

Course Structure for Semester VII (2024-25)

B. Tech. Safety and Fire Engineering

Semester VII										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				No. of Credits
			L	T	P	CA	MSE	ESE	Total	
PCC19	BTSFC701	Fire Detection and Installation Fire Fighting System-II	3	1	-	20	20	60	100	4
PCC20	BTSFC702	Hospital Safety and Risk Management	3	-	-	20	20	60	100	3
PCC21	BTSFC703	Advances in Fire and Safety	3	1	-	20	20	60	100	4
PCC22	BTSFC704	Professional Fire and Safety Engineering Management	3	1		20	20	60	100	4
PCC23	BTSFCL705	Fire Detection and Installation Fire Fighting System-II Lab	-	-	2	60	-	40	100	1
PCC24	BTSFCL706	Hospital Safety and Risk Management Lab	-	-	2	60	-	40	100	1
PROJ2	BTSFP707	Mini Project	-	-	6	60	-	40	100	3
PROJ3	BTSFP708	Seminar	-	-	2	100	-	100	200	1
LC5	BTSFD710	Drill- 5	-	-	2	50	-	-	50	1
Total			12	3	12	410	80	460	950	22

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
 PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
 HSSMC = Humanities and Social Science including Management Courses

Course Structure for Semester VIII (2024-25)

B. Tech. Safety and Fire Engineering

Semester VIII										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				No. of Credits
			L	T	P	CA	MSE	ESE	Total	
		Choose any two subjects from Annexure -A#	-	-	-	20	20	60	100	4
			-	-	-	20	20	60	100	4
PROJ4	BTSFP801/ BTSFI801	Internship or Project work	-	-	16	100	-	300	400	8
Total					16	140	40	420	600	16

ANNEXURE-A# (Provisional)

Recommendations of 8th Semester Courses in Self-study Mode from NPTEL/ SWYAM Platform

THE STUDENTS MAY CHOOSE AS PER THE AVAILABILITY OF THE SUBJECTS ON THE NPTEL/ SWYAM Platform AND USEFULNESS, EVERY YEAR

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
 PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
 HSSMC = Humanities and Social Science including Management Course

Sr No	Course Code	Course Name	Duration	Institute offering course	Name of Professor
1	BTSFC801A	Explosions and Safety	12 Weeks	IITM	Prof. K. Ramamurth
2	BTSFC801B	Theory of Fire Propagation (Fire Dynamics)	12 Weeks	IITM	Prof. V. Raghavan
3	BTSFC801C	Risk-Based Engineering	12 Weeks	Homi Bhabha National Institute(HBNI)	Prof. Prabhakar V Varde
4	BTSFC801D	Industrial Safety Engineering	12 Weeks	IITK	Prof. Jhareswar Maiti
5	BTSFC801E	Chemical Process Safety	12 Weeks	IITR	Prof. Shishir Sinha
6	BTSFC801F	Hydrogen Energy: Production, Storage, Transportation and Safety	12 Weeks	IITM	Prof. Pratibha Sharma

Six months of Internship in the industry

These subjects are to be studied on self –study mode using SWAYAM/NPTEL/Any other source

Student doing project in Industry will give NPTEL Examination/Examination conducted by the University i.e. CA/MSE/ESE

Students doing project in the Institute will have to appear for CA/MSE/ESE

SEM	I	II	III	IV	V	VI	VII	VIII	TOTAL
CREDITS	18	19	22	25	20	19	22	16	161

SEMESTER VII

Subject Title: Fire Detection and Installation Fire Fighting System-II

PCC19	BTSFC701	Fire Detection and Installation Fire Fighting System-II	3-1-0	Credit 4
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Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: At the end of the course, students will be able to

CO 1	Understand of Water-Based Firefighting Systems
CO 2	Develop proficiency in performing hydraulic calculations and designing hydrant systems
CO 3	Acquire expertise in designing and calculating spray systems tailored to specific hazards
CO 4	Design, calculate, and install fire pumping systems according to standard norms and procedures
CO 5	Develop skills in Cost Analysis and System Commissioning

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Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	3	2		2			1	1		
CO 2		3		2						
CO 3	3				3					
CO 4	3						1			
CO 5		3				1				

All units carry 12 Marks each for End Semester Examination.

Course Contents:

Unit: I

(08 Hrs.)

Provisions & applicable standards of water-based systems: Hydrants, Monitors, Risers, Sprinklers, Spray systems, Earthing, NDT and Cathodic protection for underground piping, etc.

Unit: II

(10 hrs)

Hydraulic Calculation, Design of hydrants, wet riser and dry riser system. Design of Sprinkler system: types of Sprinkler Systems, Limit of Calculation in an Empirical design process, Density-based sprinkler demand, Pressure requirement of the most remote sprinkler,

C value for pipes, Pressure losses through piping, fittings and valves, Use of velocity pressure, Elevation losses, Loops and grids

Unit: III **(10 Hrs.)**

Design, Calculation of Spray systems based on hazards, Hydraulic calculation based on standard norms and procedure.

Unit: IV **(10 Hrs.)**

Design, Calculation and installation of fire pumping system based on standard norms and procedure.

Unit: V **(08 Hrs.)**

Cost analysis, Installation, Testing and Commissioning of water based fixed firefighting system.

Learning Resources:

Reference Books & Standards:

1. Use of design standards (IS/NFPA/FM) for designing the sprinklers?
2. Use of software available for designing of sprinkler system?
3. Hydraulic calculation to check demand and supply?
4. Use various installation standards for installation of sprinkler system (IS/NFPA/FM)?
5. Specific reference material – Loss Prevention Datasheet by FM Global, FMDS 3-26; 8-9; 2-0.
6. SFPE Handbook of Fire Protection Engineering
7. Fire Protection Handbook

Subject Title: Hospital Safety and Risk Management

PCC20	BTSFC702	Hospital Safety and Risk Management	3-0-0	Credit 3
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Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: At the end of the course, students will be able to

CO 1	Demonstrate a comprehensive understanding of the importance of safety in hospital setting
CO 2	Competence in Fire Safety and Emergency Preparedness
CO 3	Acquire expertise in infection control principles, standard precautions
CO 4	Demonstrate proficiency in the safe use, maintenance, and management of medical electrical equipment
CO 5	Develop competence in the safe handling, storage, and management of medical gases and oxygen cylinders in hospital settings

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	2	2			1			3	2	
CO 2	3		3	3			2			2
CO 3			2		1	3		3		3
CO 4		3	3	3		1				
CO 5	3			3		3	2		2	

All units carry 12 Marks each for End Semester Examination.

Course Contents:

Unit I: Introduction to Hospital Safety and Regulations (08 Hrs)

Importance of safety in hospitals, Overview of hospital safety regulations and standards, Key components of a hospital safety management system, Case studies on hospital safety incidents and lessons learned.

Unit II: Fire Safety and Emergency Preparedness in Healthcare Facilities (10 Hrs)

Fire risk assessment in hospitals, Fire prevention measures and safety protocols, Design and maintenance of fire protection systems (alarms, sprinklers, extinguishers), Emergency evacuation procedures and drills, Training staff on fire safety and response, Developing and

implementing hospital emergency response plans, coordinating with local emergency services and agencies, Conducting risk assessments and scenario planning.

Unit III: Infection Control, Biological Safety, and Chemical Safety (12 Hrs)

Principles of infection control in healthcare settings, Standard precautions and use of personal protective equipment (PPE), Methods for controlling hospital-acquired infections (HAIs), Safe handling and disposal of biological waste, Role of hospital safety committees in infection control, Chemical safety protocols: storage, handling, and disposal of hazardous materials, Safety data sheets (SDS) and their importance, Incident response and management for chemical emergencies.

Unit IV: Electrical Safety and Medical Equipment Management (10 Hrs)

Safe use and maintenance of medical electrical equipment, Identifying and mitigating electrical hazards, Regular inspection and maintenance protocols, Training staff on the safe use of electrical equipment, Protocols for responding to electrical emergencies, Ensuring compliance with electrical safety standards and regulations.

Unit V: Handling and Management of Medical Gases and Oxygen Cylinders (08 Hrs)

Understanding the types of medical gases used in hospitals, Safe handling and storage of oxygen cylinders, Guidelines for transporting and securing oxygen cylinders, Maintenance and inspection of gas delivery systems, Protocols for responding to oxygen-related emergencies (leaks, fires), Training staff on the proper use and management of oxygen systems.

Reference Books:

1. "Safety and Health Management Planning" by Willie Hammer
2. "Hospital Safety: Regulatory and Management Strategies" by James T. Tweedy
3. "Fundamentals of Occupational Safety and Health" by Mark Friend and James Kohn
4. "Fire Safety Management Handbook" by Daniel Della-Giustina
5. "Emergency Management in Health Care: An All-Hazards Approach" by Joint Commission Resources
6. "Infection Control and Management of Hazardous Materials for the Dental Team" by Chris H. Miller
7. "Basic Concepts in Medicinal Chemistry" by Marc W. Harrold and Robin M. Zavod
8. "Electrical Safety Handbook" by John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, and Al Winfield

Learning Resources:

1. World Health Organization (WHO) resources on healthcare safety
2. Joint Commission International (JCI) standards for hospitals:
3. National Fire Protection Association (NFPA) guidelines
4. NFPA Healthcare Facilities Code (NFPA 99)
5. Federal Emergency Management Agency (FEMA) resources on hospital emergency preparedness

6. Centers for Disease Control and Prevention (CDC) guidelines on infection control:
7. Institute of Electrical and Electronics Engineers (IEEE) standard

Subject Title: Advances in Fire and Safety

PCC21	BTSFC703	Advances in Fire and Safety	3-1-0	Credit 4
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Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: At the end of the course, students will be able to

CO 1	Demonstrate proficiency in fire scene investigation techniques
CO 2	Apply industrial fire safety protocols
CO 3	Develop strategies for wildland fire management
CO 4	Implement fire safety measures in transportation
CO 5	Evaluate emerging technologies in fire safety

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	2	3					1			2
CO 2	3	2	3			3				
CO 3			2	3		3				
CO 4	3	2	3					3	2	2
CO 5		3				2	2		3	

All units carry 12 Marks each for End Semester Examination.

Course Contents:

Unit I: Fire Investigation and Forensics (08 Hrs)

Techniques for fire scene investigation, Determining the origin and cause of fires, Analysis of fire patterns and burn indicators, Evidence collection and preservation, Legal aspects of fire investigation and expert witness testimony

Unit II: Industrial Fire Safety (10 Hrs)

Fire hazards in industrial settings, Safety protocols for hazardous materials (HAZMAT), Explosion protection and prevention, Fire safety in chemical and petrochemical industries, Case studies of industrial fires and explosions

Unit III: Wildland Fire Management (12 Hrs)

Ecology and behavior of wildfires, Fire weather and its impact on wildfire behavior, Techniques for wildfire prevention and suppression, Use of technology in wildland firefighting (drones, GIS, satellite imaging), Impact of wildfires on communities and ecosystems

Unit IV: Fire Safety in Transportation (08 Hrs)

Fire safety measures in aviation, maritime, and rail transport, Fire protection systems in vehicles and vessels, Evacuation procedures and safety protocols for passengers, Case studies of transportation-related fire incidents, Regulatory standards and compliance for transport fire safety

Unit V: Emerging Technologies in Fire Safety (08 Hrs)

Integration of artificial intelligence and machine learning in fire detection, Use of robotics and automation in firefighting, Advances in fire-resistant materials and coatings, Smart building technologies for fire prevention and control, Future trends and innovations in fire safety technology

Reference Books:

1. "Principles of Fire Behavior" by James G. Quintiere
2. "NFPA 101: Life Safety Code Handbook" by National Fire Protection Association (NFPA)
3. "SFPE Handbook of Fire Protection Engineering" by National Fire Protection Association (NFPA)
4. "Fire Protection Handbook" by National Fire Protection Association (NFPA).
5. "Wildland Fire Behavior: Fire Management and Ecology" by Mark A. Finney

Learning Resources:

1. National Fire Protection Association (NFPA) Website
2. Fire Engineering Magazine
3. International Association of Fire Chiefs (IAFC) Online Training
4. Fire Dynamics Simulator (FDS) and Smokeview

Subject Title: Professional Fire and Safety Engineering Management

PCC22	BTSFC704	Professional Fire and Safety Engineering Management	3-1-0	Credit 4
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Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Course Outcomes: At the end of the course, students will be able to

CO 1	Demonstrate Competence in Implementing Health and Safety Management Systems
CO 2	Apply Principles of Fire Safety Engineering
CO 3	Evaluate and Control Occupational Health Hazards
CO 4	Utilize Engineering Controls for Risk Management
CO 5	Understand Legal and Regulatory Compliance

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes									
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
CO 1	3			2	2	3				2
CO 2	3		3			3				
CO 3	3	3		2		3		1		
CO 4	3								2	
CO 5	3					3				2

All units carry 12 Marks each for End Semester Examination.

Course Contents:

Unit I: Health and Safety Management Systems

Fundamentals of implementing and managing health and safety management systems within organizations. It includes understanding legal requirements, policy development, risk assessment methodologies, auditing, and continuous improvement techniques, elements from NEBOSH IGC, IOSH, and OSHA standards related to management systems.

Unit II: Fire Safety Engineering

Principles of fire science, fire dynamics, fire prevention, detection, and suppression systems. It also covers fire risk assessment, emergency planning, evacuation procedures, and relevant legislation and standards.

Unit III: Occupational Health and Industrial Hygiene

Identifying, evaluating, and controlling occupational health hazards in the workplace. It includes understanding exposure limits, hazardous substances management, workplace ergonomics, noise control, ventilation systems, and the health effects of occupational exposures. Elements from NEBOSH IGC and OSHA pertaining to occupational health and hygiene would be covered.

Unit IV: Safety Engineering and Risk Management

Engineering principles to identify and mitigate risks in various industrial settings. hazard identification techniques, risk assessment methods (such as HAZOP, FMEA), safety instrumented systems (SIS), safety integrity levels (SIL), and process safety management (PSM). elements from NEBOSH IGC, IOSH, and OSHA standards related to risk management and engineering controls.

Unit V: Legal and Regulatory Compliance

Understanding legal requirements and regulatory frameworks is crucial for safety professionals. relevant legislation, regulations, and standards related to workplace safety and health, including but not limited to OSHA regulations, international standards (ISO), and industry-specific guidelines. It also addresses enforcement mechanisms, penalties for non-compliance, and the role of safety professionals in ensuring organizational compliance.

References:

1. "Safety Management Systems in Aviation" by Alan J. Stolzer, Carl D. Halford, and John J. Goglia
2. "Fire Protection Engineering in Building Design" by Jane Lataille
3. "Occupational Safety and Health for Technologists, Engineers, and Managers" by David L. Goetsch and Eugene R. McKenzie
4. "Safety Instrumented Systems: Design, Analysis, and Justification" by Paul Gruhn and Harry L. Cheddie
5. "Occupational Safety and Health Law Handbook" by Melissa A. Bailey and Matthew C. Cooper

Learning Resources:

1. OSHA's Occupational Health and Safety page, CDC's National Institute for Occupational Safety and Health (NIOSH) resources
2. NEBOSH International Diploma in Occupational Health and Safety materials, IOSH Managing Safely course materials
3. OSHA's official website, IOSH's Legal Compliance and Risk Management resources

4. NFPA (National Fire Protection Association) codes and standards, OSHA's Fire Safety page

Subject Title: Fire Detection and Installation Fire Fighting system -II Lab

PCC23	BTSFCL705	Detection and Installation Fire Fighting System-II Lab	0-0-2	Credit 1
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Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs./week	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

List of Practical's/Experiments/Assignments (any ten experiments from the list)

1. Hydrant Testing Demo: Hands-on inspection and testing of hydrants for functionality and compliance.
2. Sprinkler Installation Workshop: Practical guidance on installing sprinkler systems, covering spacing and mounting.
3. Hydraulic Calculation Exercise: Interactive session calculating design parameters for fire protection.
4. Designing Dry Riser Systems: Step-by-step guidance on designing riser systems for multi-story buildings.
5. Fire Pump Operation Training: Comprehensive training on operating and maintaining fire pumps.
6. Spray Systems Demonstration: Exploration of spray system types and applications in fire protection.
7. Riser Compliance Inspection: Inspection to ensure compliance with standards for wet and dry riser systems.
8. Cathodic Protection Testing: Hands-on training on testing methods for underground piping corrosion prevention.
9. Cost Analysis Project: Analysis of installation and maintenance costs for firefighting systems.

10. Commissioning Process Simulation: Simulation of testing and documenting system performance.
11. NDT Techniques Practice: Hands-on training in non-destructive testing methods for system components.
12. Emergency Response Drill: Realistic simulation of firefighting system activation during an emergency.

Subject Title: Hospital Safety and Risk Management Lab

PCC24	BTSFCL706	Hospital Safety and Risk Management Lab	0-0-2	Credit 1
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Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs./week	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

List of Practical's/Experiments/Assignments (any ten experiments from the list)

1. Fire Drill: Conduct a fire evacuation drill and evaluate staff response.
2. Risk Assessment: Perform a fire risk assessment of hospital areas.
3. Emergency Plan Review: Update the hospital's emergency response plan and assign roles.
4. PPE Training: Provide hands-on training for using personal protective equipment.
5. Biological Waste Handling: Demonstrate correct procedures for handling and disposing of biological waste.
6. Chemical Spill Drill: Simulate a chemical spill and train staff on response procedures.
7. Electrical Inspection: Inspect medical electrical equipment for hazards and maintenance needs.
8. Gas System Check: Review and inspect medical gas delivery systems and oxygen cylinders.
9. Oxygen Cylinder Inspection and Testing: Train staff on administering emergency oxygen Cylinder Inspection and Testing
10. Fire Extinguisher Training: Teach staff the PASS technique for using fire extinguishers.
11. Tabletop Exercise: Conduct a scenario-based discussion on responding to a safety incident.

12. Safety Committee Meeting: Hold a meeting to review safety incidents and improvements.

Subject Title: Mini Project

PROJ2	BTSFP707	Mini Project	0-0-6	Credit 3
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Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

In this subject head, it is expected that the student should complete the following tasks.

1. Identify problem statement / idea which is solving one problem preferably local problem may be in their University / College / nearby vicinity.
2. Do the literature survey,
3. Design the solutions
4. Implement solution using latest technology
5. Write 20-25 pages report using latex
6. Present / demonstrate the solution in front of faculty member

Subject Title: Drill -V

LC5	BTSFD710	Drill –V	0-0-2	Credit 1
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Teaching Scheme:	Examination Scheme:
Lecture: 4 hrs./week	Continuous Assessment: 50 Marks

Practical syllabus based on Standard Drill Manual and Code & Practice.

Books Recommended:

1. Fire Service Manual U. K.
2. NFPA U. S. A.
3. Drill Manual India

SEMESTER VIII

PROJ4	BTSFP801	Internship or Project work	0-0-24	Credit 12
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Teaching Scheme:	Examination Scheme:
Lecture: 24 hrs./week	Continuous Assessment: 100 Marks Mid Semester Exam: --- End Semester Exam: 300 Marks (Duration 03 hrs.)