranking - fire explosion and Index (FEI)-fire explosion and toxicity index (FETI), various indices - Hazard analysis (HAZAN)- Failure Mode and Effect Analysis (FMEA)

UNIT IV CHEMICAL PROCESS QUANTITATIVE RISK ANALYSIS 10
CPQRA Definitions-components Techniques of CPQRA-Scope of CPQRA- Applications of CPQRA- Utilization of CPQRA results. Hazard identification based on the properties of chemicals- Chemical inventory analysis- identification of hazardous processes - Estimation of source term, Gas or vapour release, liquid release, two phase release- Heat radiation effects, BLEVE, Pool fires and Jet fire- Gas/vapour dispersion- Explosion, UVCE and Flash fire, Explosion effects and confined explosion- Toxic effects- Plotting the damage distances on plot plant/layout - Software CAMEO, ALOHA & MARPLOT.

UNIT V APPLICATION OF CPQRA 10
Simple /consequence CPQRA Examples Characterization, application to a new process unit, application to an existing process unit. Intermediate/ Frequency CPQRA characterization-application to existing/new process units. Complex/risk CPQRA Characterization. Application to new or existing process Unit. Case Studies of Flixborough, Bhopal, Texas, ONGC offshore, HPCL Vizag and Jaipur IOC oil-storage depot incident; Oil, natural gas, chlorine and ammonia storage and transportation hazards.

OUTCOMES:
On successful completion of this course, the students will be able to
- Understand the basics of hazard and hazard assessment.
- Know about the various advanced equipment and testing.
- Acquire software knowledge on risk analysis.
- Obtain knowledge on application of CPQRA.
- Analyze the risk associated with chemicals process.
REFERENCE BOOKS:
## Course Articulation Matrix:

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<th>Course Outcomes</th>
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<td>Understand the basics of hazard and hazard assessment.</td>
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<tr>
<td>CO2</td>
<td>Know about the various advanced equipment and testing.</td>
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<td>CO3</td>
<td>Acquire software knowledge on risk analysis.</td>
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<td>Analyze the risk associated with chemicals process.</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE

- To gain knowledge on hazard identification, risk assessment and safety audit.
- To gain knowledge on concept of accidents and IRT.
- To learn about IS 3786, ANSI (Z16.1) and OSHA regulations.
- To gain knowledge on training methods, decision making process and roles government agencies.
- To learn about sample distribution and correlation methods.

UNIT I SAFETY MANAGEMENT CONCEPTS 10
Components of safety audit: types of audit, audit methodology, non-conformity reporting (NCR), audit checklist and report - Reports from government agencies, consultants, experts - perusal of accident and safety records, formats, implementation of audit recommendations.

UNIT II ACCIDENT INVESTIGATION AND REPORTING 10
Concepts of accident, reportable and non-reportable accidents, reporting to statutory authorities - Principles of accident prevention – Theories of accident causation - accident investigation methodology – Direct and Indirect cost analysis - documentation and reporting –Incident Recall Technique (IRT).

UNIT III SAFETY PERFORMANCE MONITORING 10
Recommended practices for compiling and measuring work injury – permanent total disabilities, permanent partial disabilities, temporary total disabilities - Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety “t” score, safety activity rate – problems - IS 3786, ANSI (Z16.1), OSHA regulations.

UNIT IV SAFETY EDUCATION, TRAINING AND EMPLOYEE PARTICIPATION 15

UNIT V DATA ANALYSIS FOR SAFETY 15
Sampling distributions – Testing of hypotheses – t-test, F-test and Chi-square test Curve fitting - Method of least squares - Regression and correlation – Rank correlation– Multiple and partial correlation – Analysis of variance - One way and two way classifications

TOTAL : 60 PERIODS
OUTCOMES:
On successful completion of this course, the students will be able to
- Understand the basic concept of safety management.
- Obtain knowledge on investigation and reporting of accident.
- Know about the safety performance indicators.
- Analyze on the impact of training and employee participation.
- Obtain knowledge on the data analysis.

REFERENCE BOOKS:

ONLINE RESOURCES:
## Course Articulation Matrix:

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<td>Obtain knowledge on the data analysis.</td>
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<td><strong>PRINCIPLES OF SAFETY MANAGEMENT</strong></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE

- To gain knowledge on factories act, Tamil Nadu factories rules.
- To learn about Indian Boilers Act and Regulations, Indian Explosive Act.
- To gain knowledge on overview of BOCW Act and rules.
- To learn about Indian Electricity Act.
- To gain knowledge on ISO 14001, ISO 9001, ISD 45001.

UNIT I

UNIT II
STORAGE AND HANDLING OF PRESSURIZED VESSELS

UNIT III
CONSTRUCTION AND ENVIRONMENTAL REGULATIONS

UNIT IV
ELECTRICITY REGULATIONS
Indian Electricity act 2003 and rules 1956.

UNIT V
REGULATIONS IN INDIA AND ABROAD

OUTCOMES:
On successful completion of the course, the student will be able to
- Obtain knowledge on welfare compensation and safety of employees in Tamil Nadu and India.
- Know the manufacturing, Storage and impact of chemicals in process industry.
- Understand on air, water acts and Motor Vehicles Act.
- Know about the distribution electricity and process of license.
- Analyze the occupational safety and health is organization.

REFERENCE BOOKS:
2. Indian Boilers Act and Regulations.

ONLINE RESOURCES:
## Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PO 1</td>
</tr>
<tr>
<td>CO1</td>
<td>Obtain knowledge on welfare compensation and safety of employees in Tamil Nadu and India.</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>Know the manufacturing, Storage and impact of chemicals in process industry</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>Understand on air, water acts and Motor Vehicles Act.</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>Know about the distribution electricity and process of license</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>Analyze the occupational safety and health is organization.</td>
<td>3</td>
</tr>
<tr>
<td>Standards And Regulation For Health, Safety And Environment</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE

- To learn the anatomy and physiology of human organs, functions and effects of various hazards on organs.
- To gain knowledge about different types of physical hazards.
- To learn the chemical hazards and various air sampling instruments.
- To gain knowledge about various biological hazards agents.
- To learn the various occupational health parameters, work capacity and work organizations.

UNIT I  ANATOMY, PHYSIOLOGY, HAZARD AND PATHOLOGY  9
Definition- Anatomy and Physiology of human organs – The lungs, Skin, Ear and Eyes – Functions of organs – Impairment of organs – Effects of various hazards on organs - Cardio pulmonary resuscitation - audiometric tests, eye tests, vital function tests.

UNIT II  PHYSICAL HAZARDS  9
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 standards- non-ionizing radiations, effects, types, radar hazards, microwaves and radio waves, lasers, TLV- cold environments, hypothermia, wind chill index, control measures of hot environments, thermal comfort, heat stress indices, acclimatization, estimation and control.

UNIT III  CHEMICAL HAZARDS  9

UNIT IV  BIOLOGICAL AND ERGONOMICAL HAZARDS  9
Classification of Bio-hazardous agents – examples, 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 V  OCCUPATIONAL HEALTH, PHYSIOLOGY AND TOXICOLOGY  9

TOTAL : 45 PERIODS
OUTCOMES:
On successful completion of this course, the students will be able to
• Obtain knowledge about anatomy and cardio pulmanory resuscitation.
• Know about octave band analyser, noise network and monitoring instruments.
• Understand about gas and vapour monitors, dust sampling collecting devices.
• Obtain knowledge about carpal tunnel syndrome, tendon pain disorders of the neck.
• Know about pre and post-employment medical examinations, categorization of job heaviness and shift works.

REFERENCE BOOKS:
<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>PO 1</th>
<th>PO 2</th>
<th>PO 3</th>
<th>PO 4</th>
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<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
<th>PSO4</th>
<th>PSO5</th>
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<td>Obtain knowledge about anatomy and cardio pulmonary resuscitation.</td>
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<tr>
<td>CO2</td>
<td>Know about octave band analyser, noise network and monitoring instruments</td>
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<td>1</td>
<td>3</td>
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<td>Understand about gas and vapour monitors, dust sampling collecting devices.</td>
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<td>Obtain knowledge about carpal tunnel syndrome, tendon pain disorders neck.</td>
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<td>2</td>
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<td>CO5</td>
<td>Know pre and post-employment, medical examinations of job.</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
COURSE OBJECTIVES:
To impart knowledge and skills required for research and IPR:

- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I RESEARCH PROBLEM FORMULATION 6
Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT II LITERATURE REVIEW 6
Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III TECHNICALWRITING /PRESENTATION 6
Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) 6

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR) 6
Traditional knowledge Case Studies, IPR and IITs.

COURSE OUTCOMES:
1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

TOTAL: 30 PERIODS
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</tbody>
</table>

REFERENCES:

OBJECTIVE
To provide comprehensive knowledge on various hazards in mechanical and thermal analyzing instrument.

5. Measurement of amount of heat released or absorbed by any chemical process using Bomb Calorimeter.
6. To analyze and assess the material properties and characteristic parameters of shock absorption testing machine.
7. Determine the minimum ignition temperature using Ignition Temperature Apparatus.

TOTAL : 60 PERIODS

OUTCOME:
The students will be able to obtain knowledge on various testing methods associated with mechanical and thermal hazards.
Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
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</thead>
<tbody>
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<td>The students will be able to obtain knowledge on various testing methods associated with mechanical and thermal hazards.</td>
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<td>MECHANICAL AND</td>
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</tr>
<tr>
<td>THERMAL HAZARD</td>
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<td>1  2  3  4  5  6</td>
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<tr>
<td>LABORATORY</td>
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<td>1  2  3  4  5  6</td>
</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE
To provide comprehensive knowledge on industrial hygiene and safe working environment.

5. Measurement of fume formation rate using Total fume chamber.
8. Measurement on strength of electromagnetic radiation in the range from ultraviolet to Infrared and including the visible spectrum using Photo-meter.
10. Assessment of Ergonomic impact using OWAS software.

TOTAL : 60 PERIODS

OUTCOME:
The students will be able to obtain knowledge and get better exposure to safe industrial hygiene practices, assessing and monitoring work environment.
## Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PO 1</td>
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<tr>
<td>CO1</td>
<td>The students will be able to obtain knowledge and get better exposure to safe industrial hygiene practices, assessing and monitoring work environment</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE

- To gain knowledge on BLEVE vapour cloud explosion.
- To learn about principles of fire extinguishers.
- To gain knowledge on industrial fire protection systems.
- To learn about the fire protection and fire safety equipment.
- To gain knowledge on explosive control.

UNIT I   PHYSICS AND CHEMISTRY OF FIRE


UNIT II   FIRE PREVENTION AND PROTECTION


UNIT III   INDUSTRIAL FIRE PROTECTION SYSTEMS


UNIT IV   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.

UNIT V   EXPLOSION PROTECTING SYSTEMS

Principles of explosion-detonation and blast waves-explosion parameters – Explosion Protection, Containment, Flame Arrestors, isolation, suppression, venting, explosion relief of large enclosure-explosion venting-inert gases, plant for generation of inert gas rupture disc in process vessels and lines explosion, suppression system based on carbon dioxide (CO₂) and halons-hazards in LPG, ammonia (NH₃).

TOTAL : 45 PERIODS

OUTCOME

On successful completion of this course, the student will able to

- Obtain knowledge on properties of fire and case studies related to fire
- Know about types, classes and chemicals used in fire extinguishers
- Analysis various fire suppression systems
- Understand the safe building design, fire resistant materials and fire testing
- Know about the principles of explosion and protecting systems
REFERENCE BOOKS:
# Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>PO1</th>
<th>PO2</th>
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</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Obtain knowledge on properties of fire and case studies related to fire</td>
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</tr>
<tr>
<td>CO2</td>
<td>Know about types, classes and chemicals used in fire extinguishers</td>
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<td>1</td>
<td>2</td>
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<tr>
<td>CO3</td>
<td>Analysis various fire suppression systems</td>
<td>3</td>
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<td>1</td>
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<tr>
<td>CO4</td>
<td>Understand the safe building design, fire resistant materials and fire testing</td>
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<td>3</td>
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</tr>
<tr>
<td>CO5</td>
<td>Know about the principles of explosion and protecting systems</td>
<td>3</td>
<td>2</td>
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<td>FIRE ENGINEERING AND EXPLOSION CONTROL</td>
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</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE

- To learn about the accidents related to various construction activities and management system.
- To gain knowledge about the prevention control in excavation and tunneling and housekeeping.
- To gain knowledge using OSHA 3146.
- To learn about safety in dams, bridges, water tanks.
- To learn about safety operation of construction machineries.

UNIT I  ACCIDENTS CAUSES AND MANAGEMENT SYSTEMS 10


UNIT II  HAZARDS OF CONSTRUCTION AND PREVENTION 8


UNIT III  FALL PREVENTION AND FALL PROTECTION 9

Fall prevention and fall protection - Fall protection in construction OSHA 3146 – OSHA requirement for working at heights, Different types of scaffolds – Design, safe erection, use and dismantling, scaffold inspection checklist, requirement for safe work platforms, stairways, gangways and ramps.
Safe access and egress – safe use of ladders- Safety Harnesses, safety nets, fall arrestors, controlled access zones, safety monitoring systems – working on fragile roofs, Height pass – accident case studies.

UNIT IV  SAFETY IN HUGE STRUCTURES 8

Safety in typical civil structures – Dams-bridges-water Tanks-Retaining Walls-Critical factors for failure-High rise buildings, Road works, and Power plant constructions.

UNIT V  CONSTRUCTION MACHINERY 10


TOTAL : 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to
- Know about the onsite construction hazard and safety legislation.
- Analyse the structural framework and safety of various construction activities.
- Obtain knowledge about the fall prevention and fall protection, safe access and egress.
- Know about the safety in high raised structured.
- Obtain knowledge about machinery used in construction.
REFERENCE BOOKS:
## Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>PO 1</th>
<th>PO 2</th>
<th>PO 3</th>
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<td>Know about the onsite construction hazard and safety legislation</td>
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<tr>
<td>CO2</td>
<td>Analyse the structural framework and safety of various construction activities.</td>
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</tr>
<tr>
<td>CO3</td>
<td>Obtain knowledge about the fall prevention and fall protection, safe access and egress</td>
<td>3</td>
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</tr>
<tr>
<td>CO4</td>
<td>Know about the safety in high raised structured.</td>
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<tr>
<td>CO5</td>
<td>Obtain knowledge about machinery used in construction.</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES
To provide comprehensive knowledge on Concept of fire and firefighting equipment

1. Study of basic Personal Protective Equipment used in industries.
2. Study and demonstration of different types of Fire Extinguisher.
3. Study and demonstration of smoke detection, Alarm and Sprinkler System.
5. Modeling effects of fire, explosion and estimating safe distance from explosion using PHAST
   1 and FLACS Software.
6. Measurement of flash point and fire point using closed cup method.
7. Analysis of fire behaviour using Cone Calorimeter.
8. Study and demonstration of fire mock drill.
10. Study on Static Electricity hazards, discharging of the same and use of antistatic materials in
    vulnerable areas.

TOTAL : 60 PERIODS

OUTCOME:
The students shall obtain a complete knowledge about fire properties and behavior, prevention
control in various environments.
### Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
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<tbody>
<tr>
<td></td>
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<td>PO1</td>
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<tr>
<td>CO1</td>
<td>The students shall obtain a complete knowledge about fire properties and behavior, prevention control in various environments</td>
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<tr>
<td>INDUSTRIAL FIRE AND SAFETY LABORATORY</td>
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</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES
To provide comprehensive knowledge about environmental parameter.

4. Measurement of concentration of dust in breathing zone using personal air sampler.
5. Measurement of speed or velocity of air using Anemometer.
8. Analysis of Effluent concentration using Effluent water analyzer.
10. Performing modeling studies using AERMOD, SCREEN3 Software.

TOTAL : 60 PERIODS

OUTCOME:
The students should be able to get through insight into the various pollutants present and their sources, behavior in environment and workplace.
### Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
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<tbody>
<tr>
<td>CO1</td>
<td>The students should be able to get through insight into the various pollutants present and their sources, behavior in environment and workplace.</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVE
To provide an understanding of sources of noise and industrial vibration control.
- To learn about the wave frequency and mathematical concepts.
- To gain the knowledge in vibration and measurements.
- To learn about sources in industries and noise ratings.
- To learn about the scope for abatement of industrial noise.

UNIT I       INTRODUCTION 10
Basic definitions and terminology used in Vibrations and acoustics – Mathematical concepts and degrees of freedom in vibratory systems – Natural frequencies and vibration modes – continuous systems and wave theory concept – wave equation and relation to acoustics – theory of sound propagation and terminology involved – Plane wave and spherical waves – Concepts of free field and diffuse field, near field and far field – frequency analysis and vibration and noise spectrum – Signature analysis and condition monitoring.

UNIT II      INSTRUMENTATION AND AUDITORY 10
Sensors used in vibration and measurements – Frequency and spectrum analyzers – Weighting networks – Hearing mechanism – relation between subjective and objective sounds – Auditory effects of noise and audiometric testing – Speech interference levels and its importance.

UNIT III       SOURCES OF NOISE AND RATINGS 10
Mechanism of noise generation and propagation in various machinery and machine components, vehicles etc. – Directivity index – Concept of Leq and estimation – Noise ratings and standards for various sources like industrial, construction, traffic, aircraft community etc. – industrial safety and OSHA regulations – Noise legislations and management

UNIT IV      NOISE CONTROL 10

UNIT V      ABATEMENT OF NOISE 5
Active noise attenuators and scope for abatement of industrial noise.

TOTAL : 45 PERIODS

OUTCOMES:
On successful completion of this course, the students will be able to
- Know about the terminology of noise and vibration.
- Obtain Knowledge about the noise instrumentation.
- Understand the sources of noise generated and various noise legislation and management.
- Know about the control measures for noise.
- Obtain knowledge of reducing industrial noise.

REFERENCE BOOKS:
## Course Articulation Matrix:

| Course Outcomes | Statement                                                                                      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|-----------------|-----------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|
| CO1             | Know about the terminology of noise and vibration.                                             | 3   | 1   | 2   | 3   | -   | -   | -   | -   | -   | -    | -    | 2    | 3    | -    | 3    | -    | -    |
| CO2             | Obtain Knowledge about the noise instrumentation                                               | 3   | 2   | 3   | 3   | 2   | -   | -   | -   | -   | -    | -    | -    | 2    | 2    | 3    | -    | -    |
| CO3             | Understand the sources of noise generated and various noise legislation and management        | 3   | 1   | 1   | 3   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | 2    | 1    | -    |
| CO4             | Know about the control measures for noise                                                    | 3   | 2   | 1   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | -    | 3    | -    | -    |
| CO5             | Obtain knowledge of reducing industrial noise                                                 | 2   | 3   | 2   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | -    | 2    | 1    | -    |
| INDUSTRIAL NOISE AND VIBRATION CONTROL |                                                                                                    | 3   | 2   | 1   | 2   | -   | -   | -   | -   | -   | -    | -    | 3    | 2    | -    | 2    | 1    | -    |

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVE

- To learn about the safety handling of ropes, hoops etc.
- To gain the knowledge about the conveying mechanisms.
- To gain the knowledge about hoisting mechanism.
- To learn about the heavy equipment.
- To gain the knowledge about goods and equipment.

UNIT I MATERIAL HANDLING

General safety consideration in material handling - Ropes, Chains, Sling, Hoops, Clamps, Arresting gears – Prime movers.

UNIT II ERGONOMICS OF CONVEYING MECHANISMS

Ergonomic consideration in material handling, design, installation, operation and maintenance of Conveying equipment, hoisting, traveling and slewing mechanisms.

UNIT III ERGONOMICS OF HOISTING MECHANISMS

Ergonomic consideration in material handling, design, installation, operation and maintenance of driving gear for hoisting mechanism – Traveling mechanism.

UNIT IV HANDLING OF HEAVY EQUIPMENTS

Selection, operation and maintenance of Industrial Trucks – Mobile Cranes – Tower crane – Checklist - Competent persons.

UNIT V STORAGE OF GOODS AND EQUIPMENTS


TOTAL : 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to

- Know about the general safety in material handling.
- Obtain knowledge about the ergonomic hazards due to conveyer machines.
- Obtain knowledge about the ergonomic hazards due to hoisting.
- Understand the operations of handling equipment.
- Know about the storage and safe handling of goods.

REFERENCE BOOKS:

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<td>Know about the general safety in material handling</td>
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<td>Obtain knowledge about the ergonomic hazards due to conveyor machines</td>
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<tr>
<td>CO3</td>
<td>Obtain knowledge about the ergonomic hazards due to hoisting</td>
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<td>Understand the operations of handling equipment</td>
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<tr>
<td>CO5</td>
<td>Know about the storage and safe handling of goods</td>
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</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE

- To gain the knowledge about emission, regulation, control of air pollution.
- To learn about the control of particulate pollutant.
- To gain the knowledge about gaseous pollutant.
- To gain the knowledge about the removal of HCs or VOCs or NOx.
- To learn about the integrated air pollution control system.

UNIT I AIR POLLUTION 10

UNIT II PARTICULATE POLLUTANTS AND CONTROL 12

UNIT III GASEOUS POLLUTANTS AND CONTROL 8
Gaseous Pollutant control: Gas absorption in tray and packed towers – Absorption with /Without chemical reaction – Removal of SO2 – Absorption in fixed blades- Breakthrough.

UNIT IV TOXIC POLLUTANTS REMOVAL 8
Removal of HCs / VOCs – NOx removal – Wet scrubbers.

UNIT V AIR POLLUTION CONTROL 7
Integrated Air pollution control systems.

TOTAL : 45 PERIODS

OUTCOMES:
On successful completion of this course, the students will be able to
- Acquire the knowledge about the industrial air pollution.
- Obtain knowledge about sources and removal of particulate pollutants.
- Obtain knowledge about gaseous pollutants controls.
- Understand about the toxic pollutants and VOCs.
- Obtain knowledge about air pollution control system.

REFERENCE BOOKS:
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</tr>
<tr>
<td>CO1</td>
<td>Acquire the knowledge about the industrial air pollution.</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>Obtain knowledge about sources and removal of particulate pollutants.</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>Obtain knowledge about gaseous pollutants controls.</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>Understand about the toxic pollutants and VOCs.</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>Obtain knowledge about air pollution control system.</td>
<td>3</td>
</tr>
<tr>
<td>DESIGN OF AIR POLLUTION CONTROL SYSTEM</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE

- To gain knowledge about metal and wood working machineries.
- To learn about zero mechanical state and other guarding mechanisms.
- To gain knowledge about welding and gas cutting.
- To learn about cold forming and hot working.
- To gain knowledge about engineering devices in industries.

UNIT I SAFETY IN METAL WORKING MACHINERY AND WOOD WORKING MACHINES

General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines, Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards.

UNIT II PRINCIPLES OF MACHINE GUARDING


UNIT III SAFETY IN WELDING AND GAS CUTTING

Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases-colour coding – flashback arrestor – leak detection-pipe line safety-storage and handling of gas cylinders.

UNIT IV SAFETY IN COLD FORMING AND HOT WORKING OF METALS

Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls, power press set up and die removal, inspection and maintenance-metal sheers-press brakes. Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills – hot bending of pipes, hazards and control measures. Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, foundry production cleaning and finishing foundry processes.

UNIT V SAFETY IN FINISHING, INSPECTION AND TESTING

Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation. Health and welfare measures in engineering industry-pollution control in engineering industry-industrial waste disposal.

TOTAL : 45 PERIODS
OUTCOMES:
On successful completion of this course, the students will be able to
- Know about the safety rules, principles, maintenance of machineries.
- Understanding the principles of machine guarding.
- Obtain knowledge of handling of flammable material for machining purposes.
- To know about the safety in forging operations.
- To know about the relief valve in various pressure vessels.

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<tr>
<td>CO1</td>
<td>Know about the safety rules, principles, maintenance of machineries.</td>
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<tr>
<td>CO2</td>
<td>Understanding the principles of machine guarding.</td>
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<tr>
<td>CO3</td>
<td>Obtain knowledge of handling of flammable material for machining purposes.</td>
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<tr>
<td>CO4</td>
<td>To know about the safety in forging operations.</td>
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<tr>
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<td>To know about the relief valve in various pressure vessels.</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE

- To learn about various sources of air and water pollutions.
- To gain knowledge about the solid waste management.
- To gain knowledge on environment measurement control.
- To learn about various environmental legislations.
- To gain knowledge on pollution control in process industries.

UNIT I AIR AND WATER POLLUTION

UNIT II SOLID WASTE MANAGEMENT

UNIT III ENVIRONMENTAL MEASUREMENT AND CONTROL

UNIT IV ENVIRONMENTAL ACTS AND RULES

UNIT V POLLUTION CONTROL IN PROCESS INDUSTRIES

TOTAL : 45 PERIODS

OUTCOMES:
On successful completion of this course, the students will be able to
- Understand the various pollutions sources for air and water pollution and their effects.
- Know about the methods and disposal of solid waste in effective manner.
- Obtain knowledge about different instrument used to measure pollutant levels.
- Know about rules and regulation derived for pollutant and E-waste control.
- Analyze pollution control in cement, paper and petroleum industries.
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<td>Understand the various pollutions sources for air and water pollution and their effects.</td>
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</tr>
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<td>CO2</td>
<td>Know about the methods and disposal of solid waste in effective manner.</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>Obtain knowledge about different instrument used to measure pollutant levels.</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>Know about rules and regulation derived for pollutant and E-waste control.</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>Analyze pollution control in cement, paper and petroleum industries.</td>
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<tr>
<td><strong>ENVIRONMENTAL POLLUTION CONTROL</strong></td>
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<td>3</td>
</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES

- To learn about man-machine system concept.
- To gain knowledge on various human behavior and their attitudes.
- To learn about ergonomics application in work system.
- To gain knowledge on various safety factors.
- To learn about personal protective equipment’s standards and their testing procedure.

UNIT I INTRODUCTION
Man-machine system Concept – Human factors Engineering and its Applications - Man as Information processor, Sensor, Controller.

UNIT II BASIC BEHAVIOURAL CONCEPT

UNIT III ERGONOMICS
Ergonomic Principles – ergonomics Application in a work system – motion economy Principle – environmental effects.

UNIT IV SAFETY FACTORS

UNIT V PERSONAL PROTECTIVE EQUIPMENTS
Personal protective equipment’s (different types, specifications, standards, testing procedures, and maintenance).

TOTAL : 45 PERIODS

OUTCOMES:
On successful completion of this course, the students will be able to
- Obtain knowledge about human factor engineering and its applications.
- Know about motivations frustration and conflicts.
- Obtain knowledge about ergonomic principles.
- Understand about physiological and legal factors.
- Know about personal productive equipment.

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<td>Obtain knowledge about ergonomic principles.</td>
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<td>CO4</td>
<td>Understand about physiological and legal factors</td>
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<td>CO5</td>
<td>Know about personal productive equipment.</td>
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</tr>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES

- To learn about structures and features of OSHAS 1800.
- To gain knowledge on general requirements in operational health and safety 18001 policy.
- To learn about control of records, internal audit and management review.
- To gain knowledge about legal aspect of ISO 14001 and ISO 9000.
- To learn about different methods of environmental impact Assessment.

UNIT I  OHSAS STANDARD  9

UNIT II  OHSAS 18001 POLICY & PLANNING, IMPLEMENTATION AND OPERATION  9

UNIT III  CHECKING AND REVIEW GUIDELINES  9
Checking- Performance measurement and monitoring-Evaluation of compliance-Incident investigation, nonconformity, corrective action and preventive action-Control of records-Internal audit-Management review - guidelines for implementation of 18001:2007 -Examples of items for hazard identification checklist – Comparison of risk assessment tool and methodologies.

UNIT IV  ISO 14001 AND ISO 9000  9
ISO 14001 - Environmental management systems - Requirements with guidance for use - Environmental policy- Environmental aspects - Legal and other requirements - Objectives, targets and programme(s)- Implementation and operation – Checking - Management review- Guidance for use - Principles (ISO 14004), clauses 4.1 to 4.5. Documentation requirements, 3 levels of documentation for ISO 14000 based EMS, steps in ISO 14001. Implementation plan, Registration, Importance of ISO 14000 to the Management. Guidelines for environmental management systems auditing -General principles, Managing audit programme - Audit activities, steps in audit, Audit plan. Competence of auditors.

UNIT V  ENVIRONMENT IMPACT ASSESSMENT  9
ISO 14040(LCA), General principles of LCA, Stages of LCA, Report and Review. ISO 14020 (Eco labeling) – History, 14021, 14024, Type I labels, Type II labels, ISO 14024, principles, rules for eco labeling before company attempts for it. Advantages - EIA in EMS, Types of EIA, EIA methodology EIS, Scope, Benefits. Audit-methodology, Auditors Audit results management review-Continual improvement.

TOTAL : 45 PERIODS
OUTCOMES:
On successful completion of this course, the students will be able to

- Know about on OHSAS 18001 policy and planning.
- Obtain knowledge about ISO 14001 thoroughly.
- Know about ISO 14040 (LCA), ISO 14020 (Eco labelling), ISO 14024 and EIA in EMS.

REFERENCES:
### Course Articulation Matrix:

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<td>Obtain knowledge about OSHAS 18001: 2007, ISO 14001: 2004, ISO 9001: 2000 and ILO – OSH: 2001.</td>
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<td>CO3</td>
<td>Obtain knowledge about ISO 14001 thoroughly.</td>
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<td>CO4</td>
<td>Analyze on the impactation of training and employee participation.</td>
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<td>CO5</td>
<td>Know about ISO 14040 (LCA), ISO 14020 (Eco labelling), ISO 14024 and EIA in EMS.</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES

- To gain the knowledge on prevention of accident & accident reporting system in opencast mines.
- To learn about warning sensor, gas detectors and evacuation from confined space.
- To gain the knowledge on hazards due to collapse and atmospheric pollutions.
- To learn about fault tree analysis and failure mode and effect analysis.
- To gain the knowledge on cost of accident emergency preparedness.

UNIT I OPENCAST MINES
Causes and prevention of accident from: Heavy machinery, belt and bucket conveyors, drilling, hand tools-pneumatic systems, pumping, water, dust, electrical systems, and fire prevention. Garage safety – accident reporting system-working condition-safe transportation – handling of explosives

UNIT II 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. – Confined space classifications – Safe entry, working and evacuation from confined space.

UNIT III TUNNELLING

UNIT IV RISK ASSESSMENT

UNIT V ACCIDENT ANALYSIS AND MANAGEMENT

OUTCOMES:
On successful completion of this course, the student will be able to
- Know about prevention of accident and safe transportation of explosives.
- Understand the effect of gases, occupation hazard and working condition.
- Analyze the ventilation and lighting and PPE’S during tunneling.
- Knowledge on risk assessment using advance techniques.
- Knowledge about accident analysis and measure for improving safety in mines.

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<td>Knowledge on risk assessment using advance techniques.</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE

- To gain knowledge about the concept and principles of ventilation systems.
- To learn about the dilution ventilation system and acclimatization.
- To gain knowledge about air contamination characteristic and hood design and air cleaning system.
- To learn about design and testing of local exhaust ventilation system.
- To gain knowledge about ventilation to specific operation areas.

UNIT I   GENERAL PRINCIPLES OF VENTILATION
Introduction - supply and exhaust systems - Basic definitions - Principles of air flow-Acceleration of air and Hood entry losses - Duct losses - Multiple hood exhaust system.

UNIT II   GENERAL INDUSTRIAL VENTILATION

UNIT III LOCAL EXHAUST HOODS AND AIR CLEANING DEVICES

UNIT IV DESIGN AND TESTING OF INDUSTRIAL VENTILATION

UNIT V VENTILATION SYSTEM FOR SPECIFIC OPERATIONS

OUTCOMES:

- Get insight into general principle and basics of industrial ventilation
- Obtain knowledge about effects of ventilation on human health and their preventive measures
- Analyze the design and characteristic of various ventilation systems
- Knowledge about various construction guidelines and design aspects of ventilation system
- Understand the ventilation system for specific operation

TOTAL : 45 PERIODS
REFERENCES:
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<td>Get insight into general principle and basics of industrial ventilation</td>
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<tr>
<td>CO2</td>
<td>Obtain knowledge about effects of ventilation on human health and their preventive measures</td>
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<tr>
<td>CO3</td>
<td>Analyze the design and characteristic of various ventilation systems</td>
<td>3 2 2 2 3 - - - - - - 3 3 - 2 - -</td>
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<td>Knowledge about various construction guidelines and design aspects of ventilation system</td>
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<td>CO5</td>
<td>Understand the ventilation system for specific operation</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE
- Understand the concept of spinning and safety precautions.
- Know about hazards in basic textile operations.
- Know about hazards in finishing process and its effluents.
- Understand the welfare measures for textile workers.
- Learn about the regulation of the textile industry.

UNIT I  INTRODUCTION  9
Process flow charts of i) short staple spinning, ii) long staple spinning, iii) viscose rayon and synthetic fibre, manufacturer, iv) spun and filament yarn to fabric manufacture, v) jute spinning and jute fabric manufacture-accident hazard, guarding of machinery and safety precautions in opening, carding, combing, drawing, flyer frames and ring frames, doubles, rotor spinning, winding, warping, softening/spinning specific to jute.

UNIT II  TEXTILE HAZARDS I  9
Accident hazards i)sizing processes- cooking vessels, transports of size, hazards due to steam ii) Loom shed – shuttle looms and shuttles looms iii) knitting machines iv) nonwovens.

UNIT III  TEXTILE HAZARDS II  9
Scouring, bleaching, dyeing, punting, mechanical finishing operations and effluents in textile processes.

UNIT IV  HEALTH AND WELFARE  9
Health hazards in textile industry related to dust, fly and noise generated-control measures-relevant occupational diseases, protective equipment-health and welfare measures specific to textile industry, Special precautions for specific hazardous work environments.

UNIT V  SAFETY STATUS  9
Relevant provision of factories act and rules and other statues applicable to textile industry – effluent treatment and waste disposal in textile industry.

TOTAL : 45 PERIODS

OUTCOME
On successful completion of this course, the students will be able to
- Understand the process flow of various manufacturing process for different materials and safety precautions for the process.
- Obtain knowledge about hazards present in various textile processes.
- Know about the effluent discharge of the textile process.
- Understand the various preventive methods and precautions available for the textile processes.
- Analyze the statuses and norms for textile industry and its effluents.

REFERENCES:
2. Elliot B. Grover and Hamby D.S, “Hand book of textile testing and quality control” Textile Book Publishers (Interscience), New York,
3. “Quality tolerances for water for textile industry”, BIS.
5. Little, A.H., “Water supplies and the treatment and disposal of effluent” the textile institute, Manchester.
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<td>Understand the process flow of various manufacturing process for different materials and safety precautions for the process.</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE

- To learn about the history and verity of dock safety legislation and regulation.
- To learn about the process, hazards present in cargo ships and safety measures.
- To understand the safety for lifting appliances.
- To understand the safety measures for transportations.
- To learn about emergency response and welfare of workers.

UNIT I  HISTORY OF SAFETY LEGISLATION  9

History of dock safety status in India-background of present dock safety statues- dock workers (safety, health and welfare) act 1986 and the rules and regulations framed there under, other statues like marking of heavy packages act 1951 and the rules framed there under - manufacture, storage and import of hazardous chemicals. Rules 1989 framed under the environment (protection) act, 1989 – few cases laws to interpret the terms used in the dock safety statues. Responsibility of different agencies for safety, health and welfare involved in dock work.

UNIT II  WORKING ON BOARD THE SHIP  9

Types of cargo ships – working on board ships – Safety in handling of hatch beams – hatch covers including its marking, Mechanical operated hatch covers of different types and its safety features – safety in chipping and painting operations on board ships – safe means of accesses – safety in storage etc. – illumination of decks and in holds – hazards in working inside the hold of the ship and on decks – safety precautions needed – safety in use of transport equipment - internal combustible engines like fort-lift trucks pay loaders etc. Working with electricity and electrical management – Storage – types, hazardous cargo – Oil, Chemicals and Flammable Liquids Tankers – Man Entry, Dock Entry & Hot work of hazardous cargo ships.

UNIT III  LIFTING APPLIANCES  9

Different types of lifting appliances – construction, maintenance and use, various methods of rigging of derricks, safety in the use of container handling/lifting appliances like portainers, transtainer, top lift trucks and other containers – testing and examination of lifting appliances – portainers – transtainers – top lift trucks – derricks in different rigging etc. Use and care of synthetic and natural fiber ropes – wire rope chains, different types of slings and loose gears.

UNIT IV  TRANSPORT EQUIPMENT  9

The different types of equipment for transporting containers and safety in their use safety in the use of self-loading container vehicles, container side lifter, and fork lift truck, dock railways, conveyors and cranes. Safe use of special lift trucks inside containers – Testing, examination and inspection of containers – carriage of dangerous goods in containers and maintenance and certification of containers for safe operation Handling of different types of cargo – stacking and unstacking both on board the ship and ashore.

UNIT V  EMERGENCY ACTION PLAN AND DOCK WORKERS (SHW) REGULATIONS 1990  9

Emergency action Plans for fire and explosions - collapse of lifting appliances and buildings, sheds etc., - gas leakages and precautions concerning spillage of dangerous goods etc., - Preparation of on-site emergency plan and safety report. Dock workers (SHW) rules and regulations 1990-related to lifting appliances, Container handling, loading and unloading, handling of hatch coverings and beams, Cargo handling, conveyors, dock railways, forklift.

TOTAL : 45 PERIODS
OUTCOMES:
On successful completion of this course, the students will be able to
- Know about history of dock safety legislation, welfare acts for workers and environment protection.
- Understand the types of cargo ships, deck illumination and safety measures for combustible fuels present in cargo ships.
- Know about various types of lifting appliances.
- Learn about transportation devices for containers and handling methods.
- Know about how to respond to various emergency situation, dock workers rules and regulations.

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<td>Know about how to respond to various emergency, dockworkers rules and regulations.</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVE

- To gain knowledge on hazard assessment, pressure system, and process machinery.
- To learn more about various testing methods, monitoring and inspection.
- To learn about protective devices modification of planned, permit system emergency planning.
- To gain knowledge on arrestors, LPG and LNG storages, renting and relief.
- To gain knowledge on over all planned operation, start up and shut down operations.

UNIT I       SAFETY IN PROCESS DESIGN AND PRESSURE SYSTEM DESIGN                  10

Design process, conceptual design and detail design, assessment, inherently safer design chemical reactor, types, batch reactors, reaction hazard evaluation, assessment, reactor safety, operating conditions, unit operations and equipment, utilities. Pressure system, pressure vessel design, standards and codes- pipe works and valves heat exchangers- process machinery- over pressure protection, pressure relief devices and design, fire relief, vacuum and thermal relief, special situations, disposal- flare and vent systems- failures in pressure system, Effects Estimation of hazard assessment.

UNIT II      PLANT COMMISSIONING AND INSPECTION                                                          9

Commissioning phases and organization, pre-commissioning documents, process commissioning, commissioning problems, post commissioning documentation Plant inspection, pressure vessel, pressure piping system, non-destructive testing, pressure testing, leak testing and monitoring- plant monitoring, performance monitoring, condition, vibration, corrosion, acoustic emission-pipe line inspection.

UNIT III       PLANT MAINTENANCE, MODIFICATION AND EMERGENCY                              9

PLANNING
Management of maintenance, hazards- preparation for maintenance, isolation, purging, cleaning, confined spaces, permit system- maintenance equipment- hot works- tank cleaning, repair and demolition- online repairs- maintenance of protective devices modification of plant, problems- controls of modifications. Emergency planning, disaster planning, onsite emergency- offsite emergency, APELL

UNIT IV      STORAGES AND TRANSPORTATION                                                                   8

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 (NOT arrest)arrestors, Spark Arrestor, fire relief- fire prevention and protection- LPG storages, pressure storages, layout, instrumentation, vaporizer, refrigerated storages, Cryogenic Storage- LNG storages, hydrogen storages, toxic storages, toxic release & control methodologies, chlorine storages, ammonia storages, other chemical storages- underground storages- loading and unloading facilities- drum and cylinder and Pressure Vessel storage – Importance of Ullage - ware house, storage hazard assessment of LPG and LNG Hazards during transportation-pipeline transport.

UNIT V      PLANT OPERATIONS                                                                                                9

Operating discipline, operating procedure and inspection, format, emergency procedures hand over and permit system- start up and shut down operation, refinery units- operation of fired heaters, driers, storage- operating activities and hazards- trip systems- exposure of personnel. Specific safety consideration of cement, Paper, pharmaceutical, petroleum, petro-chemical, rubber, fertilizer and distilleries.

TOTAL : 45 PERIODS
OUTCOMES:
On successful completion of this course, the students will be able to
- Understand the basic safety in process design and pressure system design.
- Know about planned commissioning and inspection.
- Obtain knowledge on equipment maintenance and several emergency plans.
- Know about hazardous gases transportation and storages.
- Obtain knowledge on specific safety considerations.

REFERENCES:
2. Safety and Hazards Management in Chemical Industries – 1 Dec 2013.
## Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
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<td>PO1</td>
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<tr>
<td>CO1</td>
<td>Understand the basic safety in process design and pressure system design</td>
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<tr>
<td>CO2</td>
<td>Know about planned commissioning and inspection.</td>
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<tr>
<td>CO3</td>
<td>Obtain knowledge on equipment maintenance and several emergency plans</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>Know about hazardous gases transportation and storages</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>Obtain knowledge on specific safety considerations</td>
<td>2</td>
</tr>
<tr>
<td>SAFETY IN CHEMICAL INDUSTRY</td>
<td></td>
<td>3</td>
</tr>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE

- To learn about the concept of maintenance, TPM features and its implementation and Tero technology.
- To learn about the safe inventory management and its control, maintenance, Five Zero concept, Root Cause analysis, FMECA.
- To understand the concept of reliability prediction models, RBD approach, application of Baye’s theorem and Markov analysis.
- To know about reliability concepts and failure models, MTBF, MTTF, mortality curve, hazard plotting.
- To know how to assess the reliability of systems, non-parametric methods and replacement models.

UNIT I MAINTENANCE CONCEPTS


UNIT II MAINTENANCE MANAGEMENT AND INVENTORY CONTROL


UNIT III RELIABILITY CONCEPTS AND FAILURE DATA ANALYSIS

Reliability function – failure rate – mean time between failures (MTBF) – mean time to failure (MTTF) – prior and posteriori concept - mortality curve - Life cycle assessment, useful life, availability, maintainability, system effectiveness - Time to failure distributions – Exponential, normal, Gamma, Weibull, ranking of data – probability plotting techniques – Hazard plotting

UNIT IV RELIABILITY PREDICTION MODELS


UNIT V RELIABILITY ASSESSMENT


TOTAL : 45 PERIODS

OUTCOMES:

On successful completion of the course, the student will be able to

- Understand the necessity, objective, challenges, methods and cost involved in maintenance.
- Understand various techniques of maintenance management, optimization and reliability maintenance.
- Learn about various tools of reliability functions and various failure distributions.
- Gain knowledge about various systems and analysis of reliability prediction models.
- Learn about the testing, monitoring, allocation and cost analysis of reliability.
REFERENCE BOOKS:

ONLINE SOURCES:
**Course Articulation Matrix:**

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
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<td>CO1</td>
<td>Understand the necessity, objective, challenges, methods and cost involved in maintenance.</td>
<td>PO1 2 3 4 5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PSO1 PSO2 PSO3 PSO4 PSO5</td>
</tr>
<tr>
<td>CO2</td>
<td>Understand various techniques of maintenance management, optimization and reliability maintenance.</td>
<td>PO1 2 3 4 5</td>
</tr>
<tr>
<td>CO3</td>
<td>Learn about various tools of reliability functions and various failure distributions</td>
<td>PO1 2 3 4 5</td>
</tr>
<tr>
<td>CO4</td>
<td>Gain knowledge about various systems and analysis of reliability prediction models.</td>
<td>PO1 2 3 4 5</td>
</tr>
<tr>
<td>CO5</td>
<td>Learn about the testing, monitoring, allocation and cost analysis of reliability.</td>
<td>PO1 2 3 4 5</td>
</tr>
<tr>
<td>RELIABILITY ENGINEERING</td>
<td></td>
<td>PO1 2 3 4 5</td>
</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES
- To study the pollutants and characteristics in water and waste water.
- To know the physical treatment principles, mass transfer isotherms and mass transfer coefficient.
- To know chemical treatment principles, solvent extraction, advance oxidation.
- To provide knowledge on design of conventional treatment plants and their O & M aspects.
- To design the industrial water treatment process, demineralizers and residue arrangement.

UNIT I INTRODUCTION 3

UNIT II PHYSICAL TREATMENT PRINCIPLES 10

UNIT III CHEMICAL TREATMENT PRINCIPLES 9

UNIT IV DESIGN OF CONVENTIONAL TREATMENT PLANTS 15

UNIT V DESIGN OF INDUSTRIAL WATER TREATMENT AND RECLAMATION 8

TOTAL: 45 PERIODS

OUTCOMES:
On successful completion of the course, the student will be able to
- Understand the characteristics & level of the pollutants in water and waste water.
- Know about the principles of the physical treatment process.
- Obtain knowledge about chemical treatment process and recent advancements in the field.
- Understand about the design of conventional treatment plants, filters and recent advancements.
- Analyze the knowledge of water treatment, reverse osmosis and reclamation process in the industry.
REFERENCES:
## Course Articulation Matrix:

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<td>CO1</td>
<td>Understand the characteristics &amp; level of the pollutants in water and waste water</td>
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<tr>
<td>CO2</td>
<td>Know about the principles of the physical treatment process.</td>
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</tr>
<tr>
<td>CO3</td>
<td>Obtain knowledge about chemical treatment process and recent advancements in the field.</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>Understand about the design of conventional treatment plants, filters and recent advancements</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>Analyze the knowledge of water treatment, reverse osmosis</td>
<td>2</td>
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</table>
and reclamation process in the industry.

| PHYSICAL AND CHEMICAL TREATMENT OF WATER AND WASTE WATER | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | - | 2 | - | 2 | 1 | - |

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES
- To study about safety in process design and pressure system design, batch reactor, flare and vent system.
- To provide the knowledge about plant commissioning and inspection, pre and post commissioning documents.
- To study about plant operation prevailing, trip system.
- To study about maintenance, modification and emergency planning, repair and demolition.
- To provide knowledge about storage condition in process industries.

UNIT I SAFETY IN PROCESS DESIGN AND PRESSURE SYSTEM DESIGN 9
Design process, conceptual design and detail design, assessment, inherently safer design chemical reactor, types, batch reactors, reaction hazard evaluation, assessment, reactor safety, operating conditions, unit operations and equipment, utilities. Pressure system, pressure vessel design, standards and codes- pipe works and valves heat exchangers process machinery- over pressure protection, pressure relief devices and design, fire relief, vacuum and thermal relief, special situations, disposal- flare and vent systems- failures in pressure system.

UNIT II PLANT COMMISSIONING AND INSPECTION 9
Commissioning phases and organization, pre-commissioning documents, process commissioning, commissioning problems, post commissioning documentation Plant inspection, pressure vessel, 69 pressure piping system, non-destructive testing, pressure testing, leak testing and monitoring- plant monitoring, performance monitoring, condition, vibration, corrosion, acoustic emission-pipe line inspection.

UNIT III PLANT OPERATIONS 9
Operating discipline, operating procedure and inspection, format, emergency procedures hand over and permit system- start up and shut down operation, refinery units- operation of fired heaters, driers, storage- operating activities and hazards- trip systems- exposure of personnel-colour coding of pipes and cylinders – Corrosion prevention for underground pipes.

UNIT IV PLANT MAINTENANCE, MODIFICATION AND EMERGENCY PLANNING 9
Management of maintenance, hazards- preparation for maintenance, isolation, purging, cleaning, confined spaces, permit system maintenance equipment- hot works- tank cleaning, repair and demolition- online repairs- maintenance of protective devices modification of plant, problems- controls of modifications. Emergency planning, disaster planning, onsite emergency-offsite emergency, APELL.

UNIT V STORAGES 9
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

TOTAL : 45 PERIODS
OUTCOMES:
On successful completion of this course, the students will be able to
- Analyze the different safety aspect in process design and pressure system, heat exchanger, pressure relief valve, flare and vent system.
- Understand the concept of commissioning and inspection.
- Obtain knowledge of operation prevailing in corrosion prevention, underground pipes.
- Know about management of on-site and off-site emergency planning, maintenance, disaster planning
- Analyze about the details of storages in industries, vents, relief valves, storage.

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<td>Analyze the different safety aspect in process design and pressure system, heat exchanger, pressure relief valve, flare and vent system</td>
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<td>CO2</td>
<td>Understand the concept of commissioning and inspection.</td>
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<tr>
<td>CO3</td>
<td>Obtain knowledge of operation prevailing in corrosion prevention, underground pipes</td>
<td>2</td>
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<tr>
<td>CO4</td>
<td>Know about management of on-site and off-site emergency planning, maintenance, disaster planning</td>
<td>3</td>
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<tr>
<td>CO5</td>
<td>Analyze about the details of storages in industries, vents, relief valves, storage</td>
<td>2</td>
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<tr>
<td>SAFETY IN PROCESS INDUSTRIES</td>
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<td>2</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES

- To provide comprehensive knowledge on quantitative estimation principle, BERTRAND’S method estimation.
- To study about analysis of coal and fertilizers and estimation of nitrogen in ammonia fertilizers.
- To study about rapid methods of analysis of cement and quality assessment of cement.
- To study about purity index of oil, saponification value and iodine value of oils.
- To provide knowledge about quality standards of drinking water and estimation of chemical oxygen demand.

UNIT I QUANTITATIVE ESTIMATION - PRINCIPLE 8
Types of Analysis- Principles underlying Quantitative estimation- Purity of simple sugars Principle are underlying BERTRAND’S method- Estimation of percentage purity of phenol (By tribromo phenol formation method) - Estimation of percentage purity of glycerol- Principles underlying above estimations.

UNIT II ANALYSIS OF COAL AND FERTILIZER 8
Analysis of Coal- Suitability for thermal power plants- Proximate and ultimate analysis of coal -underlying principles- Correlation between thermal energy and fixed carbon- Estimation of nitrogen in ammonia fertilizers and soil- Principles underlying Kjeldahl’s method.

UNIT III STANDARD AND RAPID METHODS OF ANALYSIS OF CEMENT 10
Types of analysis of cement- Standard and rapid methods- Fundamentals generalizations underlying the above estimations- Quality assessment of Cement.

UNIT IV PURITY INDEX OF OIL 9
Estimation of freshness and purity of a vegetable oil- Principles underlying estimation of free acid value, Saponification value and iodine value- Causative factors of rancidity of oil.

UNIT V QUALITY STANDARDS OF DINKING WATER 10
Estimation of Chloride, Sulphate, Total Dissolved Solids and Dissolved Oxygen in the given sample of water- Principles underlying estimation of chemical oxygen demand (COD) - Principles underlying water purification strategies- World Health Organization prescribed standards of drinking water.

TOTAL : 45 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
- Understand the concepts of quantitative estimation, purity of sugar, phenol and glycerin.
- Analyze the knowledge on the analysis of coal and fertilizer.
- Know about the rapid methods of analysis of cements.
- Obtain knowledge about purity of index of oils.
- Analyze the purity of drinking water to the prescribed standards of the drinking water and WHO standards of water.

REFERENCES:
2. Technical Analysis Lab Manuals- Volume I and II by Dr.K.Srinivasan and Dr.P.Gnanasundaram, Anna University, Chennai.
## Course Articulation Matrix:

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<td>CO1</td>
<td>Understand the concepts of quantitative estimation, purity of sugar, phenol and glycerin</td>
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<td>CO2</td>
<td>Analyze the knowledge on the analysis of coal and fertilizer</td>
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<tr>
<td>CO3</td>
<td>Know about the rapid methods of analysis of cements</td>
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<td>CO4</td>
<td>Obtain knowledge about purity of index of oils</td>
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<td>2</td>
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<td>CO5</td>
<td>Analyze the purity of drinking water to the prescribed standards of the drinking water and WHO standards of water</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES

- To obtain knowledge about the safety requirements in transportation of hazardous goods, TREM, IMDG and IATA.
- To learn the road transport, motor vehicle Act, insurance and surveys.
- To gain knowledge on Driver and safety, fleet accident frequency, incentives, slogans, emergency planning and HAZMAT codes.
- To learn about road safety, alignment and gradient, illumination, clearance-tracks-warning.
- To learn about shop floor and repair shop safety, servicing and handling, maintenance equipment and other safety practices.

UNIT I TRANSPORTATION OF HAZARDOUS GOODS 9

UNIT II ROAD TRANSPORT 8
Introduction – Road safety Improving factors – Accidents Causes due to drivers and pedestrians - design, selection, operation and maintenance of motor trucks preventive maintenance - motor vehicles act – motor vehicle insurance and surveys.

UNIT III DRIVER AND SAFETY 9

UNIT IV ROAD SAFETY 10

UNIT V SHOP FLOOR AND REPAIR SHOP SAFETY 9
Transport precautions-safety on manual, mechanical handling equipment operations safe driving-movement of cranes-conveyors etc., servicing and maintenance equipment grease rack operation-wash rack operation-battery charging-gasoline handling-other safe practices-off the road motorized equipment.

OUTCOMES:
On successful completion of the course, the student will be able to

- Obtain knowledge about transportation of hazardous goods and procedure involved.
- Know about the road transport, design, selection, operation and maintenance.
- Understand the safety involved in Emergency planning and HAZMAT codes and programs on driver safety.
- Obtain information related to safety such as alignment and gradient.
- Know about the servicing, handling and maintenance of equipment.

TOTAL : 45 PERIODS
REFERENCES:
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<tr>
<td>CO1</td>
<td>Obtain knowledge about transportation of hazardous goods and procedure involved</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>Know about the road transport, design, selection, operation and maintenance</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>Understand the safety involved in Emergency planning and HAZMAT codes and programs on driver safety</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>Obtain information related to safety such as alignment and gradient</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>Know about the servicing, handling and maintenance of equipment</td>
<td>3</td>
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<tr>
<td>TRANSPORT SAFETY</td>
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</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES

- To learn the physical, chemical and other properties of powders, synthesis of Nano-powders and charging of powders.
- To know about the metal powders and characterization, SEM, AFM, solid propellants and pyro techniques.
- To learn the dust explosion, Hartmann vertical tube apparatus and hybrid test.
- To know about the dust handling plants and electrostatic hazards and electroplating.
- To learn the dust evaluation and control, environmental protection and NIOSH guidelines.

UNIT I INTRODUCTION


UNIT II METAL POWDERS AND CHARACTERIZATION


UNIT III DUST EXPLOSION


UNIT IV 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-spark-carona-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.

UNIT V 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 – Housekeeping – storage – labeling – warning sign – restricted areas - Environmental protections. Evaluation procedures and control measures for particulates (Respirable), Asbestos and other fibres, silica in coal mine - NIOSH guide to the selection and use of particulate respirators – case studies

OUTCOMES:

On successful completion of the course, the student will be able to

- Obtain knowledge about various properties of powders, their handling methods and charging of powders.
- Understand the metal powders and their characterization and their measurements, types and significance.
- Know about dust explosion accidents and obtain information on tests carried out, prevention and protection.
- Obtain knowledge about the dust handling plant and electrostatic hazards.
- Understand dust evaluation and control, NIOSH guide.
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<td>PO 1 PO 2 PO 3 PO 4 PO 5 PO 6 PO 7 PO 8 PO 9 PO1 0 PO1 1 PO1 2 PSO 1 PSO 2 PSO 3 PSO 4 PSO 5</td>
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<tr>
<td>CO1</td>
<td>Obtain knowledge about various properties of powders, their handling methods and charging of powders.</td>
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</tr>
<tr>
<td>CO2</td>
<td>Understand the metal powders and their characterization and their measurements, types and significance</td>
<td>2 1 2 1 2 - - - - - - - 2 3 - 3 1 -</td>
</tr>
<tr>
<td>CO3</td>
<td>Know about dust explosion accidents and obtain information on tests carried out, prevention and protection</td>
<td>2 3 2 2 3 - - - - - - - 3 3 - 3 - -</td>
</tr>
<tr>
<td>CO4</td>
<td>Obtain knowledge about the dust handling plant and electrostatic hazards</td>
<td>3 1 1 2 3 - - - - - - - 2 2 - 3 2 -</td>
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<tr>
<td>CO5</td>
<td>Understand dust evaluation and control, NIOSH guide</td>
<td>3 3 2 1 - - - - - - - 2 2 - 3 - -</td>
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<td>SAFETY IN POWDER HANDLING</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES

- To provide basic electrical concepts and working principles.
- To provide the Standards and requirements, Indian Electrical acts and rules.
- To know about the electrical hazards, National Electricity safety code, protection measures and PPE requirements.
- To learn the electrical protection and maintenance, discharge rods and Earthing device.
- To study the hazard area classification-Electrical equipment (IS NFPA, API and OSHA standards).

UNIT I  BASIC ELECTRICAL  12

UNIT II  STANDARDS AND REQUIREMENTS  10
Standards and statutory requirements – Indian electricity acts and rules – statutory requirements from Electrical inspectorate.

UNIT III  ELECTRICAL HAZARDS  9

UNIT IV  ELECTRICAL PROTECTION AND MAINTENANCE  8
Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance.

UNIT V  CLASSIFICATION OF HAZARDOUS AREAS  6
Hazardous area classification and classification of electrical equipment’s for hazardous areas (IS, NFPA, API and OSHA standards).

TOTAL : 45 PERIODS

OUTCOMES:
On successful completion of the course, the student will be able to

- Understand the basic concepts and working principles of electrical equipment and typical supply situations.
- Obtain knowledge about standards and requirements.
- Analyze various electrical hazards and protection measure and PPE requirements can be understood.
- Obtain knowledge about electrical protection and preventive maintenance.
- Understand about the classification of hazardous area and the electrical equipment used.

REFERENCES:
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES
- To gain the knowledge about various chemicals used in fireworks, combustion properties.
- To learn about hazardous pollution prevention, barriers.
- To learn about factories act, explosive act, rules and process safety, fire prevention and control.
- To gain the knowledge about handling and transport.
- To learn about waste control in fireworks, storage and safe disposal.

UNIT I       PROPERTIES OF FIREWORKS CHEMICALS
Combustion properties – potassium nitrate (KNO₃), potassium chlorate (KClO₃), barium nitrate (Ba(NO₃)₂), calcium nitrate (Ca(NO₃)₂), Sulphur (S), Phosphorous (P), antimony (Sb), Pyro Aluminum (Al) powder-Reactions-metal powders, Borax, ammonia (NH₃) – Strontium Nitrate, Sodium Nitrate, Potassium per chloride. Fire and explosion, impact and friction sensitivity.

UNIT II      STATIC CHARGE AND DUST

UNIT III       PROCESS SAFETY

UNIT IV      MATERIAL HANDLING
Manual handling – wheel barrows-trucks-bullock carts-cycles-automobiles-fuse handling – paper caps handling-nitric acid handling in snake eggs manufacture-handling the mix in this factory-material movement-godown-waste pit - Transportation: Packing-magazine-design of vehicles for explosive transports loading into automobiles transport restrictions-case studies-overhead power lines-driver habits-intermediate parking-fire extinguishers-loose chemicals handling and transport.

UNIT V      WASTE CONTROL AND USER SAFETY

TOTAL : 45 PERIODS

OUTCOMES:
On successful completion of this course students will be able to
- Understand the properties of various chemicals in fireworks.
- Know about the hazards in fire work factories.
- Obtain knowledge on process safety in various stages.
- Analyze the various handling process of materials.
- Know about waste control methods in other countries and role of fire service.
REFERENCES:
2. Conkling J., Chemistry of Pyrotechnics: Basic Principles and Theory; Marcel Dekker Inc.: New York.
## Course Articulation Matrix:

<table>
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<td>Understand the properties of various chemicals in fireworks</td>
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<td>Know about the hazards in firework factories</td>
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<td>Obtain knowledge on process safety in various stages</td>
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<td>CO4</td>
<td>Analyze the various handling process of materials</td>
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<td>Know about waste control methods in other countries and role of fire service</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVE
To ensure knowledge on the safe handling of oil and gas.

UNIT I       PETROLEUM PRODUCTS  
Flash point - Classification of petroleum products – Class A,B,C & Excluded  - LEL – UEL –  

UNIT II      UPSTREAM & DOWNSTREAM OPERATION  
On and off shore oil operation – Construction of Installation – Pipe line Construction –  
Maintenance and repair activities – Safety and associated hazards - transportation - Petroleum  
product storage.

UNIT III      SAFETY HANDLING OF HYDROCARBON  
Boil over phenomena - Hydro Carbon Detector (HCD) – Remote Operated Shut Off valves  
(ROSOV) – Firefighting techniques – Foam types – AFFF, ARAFFF, and Rim Seal Fire  
Protection System - Foam Pourer – Foam monitor – Medium Expansion Foam Generator  
(MEFG), High Volume Long Range (HVLR) Monitor.

UNIT IV      DISASTER MANAGEMENT PLAN  
Basic of major DMP - Objective of DMP - Categories of Emergencies – Quantitative Risk  
Assessment - Element of Disaster Management Plan - Mutual aid - On-site drill - Off-site drill -  
Disaster Management Act, 2005.

UNIT V      RULES & REGULATION  

OUTCOMES:
- Understand about the various classes of fuels and case studies of fire accidents
- Know about different aspects of pipeline constructional safety aspects of oil  
  transportation
- Obtain knowledge about various safety techniques of safe handling of hydro carbon
- Analyze different aspects of disaster management plans and safety management drill
- Obtain insight into various oil and natural gas legislation in India

REFERENCE BOOKS:
1. Basic Offshore Safety: Safety induction and emergency training for new entrants to the  
3. Safety of offshore oil and gas operations: Lessons from past accident analysis Michalis  
   Christou and Myrto Konstantinidou 2012.
   December 1, by HSE (Author).
### Course Articulation Matrix:

| Course Outcomes | Statement                                                                 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|-----------------|---------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| CO1             | Understand about the various classes of fuels and case studies of fire accidents | 3   | 1   | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -   | 2   | -   | 2   |    |    |    |    |    |    |
| CO2             | Know about different aspects of pipeline constructional safety aspects of oil transportation | 2   | 1   | 3   | 1   | 3   | -   | -   | -   | -   | -   | -   | -   | 2   | -   | 1   |    |    |    |    |    |    |
| CO3             | Obtain knowledge about various safety techniques of safe handling of hydrocarbon | 2   | 1   | 2   | 2   | 3   | -   | -   | -   | -   | -   | -   | -   | 2   | -   | 1   |    |    |    |    |    |    |
| CO4             | Analyze different aspects of disaster management plans and safety management drill | 3   | 2   | 2   | 1   | -   | -   | -   | -   | -   | -   | -   | -   | 2   | -   | 3   |    |    |    |    |    |    |
| CO5             | Obtain insight into various oil and natural gas legislation in India       | 2   | 2   | 1   | 3   | -   | -   | -   | -   | -   | -   | -   | 2   | 3   | -   | 2   |    |    |    |    |    |    |
| SAFETY IN OIL & GAS INDUSTRY |                                                                 | 3   | 2   | 1   | 2   | -   | -   | -   | -   | -   | -   | -   | -   | 2   | 2   | -   | 2   |    |    |    |    |    |    |

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES
- To learn about alpha, beta and gamma rays, radioactive decay, neutron modification, fast fission and thermal utilization.
- To gain the knowledge about control means, control and shut-down and problem in the operation.
- To learn about types of nuclear reactors and cycles.
- To gain the knowledge about reactor control and protection systems.
- To gain the knowledge about control of radioactive release.

UNIT I INTRODUCTION

UNIT II REACTOR CONTROL
Design considerations – Control requirements – control means – control and shut down - rods – their operation – Problems in operations – control instrumentation and monitoring – online central data processing system.

UNIT III REACTOR TYPES
Boiling water reactors – radioactivity of steam system – direct cycle and dual cycle power plants-pressurized water reactors and pressurized heavy water reactors – fast breeder reactors and their role in power generation in the Indian context – conversion and breeding – doubling time – liquid metal coolants – nuclear power plants in India.

UNIT IV SAFETY OF NUCLEAR REACTORS

UNIT V RADIATION CONTROL

OUTCOMES:
On successful completion of this course, the student will be able to
- Understand about fission and fusion process, radioactivity and effect of radiation.
- Know about control requirements, control means, control instrumentation and monitoring.
- Obtain knowledge about various reactors and various power plants in India.
- Analyze various safety related systems, awareness and emergency preparedness.
- Obtain knowledge on radiation, waste management and disposal practices and environmental release.

REFERENCES:
## Course Articulation Matrix:

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<td>Know about control requirements, control means, control instrumentation and monitoring</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES

- To learn about behavior based safety program, ABC model and BBS - case study.
- To gain the knowledge about psychological aspects of safety and safety culture system.
- To learn about main pillar of process safety management, theories of motivation and their application.
- To gain knowledge on work men compensation act, direct and indirect cost of accidents.
- To learn about element of disaster management plan, aid schemes mineral exploitation.

UNIT I BBS - INTRODUCTION 9

Behaviour based safety – overview – psychology of behaviour based management – focus on behaviour to manage the risk – leadership – behaviour safety programme for employees – measure safety programme – ABC model – BBS – case studies

UNIT II HUMAN BEHAVIOUR CHARACTERS 9


UNIT III SAFETY CULTURE 9


UNIT IV ACCIDENTS 9


UNIT V DISASTER MANAGEMENT 9


TOTAL : 45 PERIODS

OUTCOMES:
On successful completion of this course, the students will be able to

- Understand about psychological of behavior based safety and focus on behavior to manage the risk.
- Obtain knowledge about organizational behavior, perception of danger and acceptance of risk.
- Know about PSM, safety culture and ethical issue.
- Understand about the types and severity of accidents and accident investigation.
- Analyze various disasters, on-site and off-site emergencies.

REFERENCES:
2. “An introduction to production management techniques” (Wickens Christopher, Lee john).
3. Operation forecasting and modeling, CLYDE.B, STROPNG.M.S
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES

- To gain the knowledge on atmospheric disaster, meteorological phenomena and forest related disaster.
- To learn about APELL, onsite and offsite emergency.
- To gain the knowledge on ODS banking phasing out EL Nino and estimate change.
- To learn about case studies and control measures on marine waste, nuclear waste.
- To gain the knowledge about crisis organization, mutual aid and incident management.

UNIT I  INTRODUCTION  10

UNIT II  TECHNOLOGICAL DISASTERS  10
Technological Disasters-Case studies of Technology disasters with statistical details-Emergencies and control measures-APELL-Onsite and Offsite emergencies-Crisis management groups-Emergency Centers and their functions throughout the country Software on emergency controls-Monitoring devices for detection of gases in the atmosphere-Right to know act.

UNIT III  ENVIRONMENTAL DISASTER MANAGEMENT  8

UNIT IV  POLLUTION ASPECTS  8
Offshore and onshore drilling-control of fires-Case studies- Marine pollution and control- Toxic, hazardous and Nuclear wastes-state of India’s and Global environmental issues carcinogens-complex emergencies- Earthquake disasters- the nature-extreme event analysis- the immune system- proof and limits.

UNIT V  INCIDENT MANAGEMENT  9
The fundamentals of incident management, essential for effective industrial incident management covering: Incident Command System; Emergency Leadership, Emergency Risk Management; Mutual Aid & Joint Operations; Crisis Organization & Management; Response Functions & Priorities; Media Management; Scene Safety & Security; Damage Assessment; Salvage & Repair; Business Continuity; Employee Assistance; Incident Investigation; Cleanup & Restoration; and Incident Termination.

OUTCOMES:
On successful completion of this course, the students will be able to
- Understand about the disaster management and spare technology for control of geological disasters.
- Obtain knowledge on technological disaster and case study.
- Analyze environmental disasters and environmental policies
- Know about pollution from various aspects and its analysis.
- Understand the fundamentals of incident management and media management.

TOTAL : 45 PERIODS
REFERENCES:
## Course Articulation Matrix:

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<td>Understand about the disaster management and spare technology for control of geological disasters</td>
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<td>CO3</td>
<td>Analyze environmental disasters and environmental policies</td>
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<td>CO4</td>
<td>Know about pollution from various aspects and its analysis</td>
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<tr>
<td>CO5</td>
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<td>DISASTER AND INCIDENT MANAGEMENT</td>
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<td>3</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES

- To learn about sources and types of hazardous waste and legislation management in India.
- To gain knowledge about waste characterization, reduction and recycling.
- To learn about different methods of segregation, storage and transport of hazardous waste.
- To gain knowledge about bio and thermal conversion technology.
- To learn about waste disposal management in landfill.

UNIT I  WASTE CLASSIFICATION AND REGULATORY REQUIREMENTS 9

Sources and types of hazardous wastes - Need for hazardous waste management — Salient features of latest Indian legislations on management and handling of hazardous wastes, biomedical wastes, electronic wastes and discarded lead acid batteries — Elements of integrated waste management and roles of stakeholders.

UNIT II  WASTE CHARACTERIZATION, SOURCE REDUCTION AND RECYCLING 9


UNIT III  WASTE COLLECTION, TRANSPORT AND MATERIAL RECOVERY 9

Segregation and storage of hazardous wastes - compatibility, storage, labeling and handling of hazardous wastes - hazardous waste transport and manifests - Mechanical processing and material separation technologies – Physico chemical treatment of Hazardous wastes - solidification and stabilization – Case studies on waste collection and material recovery.

UNIT IV  BIOLOGICAL AND THERMAL PROCESSING OF WASTES 9

Biological and thermo chemical conversion technologies – hazardous waste incineration – Air pollution control system – residue disposal – pyrolysis - Emerging waste processing technologies.

UNIT V  WASTE DISPOSAL 9


OUTCOMES:
On successful completion of this course, the students will be able to

- Understand the various functional elements of hazardous waste management including legal health, safety and cultural issues.
- Obtain knowledge about science and engineering, fundamentals to characterize different types of hazardous waste.

TOTAL: 45 PERIODS
- Know about the design of system and processes to meet specified need of waste minimization, storage, collection, transportation and recycling.
- Understand the appropriate methods for processing and disposal of hazardous waste.
- Obtain knowledge to conduct research pertinent to hazardous waste management and communicate effectively to different stake-holders.

REFERENCES:

### Course Articulation Matrix:

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<td>Obtain knowledge about science and engineering, fundamentals to characterize different types of hazardous waste</td>
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<td>Know about the design of system and processes to meet specified need of waste minimization, storage, collection, transportation and recycling</td>
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<td>Understand the appropriate methods for processing and disposal of hazardous waste</td>
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<td>Obtain knowledge to conduct research pertinent to hazardous waste</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVE

- Offer the opportunity to apply in principle, concepts of industrial safety learned throughout the program.
- Introduce the concept of project and workload management into the graduate programme to ensure efficient completion of course in the semester.
- Updation of theory, safety legislation and accident case studies happening in real time in India.
- Facilitate the student in effective project management and improve his communication skills through presentation reviews.

This course will able to conduct largely as an individual project under the direct supervision of a member of academic staff. The specific project topic undertaken will reflect the common interests and expertise of the student and supervisor. The project work may carried out in collaboration with an Industry or a Research Organization. The project work will evaluated in three reviews.

Students will be required to:

1) Select a real time problem in industrial safety aspect in one of industrial fields
2) Perform extensive literature reviews to review current knowledge and recent technical advancements and developments in the industrial safety methodologies
3) Undertake detailed survey and practical work in the chosen industry
4) Produce progress reports to establish work completed; schedule further work within the period specified for the technical work in industrial safety.
5) Prepare a complete report describing the work undertaken and results obtained so far
6) Deliver detailed presentation on technical area of work being undertaken and outline the specific contributions of the work undertaken to that field
7) Present the work in an international/national conference involving poster presentations and demonstrations.

OUTCOMES:
On successful completion of this course, the students will be able to

- Demonstrate a sound technical knowledge and base of their selected project area.
- Undertake problem identification, assessment of risks, and suggest solutions in form of control measures to the industry, which shall bring down the prevalent risks to acceptable levels.
- Conduct project work which involves applying all the concepts of safety engineering
- Design feasible safety solutions to problems faced in complex processes utilizing a systems approach.
- Demonstrate the knowledge depth, management skills and attitude of a professional safety engineer.
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OUTCOMES:

On successful completion of this course, the students will be able to

- Demonstrate a sound technical knowledge and base of their selected project area.
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OPEN ELECTIVE COURSES (OEC)

OE5091 BUSINESS DATA ANALYTICS  L T P C  3 0 0 3

OBJECTIVES:
- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I OVERVIEW OF BUSINESS ANALYTICS  9

Suggested Activities:
- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:
- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II ESSENTIALS OF BUSINESS ANALYTICS  9

Suggested Activities:
- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:
- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III MODELING UNCERTAINTY AND STATISTICAL INFERENCE  9

Suggested Activities:
- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:
- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.
UNIT IV  ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK  

Suggested Activities:
- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:
- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V  OTHER DATA ANALYTICAL FRAMEWORKS  
Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:
- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:
- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student will be able to:
- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
- Use open source frameworks for modeling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.

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OBJECTIVES:
- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I INTRODUCTION
Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING
Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION

UNIT IV FAULT TRACING
Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V PERIODIC AND PREVENTIVE MAINTENANCE
Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

OUTCOMES:
- CO1: Ability to summarize basics of industrial safety
- CO2: Ability to describe fundamentals of maintenance engineering
- CO3: Ability to explain wear and corrosion
- CO4: Ability to illustrate fault tracing
- CO5: Ability to identify preventive and periodic maintenance

TOTAL: 45 PERIODS
OBJECTIVES:

- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation, assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I  LINEAR PROGRAMMING
Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II  ADVANCES IN LINEAR PROGRAMMING
Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III  NETWORK ANALYSIS – I
Transportation problems -Northwest corner rule, least cost method,Voges’s approximation method - Assignment problem - Hungarian algorithm

UNIT IV  NETWORK ANALYSIS – II
Shortest path problem: Dijkstra’s algorithms, Floyds algorithm, systematic method -CPM/PERT

UNIT V  NETWORK ANALYSIS – III
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

OUTCOMES:
CO1: To formulate linear programming problem and solve using graphical method.
CO2: To solve LPP using simplex method
CO3: To formulate and solve transportation, assignment problems
CO4: To solve project management problems
CO5: To solve scheduling problems

TOTAL: 45 PERIODS
OBJECTIVES:
- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING CONCEPTS
Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II INTRODUCTION TO PROJECT MANAGEMENT
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.

UNIT III PROJECT EXECUTION AND COSTING CONCEPTS
Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL
Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS
OUTCOMES:

CO1 – Understand the costing concepts and their role in decision making
CO2 – Understand the project management concepts and their various aspects in selection
CO3 – Interpret costing concepts with project execution
CO4 – Gain knowledge of costing techniques in service sector and various budgetary control techniques
CO5 - Become familiar with quantitative techniques in cost management

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REFERENCES:
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988

OE5095 COMPOSITE MATERIALS L T P C
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OBJECTIVES:

- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT I INTRODUCTION 9
Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II REINFORCEMENTS 9
Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES 9
UNIT IV  MANUFACTURING OF POLYMER MATRIX COMPOSITES

UNIT V  STRENGTH
Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.
TOTAL: 45 PERIODS

OUTCOMES:
• CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
• CO2 – Know the various reinforcements used in composite materials.
• CO3 – Understand the manufacturing processes of metal matrix composites.
• CO4 – Understand the manufacturing processes of polymer matrix composites.
• CO5 – Analyze the strength of composite materials.

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REFERENCES:
OBJECTIVES:
- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNIT I  INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE  9
Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II  BIOMASS PYROLYSIS  9
Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III  BIOMASS GASIFICATION  9

UNIT IV  BIOMASS COMBUSTION  9
Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V  BIO ENERGY  9
Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

OUTCOMES:
- CO1 – Understand the various types of wastes from which energy can be generated
- CO2 – Gain knowledge on biomass pyrolysis process and its applications
- CO3 – Develop knowledge on various types of biomass gasifiers and their operations
- CO4 – Gain knowledge on biomass combustors and its applications on generating energy
- CO5 – Understand the principles of bio-energy systems and their features

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AX5091 ENGLISH FOR RESEARCH PAPER WRITING L T P C
2 0 0 0

OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

UNIT III TITLE WRITING SKILLS 6
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS

OUTCOMES:

CO1 – Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

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OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION 6
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

UNIT III DISASTER PRONE AREAS IN INDIA 6
Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT 6
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

OUTCOMES:

CO1: Ability to summarize basics of disaster
CO2: Ability to explain critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

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AX5093 SANSKRIT FOR TECHNICAL KNOWLEDGE L T P C

OBJECTIVES
- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I ALPHABETS 6
Alphabets in Sanskrit

UNIT II TENSES AND SENTENCES 6
Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS 6
Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE 6
Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING 6
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

OUTCOMES:
- CO1 - Understanding basic Sanskrit language.
- CO2 - Write sentences.
- CO3 - Know the order and roots of Sanskrit.
- CO4 - Know about technical information about Sanskrit literature.
- CO5 - Understand the technical concepts of Engineering.

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REFERENCES
1. “Abhyaspustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbhashastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
OBJECTIVES

Students will be able to

- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I

Values and self-development–Social values and individual attitudes.

UNIT II


UNIT III


UNIT IV


TOTAL: 30 PERIODS

OUTCOMES:

Students will be able to

- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the over all personality.

Suggested reading
OBJECTIVES
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I  HISTORY OF MAKING OF THE INDIAN CONSTITUTION:
History, Drafting Committee, (Composition & Working)

UNIT II  PHILOSOPHY OF THE INDIAN CONSTITUTION:
Preamble, Salient Features

UNIT III  CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:

UNIT IV  ORGANS OF GOVERNANCE:
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V  LOCAL ADMINISTRATION:

UNIT VI  ELECTION COMMISSION:
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES:
Students will be able to:
- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reform sliding to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party (CSP) under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

Suggested reading
1. The Constitution of India, 1950 (Bare Act), Government Publication.
OBJECTIVES
Students will be able to:
- Review existing evidence on the topic to inform programme design and policy
- Making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I INTRODUCTION AND METHODOLOGY:
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT
Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes.

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

OUTCOMES:
Students will be able to understand:
- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

TOTAL: 30 PERIODS
Suggested reading

AX5097 STRESS MANAGEMENT BY YOGA

OBJECTIVES
- To achieve overall health of body and mind
- To overcome stress

UNIT I
Definitions of Eight parts of yoga (Ashtanga)

UNIT II
Yam and Niyam - Do’s and Don’t’s in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III
Asan and Pranayam - Various yoga poses and their benefits for mind & body - Regularization of breathing techniques and its effects - Types of pranayam

TOTAL: 30 PERIODS

OUTCOMES:
Students will be able to:
- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING
1. "Yogic Asanas for Group Training - Part I": Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
OBJECTIVES
- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To a waken wisdom in students

UNIT I
Neetishatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont’s) - Verses- 71,73,75,78 (do’s)

UNIT II
Approach to day to day work and duties - Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III
Statements of basic knowledge - Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68 Chapter 12 - Verses 13, 14, 15, 16,17, 18 -Personality of role model - shrimadbhagwadgeeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 -  Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

OUTCOMES:
Students will be able to
- Study of Shrimad- Bhagwad- Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and man kind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students.

Suggested reading
1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bharthrihari’s Three Satakam, Niti-sringar-vairagya, New Delhi,2010