

West Bengal State Council of Technical &
Vocational Education and Skill Development
(Technical Education Division)



Draft
Syllabus
for

Diploma in Fire Technology
and Safety [FTS]

5th Semester

2024

***CURRICULUM STRUCTURE FOR PART-III (SEMESTER 5) OF THE
FULL-TIME DIPLOMA COURSES IN FIRE TECHNOLOGY AND
SAFETY***

BRANCH: FIRE TECHNOLOGY AND SAFETY				SEMESTER 5				
SL No	Category	Code No	Course Title	L	P	Total Class per week	Credit	Full marks
1	Program Core	FTPC301	Fire Detection System II	2		2	2	100
2	Program Core	FTPC303	Fire Suppression Systems	3		3	3	100
3	Program Core	FTPC305	Incident Investigation and Safety Audit	3		3	3	100
4	Program Elective	FTPE301	Program Elective - II	3		3	3	100
5	Program Elective	FTPE303	Program Elective - III	3		3	3	100
6	Program Core	FTPC307	Health, Safety & Environment	3		3	3	100
7	Program Core	FTPC309	Fire Suppression System Laboratory	-	2	2	1	100
8	Program Core	FTPC311	Fire Detection System II Laboratory		2	2	1	100
9	Program Core	FTPC313	Industrial Pollution & Control Laboratory		2	2	1	100
10	Major Project	PR301	Major Project		2	2	1	100
11	Internship	SI301	Internship-II	-	-	0	1	100
Total				17	8	25	22	1100

Program Elective - II			Total Credit
1	Explosions and Industrial Fire Safety (FTPE301/1)	Any One	3
2	Petroleum Refinery Operations (FTPE301/2)		
3	Safety in Mines (FTPE301/3)		

Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately in each subject.

Program Elective - III			Total Credit
1	Road Safety (FTPE303/1)	Any One	3
2	Fire fighting vehicles and appliances (FTPE303/2)		



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"Karigori Bhavan", 4th Floor, Plot No. B/7, Action Area-III, New Town, Rajarhat, Kolkata-700160

Name of the Course: Diploma in Fire Technology Safety	
Category: Programme Core	Semester: Fifth
Code no.: FTPC301	Theory: 100 marks
Course/Subject Title: Fire Detection System -II	Examination Scheme: a) External Assessment: 60 marks (End Semester Examination) i) Internal Assessment: 40 marks [Class test: 20 marks Quizzes, assignment, viva voce: 10 marks Class attendance: 10 marks]
Duration: 15 weeks (Total hours per week = 3)	
Total Theoretical class/week: 2	
Credit: 2	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both continuous assessment and end semester assessment separately.	

1. Course Outcomes (COs):

After completion of this course, the student will be able to

- Understand different Fire Detection System Generations.
- Illustrate Different Generations of Fire Detection Systems.
- Explain Analogue addressable Fire Alarm System.
- Describe the Networking Protocol with voice communication, Public Address & Two-way communication.
- Understand different Gas Detectors

2. Theory Components:

The following topics / subtopics should be taught and assessed in order to develop unit outcomes for achieving the identified course outcomes.

Unit/Chapter	Topics & Sub-topics	Teaching Hour
UNIT 1: Introduction to Generations of Fire Detection System	Different Generations 1.1 Conventional 1.1.1 Definition 1.1.2 System Architecture 1.1.3 Merits & Demerits 1.2 Addressable 1.2.1 Definition 1.2.2 System Architecture 1.2.3 Merits & Demerits 1.3 Analogue Addressable 1.3.1 Definition 1.3.2 System Architecture 1.3.3 Merits & Demerits 1.4 Intelligent analogue addressable 1.4.1 Definition 1.4.2 System Architecture 1.4.3 Merits & Demerits 1.5 Special Features of Advance Technology 1.5.1 Elimination of false Alarm 1.5.2 Sensitivity adjustment of Detector (Day & Night) 1.5.3 Pre-alarm facility 1.5.4 Drift compensating 1.5.5 Addressable sounder 1.5.6 Alarm verification function.	6 hrs.
UNIT 2 : Illustrations of Different Generations of Fire Detection Systems	2.1 Conventional systems: Description with schematic diagram 2.2 Addressable system: Description with schematic diagram 2.3 Analogue addressable system: Description with schematic diagram 2.4 Intelligent analogue addressable system: Description with schematic diagram 2.5 Hybrid system: Description with schematic diagram 2.6 Very Early Smoke Detection & Alarm (VESDA) system: Description with schematic diagram Design Features 2.7 Design basis of Fire Detection & alarm system as per IS: 2189 2.8 Suitability of different types of detector in different atmosphere 2.9 Configuration of Fire Alarm panel 2.10 Loop capacity, Loop length, Battery capacity of Fire Alarm panel	10 hrs.

	2.11 Cross Zoning system. 2.12 Intelligent versus conventional Technology. 2.13 Radio based system- the future wireless technology 2.14 Video based system with IP Camera- the future technology.	
UNIT 3: Analogue addressable Fire Alarm System	Brief description, working principle and specification of the following components of Analogue addressable Fire alarm System: 3.1 Fire Alarm Panel 3.2 Addressable Heat Detector 3.3 Addressable Smoke Detector 3.4 Addressable Multi criteria Detector 3.5 Addressable Manual Call point 3.6 Addressable Modules 3.6.1 Isolator Module 3.6.2 Monitor Module 3.6.3 Control Module 3.6.4 Control Relay Module 3.7 Hooter/Horn cum Strobe 3.8 Repeater Panel 3.9 Cable 3.10 Fire control room & location of Fire Alarm panel 3.11 Graphic software with video display unit integrated with Fire Alarm Panel. 3.12 Surge protection of Fire alarm panel 3.13 Uninterrupted power supply for Fire alarm panel 3.14 Emergency power supply for Fire alarm panel.	5 hrs.
UNIT 4: Networking Protocol with voice communication, Public Address & Two-way communication	Networking 4.1 Pair to pair Network between Panels & Centrally located Graphic Display Unit 4.2 Pair to pair Network between panels with remote repeater panel 4.3 Communication by RS 485 port-for Panel to Panel (1.2 km) 4.4 Communication by RS 232 port- for Panel to Printer (5 m approx) 4.5 Modbus – on TCP / IP 4.6 BACK net. – on TCP / IP 4.7 SCADA- (Supervisory control and data acquisition system). 4.8 Communication by TCP / IP Port 4.9 Fibre Optical Cable Network. i) Single mode – 8.1 km ii) Multi mode – 2.0 km Voice communication system: 4.10 Application of voice communication system As per NBC-2016, Part-IV. 4.11 Integration of voice communication system with Fire alarm panel. Public Address System: 4.12 Role of Public Address system 4.13 Operational logic 4.14 Schematic diagram of Public Address system Two-Way Communication system: 4.15 Role of the system 4.16 Operation philosophy	6 hrs.

	4.17 Schematic diagram of the system	
UNIT 5 : Gas Detector	5.1 Different between Gas Detector & Fire Detector 5.2 Types of Gas Detector, Portable & Fixed type 5.3 Types of Gas Detector by sensing Technology (Electro Chemical, Catalytic Based sensors, Infrared (IR) and Photoionization (PID)) 5.4 Gas Detectors (No working principles/descriptions, only to be familiar with the names) 5.4.1 Single Gas Detector – CO₂, H₂S, CH₄ 5.4.2 Multi Gas Detector – a) Combustible Gases & Vapour – Methane (CH₄), Propane (C₃H₈), Butane (C₄H₁₀) Hydrogen (H₂), Acetylene (C₂H₂) b) Toxic Gases – Carbon Monoxide (CO), Hydrogen sulphide (H₂S), Sulphur di-Oxide (SO₂), Ammonia (NH₃) c) Chlorine (Cl₂) – Nitrogen di-oxide (NO₂), Phosphine (PH₃), Formaldehyde (CH₂O), Hydrogen Cyanide (HCN) Chlorine dioxide (ClO₂) 5.5 Approval Bodies (No descriptions, only to be familiar with the names): i) Petroleum Explosive Safety Organisation (PESO) ii) Central Institute of Mining Fuel & Research (CIMER) iii) BIS Codes as applicable. 5.6 Special Protection i) Flame Proof enclosure ii) Intrinsically safe 5.7 Application of Gas Detectors: a) Chemical & Petro chemical plants. b) Refineries c) Onshore & Offshore gas installations d) Hazardous storage tanks farms e) Automobiles Industries	3 hrs.
Total Lecture Classes (Sub Total):		30
No. of classes required for conducting Internal Assessment:		06
Grand Total:		36

3. Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
1	Manual of Fireman ship. Book- 9	Her Majesty's	Hobbs the printers of Southampton
2	IS:2189 Selection, Installation And Maintenance of Automatic Fire Detection & Alarm System – Code of Practice		Bureau of Indian Standard
3	Handbook on Fire & Life Safety in Building	Barendra Mohan Sen	Techno World



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Name of the Course : Diploma in Fire Technology and Safety	
Category: Programme Core	Semester: Fifth
Code no.: FTPC303	Theory: 100 marks
Course/Subject Title: Fire Suppression Systems	Examination Scheme: d) External Assessment: 60 marks (End Semester Examination) ii) Internal Assessment: 40 marks [Class test: 20 marks Quizzes, assignment, viva voce: 10 marks Class attendance: 10 marks]
Duration: 15 weeks (Total hours per week = 3)	
Total Theoretical class/week: 3	
Credit: 3	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both continuous assessment and end semester assessment separately.	

1. Course Outcomes (COs):

After completion of the course the student will be able to

- Understand the Clean Agent used in fire suppression system and its environmental effects
- Explain different gas suppression system.
- Describe the use & limitation of gas-based fire suppression system.
- Explain water mist fire suppression system.

2. Theory Components:

The following topics / subtopics should be taught and assessed in order to develop unit outcomes for achieving the identified course outcomes.

Unit/Chapter	Topics & Sub-topics	Teaching Hour
UNIT 1: Clean Agent and its Environmental Effects	Clean Agents: 3.1 Introduction to Clean Agents 3.2 Phase out of Halons, Ozone Depletion Potential (ODP), Global Warming Potential (GWP) 3.3 Classification of Clean Agents 3.4 Environmental effects of using clean agents 3.5 Toxicity limit of clean agents 3.6 Safety to Human 3.7 Working principle of clean agents 3.9 Storage Containers for clean agents	3 hrs.

UNIT 2: CO₂-Based Fire Suppression System	Automatic CO₂ System: 2.1 System Description: Design Basis with Design Standard (IS6382) 2.2 Hazards to be Protected 2.3 Major equipment with specification 2.4 System operation philosophy with Schematic Diagram 2.5 Use & Limitation 2.6 Available storage capacity & pressure	6 hrs.
UNIT 3: Inert Gas Fire Suppression System: IG – 01	Inert Gas (IG) – 01 (100% Argon) (IS15497) : Clean Agent Argon Fire Suppression System: 3.1 System Description: Design Basis with Design Standard (IS15497) 3.2 Hazards to be Protected 3.3 Major equipment with specification 3.4 System operation philosophy with Schematic Diagram 3.5 Use & Limitation 3.6 Available storage capacity & pressure	6 hrs.
UNIT 4: Inert Gas Fire Suppression System: IG – 55	IG – 55 Fire Suppression System – Aragonite (50% Argon & 50% Nitrogen) : Clean Agent Aragonite Fire Suppression System: 4.1 System Description: Design Basis with Design Standard (IS15506) 4.2 Hazards to be Protected 4.3 Major equipment with specification 4.4 System operation philosophy with Schematic Diagram 4.5 Use & Limitation 4.6 Available storage capacity & pressure	6 hrs.

UNIT 5: Inert Gas Fire Suppression System: IG – 541	IG – 541 - Inergen (52% Nitrogen 40% Argon 8% Carbon Dioxide) Clean Agent Inergen Fire Suppression System: 5.1 System Description: Design Basis with Design Standard (IS15501) 5.2 Hazards to be Protected 5.3 Major equipment with specification 5.4 System operation philosophy with Schematic Diagram 5.5 Use & Limitation 5.6 Available storage capacity & pressure	6 hrs.
UNIT 6: Inert Gas Fire Suppression System: IG – 100	IG – 100 (100% - Nitrogen) Nitrogen Fire Suppression System: 6.1 System Description: Design Basis with Design Standard (IS15525) 6.2 Hazards to be Protected 6.3 Major equipment with specification 6.4 System operation philosophy with Schematic Diagram 6.5 Use & Limitation 6.6 Available storage capacity & pressure	6 hrs.
UNIT 7: HCFC BLEND A NAFS – III Fire Suppression System	Hydro Chloro Fluoro Carbon (HCFC) Blend A Fire Suppression System: 7.1 System Description: Design Basis with Design Standard (IS15505) 7.2 Hazards to be Protected 7.3 Major equipment with specification 7.4 System operation philosophy with Schematic Diagram 7.5 Use & Limitation 7.6 Available storage capacity & pressure	6 hrs.

UNIT 8: Water Mist Fire Suppression System	High Pressure, Intermediate Pressure & Low Pressure Fire Suppression System: 8.1 System Description: Design Basis with Design Standard (IS15519) 8.2 Hazards to be Protected 8.3 Major equipment with specification 8.4 System operation philosophy with Schematic Diagram 8.5 Use & Limitation 8.6 Available storage capacity & pressure	6 hrs.
Total Lecture Classes (Sub Total):		45
No. of classes required for conducting Internal Assessment:		06
Grand Total :		51

No.	Title of Book
1	IS:6382 : Design & Installation of fixed Carbon-di-Oxide Fire Extinguishing system.
2	IS:15519 : Water mist fire protection systems . System design, installation and commissioning. Code of Practice
3	IS:15497 : Gaseous fire extinguishing systems . IG 01 extinguishing systems
4	IS:15506 : Gaseous fire extinguishing systems . IG 55 extinguishing systems
5	IS:15501 : Gaseous fire extinguishing systems . IG 541 extinguishing systems
6	IS:15525 : Gaseous fire extinguishing systems . IG 100 extinguishing systems
7	IS:15505 : Gaseous fire extinguishing systems - HCFC Blend A



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Name of the Course: Diploma in Fire Technology and Safety	
Category: Programme Core	Semester: Fifth
Code no.: FTPC305	Theory: 100 marks
Course/Subject Title: Incident Investigation and Safety Audit	Examination Scheme: e) External Assessment: 60 marks (End Semester Examination) iii) Internal Assessment: 40 marks [Class test: 20 marks Quizzes, assignment, viva voce: 10 marks Class attendance: 10 marks]
Duration: 17 weeks (Total hours per week = 3)	
Total Theoretical class/week: 3	
Credit: 3	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both continuous assessment and end semester assessment separately.	

1. Course Outcomes (COs):

- Understand fundamental concepts of Incident Investigation and Safety Audit
- Understand various aspects of different types of incidents/accidents
- Get the awareness on the roles of different Stakeholders in accident investigation and safety audit
- Evaluate the extent of implementation of safety management plan and audit outcomes
- Develop and implement the models regarding occupational health and safety audit.

2. Theory Components:

The following topics / subtopics should be taught and assessed in order to develop unit outcomes for achieving the identified course outcomes.

Unit/Chapter	Topics & Sub-topics	Teaching Hour
UNIT 1: Introduction to Incident Investigation	1.1. Incident/accident Investigation – Definition, Concepts and overview of methods 1.2. Types of Incidents/accidents and their investigation procedures 1.3. Formation of investigation team 1.4. Guidelines for investigation	6
UNIT 2: Incident investigation process	2.1. Identifying key factors of incident/accident 2.2. Incident risk and calculation of risk score 2.3. Root cause analysis 2.4. Classification of factors associated with accident 2.5. Accident/incident data collection 2.6. Methods of collating and tabulating data, record keeping	6
UNIT 3: Incident investigation Report	3.1. Incident/accident investigation Forms 3.2. Reporting to authorities in statutory forms 3.3. Methods of writing of incident investigation report. 3.4. Reporting of dangerous occurrences. 3.5. Procedure to release incident report	7

UNIT 4: Safety Audit	4.1. Safety Audit- Concept, Definition 4.2. Audit Goals, Objectives, Roles and Responsibilities 4.3. Audit Process 4.4. Types of Safety Audit 4.5. Statutory and Regulatory Compliance Audits 4.6. Records to be examined during the Safety Audit	8
UNIT 5: OHSMS audit	5.1. OHSMS Standards 5.2. Elements of Occupational Safety and Health System 5.3. Occupational health and Safety Management system Audits	8
UNIT 6: Audit reports	6.1. Preparation of audit reports 6.2. Discussion on audit outcomes 6.3. Identification and delineation of Non- conformity and potential scope of improvement 6.4. Case study on safety audit: SMP audit in mines, OHSMS audit of steel plant and petro chemical industry, Fire safety audit in large hospitals and hotels,	10
Total Lecture Classes (Sub Total):		45
No. of classes required for conducting Internal Assessment:		06
Grand Total:		51

Suggested Learning Resources

Sl. No.	Title of Book	Author	Publication
1	Industrial Safety and Maintenance Management	M.P. Poonia, S.C. Sharma	Khanna Publishing House
2	Principles Of Industrial Safety Management Understanding The Ws Of Safety At Work	Akhil Kumar Das	Phi Learning
3	Industrial Safety Management: Hazard Identification and Risk Control	L. M. Deshmukh	McGraw Hill Education (India) Private Limited
4	Industrial Safety & Environment	A. K. Gupta	Laxmi Publications
5	Code of Practice on Occupational Safety and Health Audit, IS 14489:1998	Bureau of Indian Standards	Bureau of Indian Standards
6	Guidelines for Auditing Management System, ISO 19011	International Standard Organization	International Standard Organization



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Name of the Course: Diploma in Fire Technology Safety	
Category: Program Elective	Semester: Fifth
Code no.: FTPE 301/1	Theory: 100 marks
Course/Subject Title: Explosions and Industrial Fire Safety	Examination Scheme: f) External Assessment: 60 marks (End Semester Examination) iv) Internal Assessment: 40 marks [Class test: 20 marks Quizzes, assignment, viva voce: 10 marks Class attendance: 10 marks]
Duration: 15 weeks (Total hours per week = 3)	
Total Theoretical class/week: 3	
Credit: 3	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both continuous assessment and end semester assessment separately.	

1. Course Outcomes (COs):

After completion of the course, the student will be able to

- i. Understand Fire and Explosion Phenomena
- ii. Identify Fire and Explosion Hazards
- iii. Assess Risk
- iv. Know Industrial Fire Protection Systems
- v. Implement the Regulatory and Safety Standards

2. Theory Components:

The following topics / subtopics should be taught and assessed in order to develop unit outcomes for achieving the identified course outcomes.

Chapter/UNIT	Name of the Topic	Hours
UNIT 1 Introduction to Industrial Fire and Explosion Safety	1.1 Importance of fire and explosion safety	5
	1.2 Case studies of major industrial accidents related to Fire and Explosion	
	1.3 Legal and regulatory requirements (e.g., OSHA, NFPA, ATEX, HAZOP)	
UNIT 2 Explosion Science	2.1 Definition of explosion and its classification (physical, chemical, electrical)	6
	2.2 Dust explosions: causes, prevention, and control	
	2.3 Gas and vapor explosions: causes, prevention, and control	
	2.4 BLEVE (Boiling Liquid Expanding Vapor Explosion), UVCE (Unconfined Vapour Cloud Explosion), Deflagration vs. detonation	

UNIT 3 Hazard Identification and Risk Assessment	3.1 Fire and explosion hazard identification methods 3.2 Risk assessment techniques (Qualitative and Quantitative Risk Assessment techniques) 3.3 Hazard and operability study (HAZOP) 3.4 Failure modes and effects analysis (FMEA) 3.5 Fault tree and event tree analysis	6	
UNIT 4 Explosion Prevention and Mitigation	4.1 Explosion-proof equipment and components 4.2 Inerting, venting, and suppression systems 4.3 Explosion isolation and flame arrestors 4.4 Safe design and operational procedures	5	
UNIT 5 Fire Suppression Systems	5.1 Types of fire extinguishers and their uses 5.2 Fixed fire suppression systems (water sprinklers, CO ₂ , foam, clean agent) 5.3 Different types of Fire hydrants and fire pumps used 5.4 Standpipe systems	6	
UNIT 6 Industrial Fire Safety Management	6.1 Fire safety management systems (FSMS) 6.2 Emergency response planning and drills 6.3 Fire safety audits and inspections 6.4Evacuation procedures and routes	6	

UNIT 7 Safety Standards and Regulations	7.1 Overview of NFPA standards relevant to industrial fire safety 7.2 OSHA regulations and guidelines 7.3 ATEX directives for explosive atmospheres 7.4 ISO standards on safety management	5
UNIT 8 Incident Investigation and Analysis	8.1 Fire and explosion incident investigation techniques 8.2 Root cause analysis (RCA) 8.3 Lessons learned from industrial accidents related to Fire and Explosion 8.4 Post-incident recovery and insurance considerations	6

Suggested Learning Resources:

Title of Book	Author	Publishers
Fire and Explosion Hazards Handbook of Industrial Chemicals	Tatyana A. Davletshina Nicholas P. Cheremisi	Jaico Publishing House
Dow's Fire and Explosion Index Hazard Classification Guide	American Institute of Chemical Engineers	Wiley-AIChE
Guidelines for Vapor Cloud Explosion, Pressure Vessel Burst, BLEVE, and Flash Fire Hazards	Center for Chemical Process Safety	Wiley-AIChE
The Ultimate Guide to Fire and Explosion Prevention: How to Keep Your Plant from Blowing Up and Burning Down	Jeffrey C. Nichols	Createspace Independent Pub
Handbook of Fire and Explosion Protection Engineering Principles: for Oil, Gas, Chemical and Related Facilities	Dennis P. Nolan	William Andrew
Explosion-Proof Equipment in Hazardous Area	Arvind Kumar Singh	Springer Verlag, Singapore



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Name of the Course: Diploma in Fire Technology and Safety	
Category: Program Elective	Semester: Fifth
Code no.: FTPE 301/2	Theory: 100 marks
Course/Subject Title: Petroleum Refinery Operations	Examination Scheme: g) External Assessment:60 marks (End Semester Examination) v) Internal Assessment:40 marks [Class test: 20 marks Quizzes, assignment, viva voce: 10 marks Class attendance: 10 marks]
Duration: 17 weeks (Total hours per week = 3)	
Total Theoretical class/week: 3	
Credit: 3	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both continuous assessment and end-semester assessment separately.	

2. Course Outcomes (COs):

At the end of this course, the student will be able to

- Explain the origin and composition of petroleum
- Describe distillation processes of crude petroleum.
- Explain different purification processes of petroleum products with the necessary flowchart
- Illustrate the important properties of petroleum products
- Describe different cracking and reforming processes in the petroleum industry with the necessary flowchart

3. Theory Components:

The following topics/subtopics should be taught and assessed to develop unit outcomes for achieving the identified course outcomes.

Unit	Topics & Sub-topics	Teaching Hours
Unit 1 Introduction	1.1 Origin of Petroleum. 1.2 Composition of Petroleum 1.3 Classification of Petroleum 1.4 Nature of Indian Crude 1.5 Name of some important Petroleum Products and their uses.	3
Unit: 2 Processing of Crude Oil	2.1 Concept of pre-treatment of crude oil: Desalting of Crude oil, Stabilization of crude oil, Heating of Crude oil 2.2 Working principle of Pipe Still Heater. 2.3 Description of Single Stage, Two Stage & Three Stage distillation Unit with diagram. 2.4 Atmospheric & Vacuum distillation unit with diagram.	6

Unit 3: Purification of Petroleum Products.	3.1 Objective of purification of petroleum products 3.2 Sweetening processes: Description of Doctor' Sweetening Process, Copper Chloride Sweetening Process, Solutizer Process, Catalytic Desulphurisation Process, Hydrofining Desulphurisation Process. 3.3 Dewaxing processes: Description of Chilling & Pressing process, Solvent Dewaxing (MEK & Propane) process, Catalytic Iso dewaxing process. 3.4 De-oiling of wax: Sweating, Settling and Solvent de-oiling process Acid, Alkali & Clay treatment of Petroleum products. 3.5 Concept of De-asphalting 3.6 Description of Propane de-asphalting process. 3.7 Description of De-aromatisation of Kerosene (Edeleanu Process) 3.8 Concept of some other Solvent Extraction Process; Furfural Extraction, 3.9 Phenol Extraction, Duo- Sol Extraction, Udex (Glycol) Extraction Process.	12
Unit 4: Properties of Petroleum Products	4.1 Concept of some important properties of petroleum products: Specific Gravity, Molecular Weight, Vapour Pressure, Kinematic viscosity (by Red Wood Viscometer), Viscosity Index, Flash Point (by Pensky Martin's apparatus and by close cup apparatus), Fire Point, Cloud Point, Pour Point, Freezing Point, Smoke Point, Char Value, Carbon Residue, Aniline Point, Diesel Index, Octane Number, Cetane Number, Performance Number, Emulsification, Oxidation Stability, Distillation Range, Sulphur Content, Moisture Content (Dean & Stark apparatus), Sediment, Calorific Value and Ash in Petroleum Products.	10
Unit 5: Cracking	5.1 Concept of Cracking 5.2 Types of Cracking 5.3 Influence of Various Parameters in Cracking 5.4 Thermal Cracking Processes: Description of Pyrolysis, Visbreaking and Delayed Coking 5.5 Catalytic Cracking Processes: Feed for catalytic cracking, Catalysts used in catalytic cracking, Catalytic cracking reaction, Description of Thermofer Catalytic Cracking (TCC) Moving Bed Process, Single Stage Fluidised Bed Catalytic Cracking (FCC) process, Hydrocracking.	7
Unit 6: Reforming:	6.1 Concept of Reforming 6.2 Feed for Reforming, Reforming Reactions 6.3 Types of Reforming 6.4 Thermal reforming 6.5 Catalytic reforming: Reactions involved, Effect of Variables in Catalytic Reforming 6.6 Description of commercial catalytic Reforming processes: Non-Regenerative Fixed Bed Platforming process, Regenerative fixed Bed Hydroforming process, Thermofer Catalytic Reforming (TCR) Moving Bed process, Fluidised Bed Hydroforming process	7
Sub Total: Total Lecture Classes		45
No. Of Classes Required for Conducting Internal Assessment Examination		06
Grand Total:		51

4. Suggested Learning Resources:

Sl. No.	Title of the Book	Author	Publication
1	Modern Petroleum Refining Processes	Rao	Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
2	Petroleum Refinery Engineering	Nelson	McGraw-Hill Book Co., Inc., New York, and Kogakusha Co. Ltd., Tokyo.
3	Elements of fuels, furnaces, and refractories	Gupta	Khanna Publishers, Delhi
4	Petroleum Processing	Hengstebeck	McGraw-Hill Pub. Co. Ltd., New York
5	Indian Petroleum Handbook, Petroleum Information Service	Petroleum Information Service	11, Parliament Street, New Delhi
6	Outlines of Chemical Technology	Dryden	Affiliated East-West Press Pvt. Ltd., New Delhi
7	Introduction to Chemical Engineering	Ghosal, Sanyal & Dutta	Tata McGraw-Hill Pub. Co. Ltd., New Delhi
8	Petroleum Refining Technology	Dr. Ram Prasad	Khanna Publishers
9	Petroleum Refining and Petrochemicals	N.K. Sinha	Umesh Publications



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Name of the Course: Diploma in Fire Technology and Safety	
Category: Program Elective	Semester: Fifth
Code no.: FTPE 301/3	Theory: 100 marks
Course/Subject Title: Safety in Mines	Examination Scheme: h) External Assessment:60 marks (End Semester Examination) vi) Internal Assessment:40 marks [Class test: 20 marks Quizzes, assignment, viva voce: 10 marks Class attendance: 10 marks]
Duration: 17 weeks (Total hours per week = 3)	
Total Theoretical class/week: 3	
Credit: 3	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both continuous assessment and end-semester assessment separately.	

1. Course Outcomes (COs):

After completing this course, the students will be able to:

- Acquire fundamental knowledge about the underground mine environment.
- Apply the acquired knowledge to deal with mine fires with safety.
- Explain the firedamp explosions and coal dust explosions in an underground coal mine.
- Identify the hazards associated with mining operations with their preventive measures.
- Understand different statutory provisions of the mines rescue rules,1985.

2. Theory Components:

The following topics/ subtopics should be taught and assessed in order to develop unit outcomes for achieving the identified course outcomes.

Unit/ Chapter	Topics & Sub-topics	Teaching Hour
UNIT-1: Mines and Mine Gases	1.1. Basic concepts of Mines, Mineral and Coal. 1.2. Brief classification of mining methods in India. 1.3. Overview of Mine Safety: Strata control, slope failure, dump failure, blasting. 1.4. Composition of atmospheric air and underground mine air 1.5. Mine gases and their properties, sources, physiological effects, permissible concentration/limit in percentage and ppm (Parts Per Million).	12

	1.6. Firedamp: Emission in underground working, Factors of emission, Gradual Exudation, Outburst - prediction and prevention of outburst, Gas Blowers - Dealing with Gas Blowers. 1.7. Fundamentals of streaming, layering and drainage of methane. 1.8. Statutory precautions against inflammable gas 1.9. Composition and threat of Blackdamp, Whitedamp, Stink Damp and Afterdamp in brief. 1.10. Overview of detection of mine gases using Flame Safety Lamp, Methanometer, CO detector or Multi gas detector.	
UNIT-2: Mine Fires and Dealing of Underground Fires	1. Fire due to spontaneous heating: Conditions; Crossing point temperature; Incubation period of coal; Factors governing spontaneous heating; Symptoms of spontaneous heating in underground mines; Graham's ratio and its interpretation; Preventive measures against spontaneous heating. 2. Live fire control; Direct method of dealing fire with water, sand or other suitable fire extinguishers. 3. Construction and purpose of temporary stopping, permanent stopping and explosion proof stopping in brief; Fittings provided in Stoppings; Sealing off a fire area; Pressure balancing. 4. Intentional flooding: Flooding of the fire area or the mine; 5. Dealing with fires in coal pillars, in coal stacks and machine fire.	9
UNIT-3: Firedamp Explosion and Coal dust Explosion	1. Firedamp explosion in underground mine: Conditions, Explosive mixture (Limits of explosibility); Causes and various influencing factors. 2. Le Chatelier Equation; Coward's diagram and its significance, Ignition temperature, Lag on Ignition 3. Preventive measures of firedamp explosion 4. Coal dust explosion: Conditions, Limits of explosibility (inflammability), Causes, Factors affecting explosibility (inflammability) of coal dust and prevention of coal dust explosion. 5. Fundamentals of stone dust barriers, water barriers and triggered barriers.	9
UNIT-4: Other Mining Hazards & General Safety	1. Heat & Humidity: 1.1. Source of heat in mines, concept of geothermal gradient 1.2. Effect of heat and humidity on human body and its Control measures 2. Mine Dust: Airborne respirable dust- Sources and Control measures, Physiological effects	6

	3. Inundation: 3.1. Causes of inundation from surface water and preventive measures; 3.2. Causes of inundation from underground water and preventive measures; 3.3. Causes of inundation in opencast mines and preventive measures; 4. Hazards due to use of machinery: Overview of noise, vibration, vehicular emission and mechanical hazards caused due to machineries used in belowground mines as well as opencast mines and their prevention. 5. Notified deceases (names and causes only)	
UNIT 5: The Mines Rescue Rules, 1985 and Rescue Apparatus	1. The Mines Rescue Rules, 1985: 1.1. Rescue Stations and functions of Rescue Stations 1.2. Rescue Rooms and functions of Rescue Rooms 1.3. Organisations and equipment in mines: Telephone communication, Rescue Tracings, Appointment of Rescue Trained Persons in mines, selection of persons for training in rescue work; 1.4. Entry into below ground mines for rescue or recovery work 1.5. Fresh air bases 1.6. Rescue team 2. Overview of the Rescue apparatus: 2.1. Self-contained breathing apparatus; 2.2. Gas mask; 2.3. Smoke helmets; 2.4. Self rescuer; 2.5. Reviving apparatus;	9
Sub Total: Total Lecture Classes		45
No. Of Classes Required for Conducting Internal Assessment Examination		06
Grand Total:		51

Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
1.	Elements of Mining Technology Vol. 2.	D.J. Deshmukh	Dennet Publications
2.	Mine Environment and Ventilation	G. B. Misra	OXFORD UNIVERSITY PRESS
3.	Mine Ventilation	S.P. Banerjee	
4.	Legislation in Indian Mines: A Critical Appraisal – Vol. II	PRASAD and RAKESH	
5.	A Study of Mine Management, Legislation and General Safety	S. Ghatak	
6.	Coal Mines Regulations 2017	-	-
7.	DGMS Orders & Circulars	-	-
8.	The Mines Rescue Rules, 1985	-	-



WEST BENGAL STATE COUNCIL OF TECHNICAL & VOCATIONAL EDUCATION AND SKILL DEVELOPMENT

[A Statutory Body under West Bengal Act XXVI of 2013]

(Formerly West Bengal State Council of Technical Education)

"Karigori Bhavan", 4th Floor, Plot No. B/7, Action Area-III, New Town, Rajarhat, Kolkata-700160

Name of the Course: Diploma in Fire Technology Safety	
Category: Programme Elective	Semester: Fifth
Code no.: FTPE303/1	Theory: 100 marks
Course/Subject Title: Road Safety	Examination Scheme: i) External Assessment: 60 marks (End Semester Examination) vii) Internal Assessment: 40 marks [Class test: 20 marks Quizzes, assignment, viva voce: 10 marks Class attendance: 10 marks]
Duration: 15 weeks (Total hours per week = 3)	
Total Theoretical class/week: 3	
Credit: 3	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both continuous assessment and end semester assessment separately.	

Course Objectives:

1. To understand roles and responsibilities in ensuring road safety.
2. To inculcate decision making & behavioural skills necessary to survive in the road environment.
3. To understand the causes & consequences of accidents.

Course Outcomes (COs):

The student will be able to

1. Aware about loss of life and properties every year in road accidents, traffic rules & characteristics of accident.
2. Gain information & knowledge about the causes of mishap.
3. Understand the importance of multidisciplinary approach to planning for traffic safety & rehabilitation.
4. Acquire basic knowledge use of artificial intelligence in road safety.

Chapter /UNIT	Name of the Topic	Teaching Hours
UNIT 1 Introduction to Road Safety	1.1 Road Safety and its importance. Traffic Rules and Driving Behaviour. Road Safety Management, Road Safety Action Plan.	08
	1.2 Safe System Approach, Engineering Interventions, Safe Infrastructure Safety, Education and Implementation.	
	1.3 Factors causing Incident: Basic cause- management, Road and its Condition, environmental, equipment, human behaviour; Indirect cause- unsafe acts and unsafe conditions; Direct causes- slips, trips, falls, caught in, run over, chemical exposures such as vapours, smoke.	

UNIT 2 Road Safety Engineering:	2.1 Safety in Road design, operating the road network for safety, highway driving and counter measures, vehicle design factors influencing road safety. 2.2 Road characteristics; Driver characteristics - Physical, Physiological; Environmental Characteristics; Traffic stream characteristics; Vehicle characteristics – Static and Dynamic; Urban Road and Rural Road Characteristics. 2.3 Application of Traffic Signals- Need, Signal face - Factors affecting signal design. Illumination and location of Signals, pedestrians’ safety, fixed and vehicle actuated signals. 2.4 Role of Road markings, Classification of Road markings, visibility	07
UNIT 3 Planning for Road safety	3.1 Awareness about rules and regulations of traffic. Assisting Traffic control authorities. 3.2 Safety features at the stage of design, manufacture, usage, operation and maintenance of vehicles 3.3 Driver training and licensing, Familiar with Area Traffic control 3.4 Multidisciplinary approach to planning for traffic safety and injury control. 3.5 Road side rest areas, Safety Barriers, Traffic Aid Posts.	05
UNIT 4 Responsibility of Road Safety measures	4.1 People responsible for accident prevention: Policy makers, police, politicians, community members, teachers, parents, infrastructure authorities, drivers and official road safety body. 4.2 Role of government and organisations.	04
UNIT 5 Road Safety Education	5.1 Importance of driver’s education programme, Common hazards on the road- distracted driving, speeding, drunk driving, weather conditions, fatigue, poor road conditions, pedestrian safety, vehicle maintenance. 5.2 Classification of road signs and traffic signals. 5.3 Location of Signs, measures of sign effectiveness, Types of visual perception, Sign regulations, sign visibility, sign variables, Text versus symbols.	09

UNIT 6 Incident Management	6.1 Characteristics of Traffic Incidents, Types of Incidents, Impacts, Incident management process. 6.2 Significance of Site Investigation, Physical and Operational parameters, Problem Diagnosis. 6.3 Incident traffic management; Incident Data Collection; Need for Safety Audit – Concept and Elements of Safety Audit for existing roads; Legal Requirements – Provisions of Motor Vehicle Act.	07
UNIT 7 Artificial Intelligence in Road Safety	7.1 Introduction of AI on 4 Es of Road Safety- (i) Education, (ii) Enforcement, (iii) Engineering, and (iv) Emergency care. 7.2 Motorist information, Equipment used; Planning effective Incident management program. National importance of survival of transportation systems during and after all natural disasters.	05
Sub Total: Total Lecture Classes		45
No. Of Classes Required for Conducting Internal Assessment Examination		06
Grand Total:		51

Suggested Learning Resources:

Title of Book	Author	Publishers
Traffic Engineering & Transport Planning,	Kadiyali L.R.,	Khanna Publishers, 2003
Highway Engineering	Khanna S.K. and Justo C.E. G	Nem Chand and Brothers, Roorkee, 2001
Hand Book of Highway Engineering	Robert F. Baker,	Van Nonstrant Keinhold Company, New York, 1975



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Name of the Course : Diploma in Fire Technology Safety	
Category: Programme Core	Semester: Fifth
Code no.: FTPE303/2	Theory: 100 marks
Course/Subject Title: Fire Fighting Vehicles and Appliances	Examination Scheme: j) External Assessment: 60 marks (End Semester Examination) viii) Internal Assessment: 40 marks [Class test: 20 marks Quizzes, assignment, viva voce: 10 marks Class attendance: 10 marks]
Duration: 15 weeks (Total hours per week = 3)	
Total Theoretical class/week: 3	
Credit: 3	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both continuous assessment and end semester assessment separately.	

1. Course Outcomes :

After completion this course the student will be able to

- Understand on Functional requirement of Fire Brigade Tender for **Type – ‘A’**
- Explain the functional requirement of Fire Brigade Tender for **Type – ‘B’**
- Specify the functional requirement of Fire Brigade Tender **for Emergency (Rescue)**
- Illustrate the functional requirement of Fire Brigade Tender **for Crash Fire**
- Explain the functional requirement of Fire Brigade Tender for **Dry Powder**
- Describe the specification of **Water Tanker of Capacity 12 kl with Fire Fighting Pump.**

2. Theory Components:

The following topics / subtopics should be taught and assessed in order to develop unit outcomes for achieving the identified course outcomes.

Unit/Chapter	Topics & Sub-topics	Teaching Hour
UNIT 1: Water Tender: Type –‘A’ For Fire Brigade Use	Water Tender – Type ‘A’ : 1.1 Standard of Manufacturing : IS:948 1.2 Suitable area of use of this Fire Tender - Rural Area 1.3 Capacity of water tank 1.4 List of accessories & equipment normally required to assist in operation of the appliance 1.5 Gross vehicle weight 1.6 Max speed of the vehicle 1.7 Acceleration from a standing start through the gears 1.8 Overall dimension of the appliance including turning circle. 1.9 Design construction of the Water tank, Engine, Electrical system, Pump etc. as per IS:948	8 hrs.

	1.9.1 Portable pump capacity 1.9.2 Accommodation Inside the Cab 1.9.3 Extension ladder provided 1.9.4 Accessories required 1.9.5 Marking on Fire Tender required as per BIS standard – A) Manufacturer's name or trade mark if any B) Capacity of the water tank in litres C) Year of manufacturer 1.9.6 Instruction Book	
UNIT 2: Water Tender: Type – 'B' for Fire Brigade use	Water Tender – Type 'B' : 2.7 Standard of Manufacturing : IS:950 2.8 Suitable areas of use of this Fire Tender -Town or parts of towns and industries 2.9 Capacity of Water tank 2.10 List of accessories & equipment normally required to assist in operation of the appliance 2.11 Gross vehicle weight 2.12 Max speed of vehicle 2.13 Acceleration from a standing start through the gears 2.14 Overall dimension of the appliance including turning circle. 2.15 Design construction of the Water tank, Engine, Electrical system, Pump, Primer etc. as per IS:950 2.15.1 Pump capacity 2.15.2 Accommodation Inside the Cab 2.15.3 Extension ladder provided 2.15.4 Accessories required 2.15.5 Marking on Fire tender required as per BIS standard A) Manufacturer's name or trade mark if any B) Capacity of the water tank in litters & pump capacity C) Year of manufacturer 2.9.6 Instruction Book	8 hrs.
UNIT 3: Emergency (rescue) Tender for Fire Brigade	Emergency (Rescue) Tender: 3.7 Standard of Manufacturing - IS:949 3.8 Suitable areas of use of Manufacturing – Large Fire in Cities or large Towns, major Electrical Fire (Power Station), Ship Fire, House collapse for which special equipment is required and is not available locally and major leakage of Toxic or Dangerous gases/liquids. 3.9 Schedule of equipment to be carried on the appliance Speed of the vehicle 3.10 Acceleration requirement of the vehicle	6 hrs.

	3.11 Gross vehicle weight 3.12 Overall dimension of the Appliance 3.13 Design construction of the Engine, Electrical system Body etc. as per IS:949 3.14 Extension ladder 3.15 Instruction book	
UNIT 4: Crash Fire tender for Air fields	Crash Fire Tender: 4.7 Standard of Manufacturing : IS:951 4.8 Applicable area: Airport 4.9 Capacity of water tank Class I Class II Class III Class IV 4.10 List of accessories 4.11 Primary Extinguishing agent 4.12 Dimension & other performance requirement 4.13 Pump capacity 4.8 Design & Construction - Chassis Engine, Fuel system, Exhaust system, Electrical system, All-wheel drive, Body warning lights, Primer pump, Power Take Off (P.T.O.) Ratio, Water Tank, Foam Monitor, Foam Tank. 4.9 Accommodation Inside the Cab 4.10 Minimum equipment in the Cab 4.11 Fire Fighting system primary agent 4.12 Marking a) Airport Fire Service, b) Year of manufacturer, c) Engine & Chassis number, d) Capacity of pump, e) Water tank, f) Foam tank etc. as per IS:951	8 hrs.
UNIT 5: Dry Powder Tender for Fire Brigade use (150 kg capacity).	Dry Powder Tender – 150 kg. Capacity : 5.1 Standard of Manufacturing : IS:955 5.2 Applicable area – Fires in oil, Petroleum Gaseous substances & Electrical equipment. 5.3 Overall dimension 5.4 Drive – Four Wheels drive 5.5 Design & Construction – Engine, Fuel system, Electrical Equipment, Dry Powder Fire Extinguishing Equipment, Nitrogen Cylinder Body Work etc. as per IS:955 5.6 Extension Ladder 5.7 Specification of powder 5.8 List of accessories to be carried on the vehicle 5.9 Marking – a) Manufacturer's name, b) Year of Manufacture	7 hrs.

UNIT 6: Water Tanker of capacity 12 kl with Fire Fighting Pump	Water Tanker of Capacity 12 kl with Fire Fighting Pump : Specifications 6.1 Make of the Chassis & Type 6.2 Engine specification 6.3 Fuel tank capacity 6.4 Gear box detail 6.5 Battery capacity 6.6 Types of wheels 6.7 Tools provided 6.8 Water tank capacity with details of Tank 6.9 Fire pump – Type & Capacity a) Normal pressure output b) High pressure output c) Maximum pressure d) Deep lifting capacity of pump e) Detail specification of pump 6.10 Central panel details 6.11 Details of pressure Hose reel with Gun 6.12 Details of pressure Water Monitor 6.13 Electrical system details 6.14 Accessories detail	8 hrs.
Total Lecture Classes (Sub Total):		45
No. of classes required for conducting Internal Assessment:		06
Grand Total:		51

Suggested Learning Resources:

Sl. No.	Title of Book
1	IS:948 : Functional Requirements of Water Tender - ‘A’ for Fire Brigade use.
2	IS:950 : Functional Requirements of Water Tender - ‘B’ for Fire Brigade use.
3	IS:949 : Functional Requirements for Emergency (Rescue) Tender for Fire Brigade use.
4	IS:951 : Functional Requirements for Crash Fire Tender for Air Field.
5	IS:955 : Functional Requirements for Dry Powder Tender for Fire Brigade use.
6	Specification of 12 kl water tender



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Name of the Course : Diploma in Fire Technology and Safety	
Category: Programme Core	Semester: Fifth
Code no.: FTPC307	Theory: 100 marks
Course/Subject Title: Health, Safety & Environment	Examination Scheme: k) External Assessment: 60 marks (End Semester Examination) ix) Internal Assessment: 40 marks [Class test: 20 marks Quizzes, assignment, viva voce: 10 marks Class attendance: 10 marks]
Duration: 17 weeks (Total hours per week = 3)	
Total Theoretical class/week: 3	
Credit: 3	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both continuous assessment and end semester assessment separately.	

1. Course Outcomes (COs):

After completion of the course the student will be able to

- Aware and about the risks and hazards related to occupational health.
- Get acquainted with the various causes and conducts responsible for unsafe environment.
- Know the procedures of minimizing the accidents and occupational diseases in work environment.
- Develop a positive attitude to solve the issues concerning the work place level health hazards.

2. Theory Components:

The following topics / subtopics should be taught and assessed in order to develop unit outcomes for achieving the identified course outcomes.

Unit/Chapter	Topics & Sub-topics	Teaching Hour
UNIT 1: Occupational Health, safety and Hazards	1.2. Introduction to Occupational Health Hazards, Occupational and notified diseases 1.3. Promoting Safety, Safety and Health training 1.4. Stress and Safety. 1.5. Importance of Industrial safety, role of safety department, Safety committee and Function	6
Unit 2: Industrial environmental parameters effecting health	2.1. Radiation and Industrial Hazards: Types and effects of radiation on human body, Measurement and detection of Radiation intensity. Effects of radiation on human body, Measurement – disposal of radioactive waste, Control of radiation 2.2. Industrial noise -Sources, and its control, Effects of noise on the auditory system and health, Measurement of noise, 2.3. Vibration - effects, measurement and control measures 2.4. Sources of dust, effects of dust on workers' health, dust control and monitoring 2.5. Different air pollutants in industries, Effect of different gases and particulate matter, acid fumes, smoke, fog on human health	10

UNIT 3: Safety and health at Workplace	2.7. Safety in use of various types machines and hand tools, Ergonomics of machine guarding, Principles of machine guarding of different types of machinery including special precautions, Built-in-safety devices, maintenance and repairs of guards, Working in different areas. 2.8. Plant design and Housekeeping: Plant layout, design and safe distance, Safety and good housekeeping. Ventilation and heat stress, Significance of ventilation, National Building code part VIII and Building service, Safety and good housekeeping 2.9. Industrial Lighting: Purpose of lighting, Phenomenon of lighting and safety, Lighting and the work, Standards for lighting and colour.	6
UNIT 4: Countering accident and health hazards	3.6. First aid: Body structure and Functions, Position of causality, the unconscious casualty, fracture and dislocation, Injuries in muscles and joints, Bleeding, Burns, Scalds and accidents caused by electricity, Respiratory problems, Rescue and Transport of Casualty. Cardiac massage, poisoning, wounds. 3.7. Medical examinations: IME. PME, evaluation of health condition and preventive measures 3.8. Personal Protective Equipment: Need, selection, supply, use, care and maintenance, Personal protective devices for head, ear, face, eye, foot, knee and body protection, Respiratory personal protective devices. 3.9. Ergonomics - Introduction, Definition, Objectives, Advantages. 3.10. Ergonomics Hazards like Musculoskeletal Disorders and Cumulative Trauma Disorders and controls	10
UNIT 5: Safety and health Management System	5.4. Directing safety: Definition, process, principles and techniques. 5.5. Internal safety Organization (ISO) - role, function and attribution of a ISO. communication with employees, conducting training, IME, PME, team building and group dynamics. 5.6. Financial cost towards compensations for individual worker and family, organisation and society, Procedures for compilation, utility and limitations of cost data, budgeting for safety. 5.7. Employee participation in safety - Role of Trade union in safety, health and environment. Safety promotion and safety awards, safety, competitions, audio visual publication	5
UNIT 6: Statutory framework for Occupational health and safety	6.1 Legislative measures in industrial safety: Factories Act, 1948, Workman's Compensation Act, 1948, Employees State Insurance Act, 1948, The Mines Act 1952, Air (Prevention and control) Pollution Act, 1981, Water (Prevention and Control) Pollution Act, 1974, Child Labour and Women Employee Act. ILO Convention and Recommendations on safety, health and welfare. 6.2 Occupational Safety, Health and Environment Management: Various standards by Bureau of Indian standards on safety and health, Process Safety Management (PSM) as per OSHA, PSM principles, ISO 45001:2018, EPA Standards, Performance measurements to determine effectiveness of PSM	8
Total Lecture Classes (Sub Total):		45
No. of classes required for conducting Internal Assessment:		06
Grand Total:		51

Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
1	Industrial Safety , Health and Environment Management	R.K.Jain and Sunil S.Rao	Khanna Publishing House
2	Handbook of Occupational Safety and Health	Slote.L	John Willey and Sons
3	Environmental Pollution Control Engineering	C.S. Rao	New Age International Publishers
4	Safety, Health and Environment Handboekt	K.T. Narayanan	McGraw-Hill Education
5	Industrial Safety & Environment	A. K. Gupta	Laxmi Publications
6	Principles Of Industrial Safety Management Understanding The Ws Of Safety At Work	Akhil Kumar Das	Phi Learning
7	Industrial Ergonomics	M.I. Khan	Phi Learning



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Name of the Course: Diploma in Fire Technology and Safety				
Category: Programme Core			Semester: Fifth	
Code no.: FTPC309			Theory: 100 marks	
Course/Subject Title: Fire Suppression System Laboratory			Examination Scheme: External Assessment: 40 marks (End Semester Examination) [Assignment on the day of viva voce:20 marks Viva voce (before Board of Examiners): 20 marks] Internal Assessment: 60 marks [Continuous assessment of class performance and in-time submission of Assignments: 30 Marks Viva Voce:20 Marks Class Attendance:10 Marks]	
Duration: 15 weeks (Total hours per week = 2)				
Total Practical Class/week: 2				
Credit: 1				
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both continuous assessment and end semester assessment separately.				
COMPETENCY After doing this practical course the students will be competent in facing and handling any Fire Suppression System. COURSE OUTCOMES (COs) The experimental works associated with this course will help the students to demonstrate the following industry-oriented COs related to the competency mentioned above. At the end of this course, the student will be able to: 1. Demonstrate different types of gas suppression systems 2. Handle Automatic Low Pressure Water Mist Suppression system 3. Automatic High Pressure Water Mist Suppression system 4. Operate different types of Suppression systems				
TEACHING AND EXAMINATION SCHEME				
Teaching Scheme		Credit	Examination Scheme	
			Practical	
At least 6 (Six) Practical/Experiments to be completed		1	External	Internal
			40	60
				Total
				100

Sl. No.	NAME OF THE PRACTICAL
1	Model of Automatic CO ₂ Suppression system. Familiarisation with the material & equipment used in the system with specification.
2	Model of Automatic IG-01 ((100% Argon) (IS15497) : Clean Agent) Suppression system. Familiarisation with the material & equipment used in the system with specification.
3	Model of Automatic IG-55 (Aragonite (50% Argon & 50% Nitrogen) : Clean Agent) Suppression system. Familiarisation with the material & equipment used in the system with specification.
4	Model of Automatic IG-541 (Inergen (52% Nitrogen 40% Argon 8% Carbon Dioxide) Clean Agent) Suppression system. Familiarisation with the material & equipment used in the system with specification
5	Model of Automatic IG-100 (100% - Nitrogen) Suppression system. Familiarisation with the material & equipment used in the system with specification
6	Model of Automatic Hydro Chloro Fluoro Carbon (HCFC) Blend Suppression system. Familiarisation with the material & equipment used in the system with specification
7	Model of Automatic Low Pressure Water Mist Suppression system. Familiarisation with the material & equipment used in the system with specification
8	Model of Automatic High Pressure Water Mist Suppression system. Familiarisation with the material & equipment used in the system with specification

Suggested Learning Resources:

. No.	Title of Book
1	IS:6382 : Design & Installation of fixed Carbon-di-Oxide Fire Extinguishing system.
2	IS:15519 : Water mist fire protection systems . System design, installation and commissioning. Code of Practice
3	IS:15497 : Gaseous fire extinguishing systems . IG 01 extinguishing systems
4	IS:15506 : Gaseous fire extinguishing systems . IG 55 extinguishing systems
5	IS:15501 : Gaseous fire extinguishing systems . IG 541 extinguishing systems
6	IS:15525 : Gaseous fire extinguishing systems . IG 100 extinguishing systems
7	IS:15505 : Gaseous fire extinguishing systems - HCFC Blend A



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Name of the Course : Diploma in Fire Technology Safety	
Category: Programme Core	Semester: Fifth
Code No.: FTPC311	Theory: 100 marks
Course/Subject Title: Fire Detection Systems – II (Laboratory)	Examination Scheme: External Assessment: 40 marks (End Semester Examination) [Assignment on the day of viva voce:20 marks Viva voce (before Board of Examiners): 20 marks] Internal Assessment: 60 marks [Continuous assessment of class performance and in-time submission of Assignments: 30 Marks Marks Viva Voce:20 Marks Class Attendance:10 Marks]
Duration: 15 weeks (Total hours per week = 2)	
Total Practical Class/week: 2	
Credit: 1	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both continuous assessment and end semester assessment separately.	

1. COMPETENCY

After doing this practical course the students will be competent in facing and handling any Fire Detection System.

2. Course Outcomes (COs):

The experimental works associated with this course will help the students to demonstrate the following industry oriented COs related to the above-mentioned competency.

The students will be able to

- Describe the working principle of different types of Addressable Fire Detectors.
- Operate different types of Addressable Manual Call Points and explain their limitations.
- Explain the working principle of different types of Addressable Notification Appliances used.
- Describe the working principle of the Addressable Monitor Module, Control Module, and control relay module.
- Do operation & maintenance checks of Addressable Fire Detection Alarm system.

TEACHING AND EXAMINATION SCHEME				
Teaching Scheme	Credit	Examination Scheme		
		Practical		
At least 8 (Eight) Practical/Experiments to be completed	1	External	Internal	Total
		40	60	100

Sl. No.	NAME OF THE PRACTICAL
1	Study with actual model of Spot type, Addressable Heat Detector.
2	Study with actual model of Spot type, Addressable, Optical Smoke Detector.
3	Study with actual model of Spot type, Multi-criteria Detector (Heat + Smoke).
4	Study with actual model of Spot type, Addressable Beam Detector.
5	Study with actual model of Addressable Monitor Module.
6	Study with actual model of Addressable Control Module/Control Relay Module.
7	Study with actual model of Addressable Isolator Module.
8	Study with actual model of Addressable Manual Pull Station.
9	Study with actual model of Addressable Hooter / Horn / Horn-cum-Strobe.
10	Study with actual model of different types gas detector like CO sensor, CH ₄ , HCN, H ₂ S, etc.
11	Familiarization and physical verification with actual models of different types of Fire Alarm Panel with Loop capacity, Loop length, Networking, Voice Communication System.
12	Appreciation of Addressable Intelligent type Detection system - Hands-on training of integration of Detectors, MCP, Hooters, and Fire Alarm Panel - Simulate fire condition, i.e., Heat & Smoke to check the result in the panel- Operation & maintenance checklist of Fire Detection Alarm system.

Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
1	Manual of Fireman ship. Book- 9	Her Majesty's	Hobbs the printers of Southampton
2	IS:2189: Selection, Installation And Maintenance of Automatic Fire Detection & Alarm System – Code of Practice		Bureau of Indian Standard
3	Handbook on Fire & Life Safety in Building	Barendra Mohan Sen	Techno World



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Name of the Course: Diploma in Fire Technology and Safety	
Category: Program Core	Semester: Fifth
Code no.: FTPC313	Theory: 100 marks
Subject Title: Industrial Pollution & Control Laboratory	Examination Scheme: 1. External Assessment: 40 marks (End Semester Examination) [Assignment on the day of viva voce:20 marks Viva voce (before Board of Examiners): 20 marks] 2. Internal Assessment: 60 marks [Continuous assessment of class performance and in-time submission of Assignments: 30 Marks Viva Voce:20 Marks Class Attendance:10 Marks]
Duration: 17 weeks (Total hours per week = 2)	
Total Practical class/week: 2	
Credit: 1	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and external assessment separately.	
COMPETENCY After doing this practical course the students will be competent in operating and maintaining equipment related to the Industrial Pollution & Control Lab	
COURSE OUTCOMES (COs) The experimental works associated with this course will help the students to demonstrate the following industry-oriented COs related to the competency mentioned above. At the end of this course, the student will be able to: 1. Perform various tests to assess the quality of drinking water. 2. Perform various tests to assess the quality of domestic sewage. 3. Understand the function of the various components of water treatment and sewage treatment plants.	

TEACHING AND EXAMINATION SCHEME				
Teaching Scheme	Credit	Examination Scheme		
		Practical		
At least 8 (Eight) Practical/Experiments to be completed	1	External	Internal	Total
		40	60	100

PRACTICAL	NAME OF THE PRACTICAL
1	Determination of pH value and conductivity of given water sample
2	Determination of TS, TDS, and TSS of given water sample
3	Determination of Bio-chemical Oxygen Demand of given water sample
4	Determination of Chemical Oxygen Demand of given water sample
5	Determination of CO ₂ of given water sample
6	Determination of total residual chlorine in a water sample.
7	Determination of sodium and potassium by flame photometer
8	Determination of optimum lime soda dose for hardness removal
9	Determination of the optimum coagulant dose using the jar test
10	Sampling of PM ₁₀ / PM _{2.5} in ambient air and the determination of its concentration
11	Measurement of Sulphur dioxide (SO ₂) concentration in the ambient air
12	Measurement of oxides of Nitrogen (NO _x) concentration in the ambient air
13	Calculation of emission rates (ER) for different exhaust gases emitting from vehicular tailpipe
14	Calculation of air change rate (ACH) of indoor environment air and deposition rate of particulate concentration of different sizes
15	Estimation of respiratory deposition doses (RDD) to human beings under different conditions
16	Study of Electrostatic precipitator.
17	Study of different types of pollution caused by various types of fire extinguishing agents.
18	Measurement of noise level (db).
19	Study of soil quality index(pH, organic matter, phosphorus, potassium and electrical conductivity.

Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
1.	Environmental Engineering	Sharma S.C	Khanna Publishing House, New Delhi
2.	Environmental Engineering	Basak N N	McGraw Hill Publishers
3.	Environmental Engineering Vol. I and Vol. II	Garg, S.K.	Khanna Publishers
4	Water Supply and Sanitary Engineering	Birdie, G. S. and Birdie, J. S.	Dhanpat Rai
5	Elements of Environmental Pollution Control	Gupta, O.P.	Khanna Publishing House, Delhi
6	Environmental Pollution Control Engineering	Rao, C.S.	New Age International
7	Environmental Engineering, vol. I and II	Punmia, B. C.	Laxmi Publishers
8	Environmental Engineering	Peavy H. S., Rowe D. R., and Tchobanoglous G	McGraw Hill Publishers
9	Drinking Water — Specification	BIS: 10500	BIS, New Delhi.
10	General Standards for Discharge of Environmental Pollutants	CPCB	CPCB, New Delhi



**WEST BENGAL STATE COUNCIL OF TECHNICAL
& VOCATIONAL EDUCATION AND SKILL DEVELOPMENT**

[A Statutory Body under West Bengal Act XXVI of 2013]

(Formerly West Bengal State Council of Technical Education)

"Karigori Bhavan", 4th Floor, Plot No. B/7, Action Area-III, New Town, Rajarhat, Kolkata-700160

Name of the Course: Diploma in Fire Technology and Safety			
Category: Major Project	Semester : Fifth		
Code No. : PR301	Full Marks: 100		
Course Title : Major Project	Sessional Examination Scheme:		
Duration : 17 weeks (total hours per week = 2)	External Assessment (End Semester Sessional Examination)		
	Evaluation of major project progress report	20	40 marks
	Viva Voce on to the progress and future plans of completion of major projects	20	
	Internal Assessment		
Total Practical class / week : 2	Continuous assessment of performance, contribution and in time submission of progress of major project.	30	60 marks
	Seminar Presentation and Viva Voce on to the progress of major projects at the end of the semester.	20	
Credit: 1	Class attendance (based on project diary).	10	
	Total marks		
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.			

1. Course Outcomes (COs):

Depending upon the nature of the projects undertaken, some of the following major course outcomes can be attained (apart from these, other COs may also be attained depending upon the types of project).

After completion of the project, the students will be able to:

- Implement the planned activity individually and/or as team.
- Select, collect and use required information / knowledge to solve the identified problem.
- Take appropriate decisions based on collected and analysed information.
- Incorporate energy and environment conservation principles.
- Consider the ethical issues related to the project (if there is any).
- Assess the impact of the project on society (if there is any).
- Communicate effectively and confidently as a member and leader of team.
- Prepare project report following proper guideline using appropriate tools (if any).

2. Course details:

As the implementation of the major project progresses and which has to be submitted at the end of project work, one of the outputs of this course is a detailed Project Report that is continuously prepared by the student. There will also be regular progressive assessment by the Teachers / Project Guides. Such major project work has to be executed throughout 5th and 6th semester and has to be

completed at the end of 6th semester. At the end of 5th semester, each student has to present a seminar presentation on progress and future plans of completion of major project and has to submit a progress report on major project.

3. Guidelines for Major Project: (Execution and Report Writing)

As soon as the project plan is approved by the Teacher / Project Guide, the student will begin to work according to it and would also continue to maintain a dated Project Diary for the whole semester.

3.1 Suggested contents of the Project report:

- a) Title page (Polytechnic name along with name of team members and mentor teacher).
- b) Certificate (in the Format given in this document as annexure A).
- c) Acknowledgements (this may need revision at the end of the final semester).
- d) Abstract (in one paragraph not more than 200/ 150 words).
- e) Content Page.
- f) Abbreviations (if any).

3.2 Headings / Chapters (Sub headings can also be kept, if required):

- a) **Introduction and Background Study** (In this section student will write Basic information about project topic, definition of few important terms, represents a study of previously existing material / literature collected from Books, research work or internet, on the project topic) and identification of the problem issue.
- b) **Objective of the project**
- c) **Methodology / Planning of Execution**
- d) **Procedure Followed**
- e) **Results and Discussion**
- f) **Conclusions**
- g) **Future Scope of Work**
- h) **Appendix (if any)**
- i) **References (must)**

Note:

- i. The report should contain relevant figures and tables (including charts, graphs, diagrams, etc.) with proper captions.
- ii. Originality of the report (written in own words) would be given more importance rather than quality of printing and use of glossy paper, etc.

4. Assessment of Project Work:

Project work has two components, first is Progressive Assessment (PA), while another is End Semester Examination (ESE).

4.1 Progressive Assessment (PA) Guidelines and Criteria:

Project guide is supposed to carry out this assessment. It is a continuous process, during which for developing desired qualities in the students, faculty should orally give informal feedback to students about their performance and interpersonal behaviour while guiding them on their project work every week.

4.2 End Semester Examination (ESE):

Evaluation shall be carried out according to following criteria. For each project, students from the concerned group should be asked to make presentation of their project, in front of the external and internal examiners which should be followed by question-answer session to ascertain the contribution made by each student.

5. Suggested fields of Major Projects for Continuous Assessment:

The list of major project fields, which may be selected and executed by the students towards attainment of the required competency:

- a) Fire modeling and simulation based project using computational fluid dynamics (CFD) Analysis Software
- b) Design based project
- c) Experiment based project
- d) Computer program based project
- e) Industry sponsored projects
- f) Literature survey based projects
- g) Investigative projects
- h) Maintenance based projects
- i) Low cost automation projects
- j) Innovative / Creative projects
- k) Environmental management systems projects
- l) Market research / survey based projects

Note:

Project can be selected other than the area specified above. Project should provide viable and feasible solution to the problem identified.

6. Suggested Scheme for Internal Assessment: [Total Marks: 60]

Involvement	Total Marks
Continuous assessment of performance, contribution and in time submission of progress of major project.	30
Seminar Presentation and Viva Voce on to the progress of major projects at the end of the semester.	20
Class attendance (based on project diary).	10
Total Internal Assessment:	60
Pass criterion for Internal Assessment = 24 Marks [Minimum]	

7. Suggested Scheme for End Semester Examination: [Total Marks: 40]

Involvement	Total Marks
Evaluation of major project progress report on the day of End Semester Exam.	20
Viva Voce on to the progress and future plans of completion of major project on the day of End Semester Exam.	20
Total External Assessment:	40
Pass criterion for Internal Assessment = 16 Marks [Minimum]	

8. Rubrics for the internal assessment of Major Project:

The 'Process and Product' related skills associated with each major project work are to be assessed according to a suggested sample as given below:

Sl. No.	Performance Indicators
01	Identify, analyze & define the problem statement.
02	Generate alternative solutions for the identified problem.

03	Compare & select feasible solutions from alternatives generated.
04	Execution (design, develop, manufacture & operate equipment / program), data recording, analyze and generate conclusion to the problem statement.
05	Submission of major projects progress report in time.
06	Viva voce

During conducting such major project work (laboratory / field based), the following social Skills / attitudes which are Affective Domain Outcomes (ADOs) are to be developed through the experiences:

- Follow the safety practices.
- Practice good housekeeping.
- Demonstrate working as a leader / team member.
- Maintain tools and equipment in good working condition.
- Follow ethical practice.



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Name of the Course: Diploma in Fire Technology and Safety	
Category: Internship	Semester: Fifth
Code No.: SI301	Full Marks: 100
Course Title: Internship - II	Examination Scheme: Internal Assessment:100 marks [Submission of report after Industrial visit – 60 marks (in scheduled time) Seminar on Internship – 40 marks]
Duration:	
Total practical class/week (after 4 th Semester): Nil	
Credit:1	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in internal assessment.	

1. Course Outcomes (COs):

After completion of the Internship, the students will be able to:

- Understand practical, real-world experience in a specific field,
- Gain individual skills, knowledge, and a better understanding of the profession.
- Develop job-related skills, exploring career options.
- Build a professional network, and gaining a sense of what a particular job entails

Suggested Internship Project Work in 5th Semester

After the 4th Semester, for **Internship-II**, students are required to be involved to undergo internship with industry

/ NGOS / Government Organizations / Micro / Small / Medium Enterprises to make themselves ready for the industry. All stakeholders including Training & Placement Cell and concerned teachers will take necessary initiatives to coordinate the internship program for the students. Online internship options may be explored.

After completion of Internship II, the student should prepare a comprehensive report to indicate what he/she has observed and learnt during internship period. The student may contact Industrial Supervisor / Faculty Mentor/TPO for assigning topics and problems and should prepare the final report on the assigned topics. The Industrial Supervisor / Internship Faculty Mentor, TPO and HOD would sign the training report.

The Internship report will be evaluated based on the following criteria (as applicable):

Sl.No.	Criteria for evaluation of Internship Report [60 marks]
1.	Originality
2.	Adequacy and purposeful write-up
3.	Organization, format, drawings, sketches, style, language
4.	Practical applications and relationships with basic theory
5.	Concepts taught in the course outcome
6.	Practical applications, relationships with basic theory and concepts taught in the course.
7.	Attendance record, daily diary, quality of the Internship Report

Seminars must be arranged for the students based on his/her training report, before an internal committee constituted by the concerned department of the institute. The evaluation will be based on the following criteria:

Sl.No.	Criteria for evaluation of Internship Seminar [40marks]
1.	Quality of content presented
2.	Proper planning for presentation
3.	Effectiveness of presentation
4.	Depth of knowledge and skills
5.	Viva voce
Total Marks:100	
Pass criterion for Internship-II = 40 Marks [Minimum]	

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