School of Advanced Engineering

B. Tech in Fire & Safety Engineering

Specializations: Risk Analysis/Disaster Management/Environment

Programme Handbook

2023-27

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Contents

1.0 Abbreviations

Cat	-	Category
Cr	-	Credits (*A credit is equivalent to one lecture hour/ one hour of tutorial/ two hours of Laboratory)*
L	-	Lecture
T	-	Tutorial
P	-	Practical
ENGG	-	Engineering Sciences (including General, Core)
HUM	-	Humanities (including Languages, Social Sciences, and others)
SCI	-	Basic Sciences (including Mathematics)
PRJ	-	Project Work (including Seminars, Dissertation, and Internships)
PE	-	Program Elective (includes Specialization courses)
TC	-	Total Credits
FSE	-	Fire & Safety Engineering
CT	-	Critical Thinking
EVS	-	Environment Science
CHE	-	Chemical Engineering
CHY	-	Chemistry
CSE	-	Computer Science and Engineering
CVL	-	Civil Engineering
CUL	-	Cultural Education
EAC	-	Electronics and Computer Engineering
ECE	-	Electronics and Communication Engineering
EEE	-	Electrical and Electronics Engineering
ELC	-	Electrical and Computer Engineering
MAT	-	Mathematics
MEE	-	Mechanical Engineering
PHY	-	Physics
UE	-	University Elective (includes Signatory, Exploratory and Open Electives)

2.0 Director/ Dean Message

3.0 Vision and Mission of the University:

Vision of UPES

To be an Institution of Global standing for developing professionally competent talent contributing to nation building.

Mission of UPES

- Develop industry-focused professionals with an international outlook.
- Foster effective outcome-based education system to continually improve teaching-learning and research.
- Inculcate integrative thought process among students to instill lifelong learning.
- Create global knowledge eco-system through training, research & development, and consultancy.
- Practice and promote high standards of professional ethics and develop harmonious relationship with environment and society.

4.0 Vision and Mission of the School

Vision of School

To be a forerunner in engineering education by delivering excellent engineering graduates fortified with sound knowledge and integrity, by performing cutting-edge research and by innovating new technologies to benefit the nation and the world at large.

Mission of School

- To develop industry focused engineers with expertise in the areas of oil and gas, energy, infrastructure, transportation, electronics, automotive design and aviation.
- To sustain a strong focus on delivering excellent engineering and science education by providing an exposure to the concurrent research and industry trends and by employing innovative pedagogy tools/ techniques.
- To promote research, technology incubation and entrepreneurship to address the most pressing needs of our society and nation.
- To maintain a professional and ethical environment conducive to the intellectual growth of faculty and students, fostering communication, dialogue and sharing of ideas.
- To strengthen our linkages with academic institutes worldwide, industry and alumni network for evolving our programs towards better student outcomes.

5.0 About the Cluster/ Department/ Centre

The Sustainability Cluster, formerly known as the HSE & Civil Engineering Department, is a dynamic academic department committed to providing a diverse range of educational programs in the fields of Occupational Health, Safety, Fire, Civil, and Sustainability Engineering. Offering graduate, postgraduate, and PhD degrees, the department caters to students aspiring to become professionals in the intersection of engineering in safety, civil, and sustainability. The undergraduate and postgraduate curriculums are designed to lay strong foundations in the areas of health, safety, fire, environment, civil & sustainability. Our advanced electives, along with hands-on training on live projects, prepare our students to solve challenges that go beyond the scope of traditional engineering.

Since its inception, this program has enabled students to gain highly sought-after technical & professional skills, grooming them into the most desired professionals in the industry. The cluster has a team of strong full-time faculty with sound academic and industry backgrounds. Our Alumni are working across the world with various organizations of excellent repute. Since the inception of this program, students have been well-placed in various jobs in core sectors, with lucrative remunerations. These programs have rich science and engineering delivery which helps students develop their professional & technical skills and can provide their input to the organizations wherever they are working. The strong industrial connection of this cluster gives an advantage to our students for their onsite exposure and timely completion of the industrial internship/project work. The overall aim of this cluster is to impart quality education along with the overall development of the students. This cluster has five student chapters/clubs such as Green Up Club, American Society of Safety Professionals (ASSP), Fire & Security Association of India (FSAI), American Society of Civil Engineers (ASCE), and Indian Green Building Council (IGBC) to engage students in their personal & professional career developments.

Research Focus

S.NO	CORE	RESEARCH AREAS
1.	Safety Engineering	Process Safety, Risk Analysis, Construction Safety, Human Factors and Behaviour Based Safety, Engineering, Fire Safety, Computational Fire Modelling (FDS), Occupational Health and Safety
2.	Environmental Engineering	Air, Water, Soil and all topics pertaining to UNSDG.
3.	Civil Engineering	Water Resources Engg., Transportation Engg., Geotechnical Engg., and Structural Engg.

6.0 Programme Overview

The B. Tech. in Fire & Safety Engineering program offered by UPES School of Advanced Engineering aims to equip students with comprehensive knowledge and skills in various aspects of risk assessment, accident investigation, and safety strategies development for a diverse range of projects. The program is designed to produce industry-ready professionals who can effectively handle fire and safety challenges in different settings. This is achieved through a well-structured curriculum that includes specialized courses such as fire hazards and forensics, structural fire protection design, fire risk assessment & planning, real-time risk reduction dynamics, functional safety through AI/ML, fire modeling, and simulation, as well as the development of modern safety gear.

The program prides itself on having a faculty comprised of experienced experts from nationally recognized institutions and foreign universities. This ensures that students receive high-quality education and exposure to international best practices in the field of fire and safety engineering. Graduates of this program are in high demand by industries as "Safety Officers" and "Fire and Safety Officers," as they are mandated under the Factories Act 1948 of India. Their expertise is essential in ensuring workplace safety, minimizing accidents, and enhancing overall work efficiency and company profitability.

The success of UPES fire & safety engineering graduates can be seen through their widespread employability across leading industries and firms in India and abroad. With their specialized knowledge and skills, they are well-equipped to take on critical roles in fire and safety management, thus contributing significantly to the safety and well-being of organizations and communities. Overall, the B. Tech. in Fire & Safety Engineering program at UPES School of Advanced Engineering stands out as an excellent choice for aspiring professionals seeking to make a positive impact in the field of fire and safety engineering.

7.0 Programme Educational Objectives for B. Tech. FSE

1. Graduates will provide solutions to various multi-disciplinary Fire and Safety problems through application of analytical and managerial skills.
2. Graduates will contribute to societal development through sustainable, professional and ethical decisions.
3. Graduates will have higher order thinking and leadership skills to become technological leaders of tomorrow.
4. Graduates will have tendency to pursue higher education, become entrepreneur and/or contribute innovative research in technological development.

8.0 Programme Outcome and Programme Specific Outcomes

Programme Outcomes (POs)

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs)

1. Develop analytical skills to solve problems related to fire, safety, occupational health and environment in various industries/organizations.
2. Design and operation of various firefighting, safety, and environmental monitoring, analysis and control tools.
3. Apply basic fire and safety concepts to design, computational model, operation, legal compliance and develop safety culture in various industries.

9.0 Academic Integrity Policy

a. University Integrity Policy

b. Course integrity policy

10.0 Overview of Credit Allocation/ Credit Break up

Category-wise Credit distribution

Category	Number of Credits
Major Core (MC)	
Basic Sciences - Core (SCI)	17
Engineering Sciences - Core (ENGG)	78
Signature courses (SC)*	06
Life Skill Courses (LSC)*	15
Exploratory Courses (EC)*	18
Humanities (HUM)	00
Projects (PRJ)	16
Mandatory Non-Credit Courses (NCC)	00
Major Elective (ME)	15
Total	165

* Electives

- Major core subjects include those subjects that are mandatory for all similar programmes and program specific courses. To be eligible for the degree, students must successfully finish each of the courses.
- Major elective courses provide the students the opportunity to study courses that are more complex and specialized, in their field of specialization.

Major Core (BSE)		**Total number of Credits: 17 Credits**			
Course Code	**Course Title**	**L**	**T**	**P**	**TC**
MATH1050	Engineering Mathematics I	3	1	0	4
PHYS1002	Physics	3	1	0	4
PHYS1102	Physics Lab	0	0	1	1
MATH1051	Engineering Mathematics II	3	1	0	4
CHEM1013	Chemistry	3	0	0	3
CHEM1113	Chemistry Lab	0	0	1	1
				Total Credits	**17**

Major Core (BE)	Total number of Credits: 78 Credits				
Course Code	**Course Title**	**L**	**T**	**P**	**TC**
MEPD1003	Workshop Practices	1	0	1	2
MECH1001	Engineering Graphics	1	0	1	2
CSEG1008	Object Oriented Programming	3	0	0	3
CSEG1108	Object Oriented Programming Lab	0	0	1	1
MECH1008	Basic of Mechanical Engineering	2	0	0	2
MECH1002	Engineering Mechanics	3	0	0	3
ECEG1004	Basic Electrical and Electronics Engineering	3	0	0	3
ECEG1104	Basic Electrical and Electronics Engineering Lab	0	0	2	1
MECH2066	Fluid Mechanics	2	0	0	2
MECH2123	Fluid Mechanics Lab	0	0	2	1
MECH2067	Thermodynamics & Analytical Instruments	2	1	0	3
HSFS2022	Fundamentals of Fire Engineering	3	0	0	3
HSFS2003	First Aid and Emergency Procedure	2	0	0	2
HSFS2023	Behaviour Based Safety	2	1	0	3
CSEG2049	Programming in Python	0	0	2	1
MECH2068	Strength of Material	2	0	0	2
MECH2168	Strength of Material Lab	0	0	2	1
HSFS2024	Planning and Design of Fire Protection Systems	2	1	0	3
HSFS2117	Safety Engineering Lab	0	0	2	1
HSFS 3004	Occupational Safety and Industrial Hygiene	3	0	0	3
HSFS2118	Industrial Hygiene Lab	0	0	2	1
HSFS2025	Principles of Engineering Design	2	0	0	2
CIVL2035	Problem Solving using MATLAB	0	0	2	1
HSFS3045	Unit Operations in Chemical Engineering	2	0	0	2
HSFS3129	Fire Engineering Lab	0	0	2	1
HSFS3047	Legal Aspects of Environment, Health & Safety	2	0	0	2
HSFS3046	Structural Fire Protection Design	2	1	0	3
HSFS3128	Fire Safety Field Training	0	0	2	1

HSFS3010	Environmental Eng. & Management	2	1	0	3
HSFS3110	Environmental Eng. Lab.	0	0	2	1
HSFS3049	Construction Safety and Management	3	0	0	3
HSFS3050	Hazard Identification and Risk Analysis	2	1	0	3
HSFS4018	Electrical System Safety and its Design	3	0	0	3
CHEM4022	Chemical Technology & Reaction Eng.	2	0	0	2
HSFS4034	Fire Risk Assessment & Planning	2	1	0	3
ECEG4039	Process Instrumentation & Control Engineering	2	0	0	2
HSFS4030	Safety in Transportation Sector	2	0	0	2
HSFS4022	Leadership in Safety	0	0	2	1
				Total Credits	**78**

Signature courses (SC)		**Total Number of Credits: 6 Credits**			
Course Code	**Course Title**	**L**	**T**	**P**	**TC**
SLSG0102	Critical Thinking and Writing	2	0	0	2
SSEN0101	Environment Sustainability & Climate Change	2	0	0	2
SSEN0102	Environment Sustainability & Climate Change (Living Lab)	0	0	2	2
				Total Credits	**6**

Life Skill Courses (LSC)		**Total Number of Credits: 15 Credits**			
Course Code	**Course Title**	**L**	**T**	**P**	**TC**
SLLS0101	Living Conversations	2	0	0	2
SLSG0102	Critical Thinking	2	0	0	2
SLSG0103	Technologies of the Future	2	0	0	2
SLLS0201	Design Thinking	2	0	0	2
SLSG0104	Meta 101	1	0	0	1
SLLS0202	Working with Data	2	0	0	2
SLLS0103	Leadership & Teamwork	2	0	0	2
SLSG0205	Start your Start-up	2	0	0	2
				Total Credits	**15**

Projects (PRJ)					**Total Number of Credits: 16 Credits**
Course Code	**Course Title**	**L**	**T**	**P**	**TC**
PROJ3149	Capstone -I	2	0	0	2
PROJ4135	Research Project-I	1	0	2	2
PROJ4138	Capstone II	2	0	0	2
PROJ4141	Research Project-II	0	0	16	8
INDT3105	Industrial Visit				1
INDT4104	Industrial Internship	0	0	0	1
				Total Credits	**16**

Mandatory Non-Credit Courses					**Total Number of Credits: 0 Credits**
Course Code	**Course Title**	**L**	**T**	**P**	**TC**
EMPL002	EDGE-SoftSkills	0	0	0	0
EMPL003	EDGE – Advance Communication	0	0	0	0
EMPL004	EDGE – Advance Communication II	0	0	0	0
SLLS2001	Social Internship	0	0	0	0
				Total Credits	**0**

Exploratory Courses (EC)					**Total Number of Credits: 18 Credits**
	Exploratory 1	3	0	0	3
	Exploratory 2	3	0	0	3
	Exploratory 3	3	0	0	3
	Exploratory 4	3	0	0	3
	Exploratory 5	3	0	0	3
	Exploratory 6	3	0	0	3
				Total Credits	**18**

Major Electives (Specialization I)					**Total Number of Credits: 3 Credits**
Course Code	**Course Title**	**L**	**T**	**P**	**TC**
SUEN2009P	Sustainability Engineering	3	0	0	3

				Total Credits	**3**
Major Electives (Specialization II)		**Total Number of Credits: 3 Credits**			
Course Code	**Course Title**	**L**	**T**	**P**	**TC**
HSFS3048P	Process Safety and Security	3	0	0	3
				Total Credits	**3**
Major Electives (Specialization III)		**Total Number of Credits: 3 Credits**			
Course Code	**Course Title**	**L**	**T**	**P**	**TC**
HSFS3051P	Water Security, Refugee Health and Sanitation	3	0	0	3
HSFS3052P	Shelter and Settlement in Disaster	3	0	0	3
HSFS3053P	Environmental Surveillance and One Health	3	0	0	3
HSFS3054P	Environment Toxicology and Risk Assessment	3	0	0	3
HSFS3055P	Human Factors Engineering	3	0	0	3
CSEG3013P	Modelling and Simulation	3	0	0	3
				Total Credits	**3**
Major Electives (Specialization IV)		**Total Number of Credits: 3 Credits**			
Course Code	**Course Title**	**L**	**T**	**P**	**TC**
HSFS4035P	Emergency Response and Disaster Management Plan	3	0	0	3
HSFS4036P	Natural and Man-Made Disasters	3	0	0	3
HSFS4037P	Environmental Monitoring and Assessment	3	0	0	3
HSFS4038P	Environmental Impact Assessment	3	0	0	3
HSFS4039P	Fluid Power Safety	3	0	0	3
HSFS4040P	Probability and Reliability Engineering	3	0	0	3
				Total Credits	**3**
Major Electives (Specialization V)		**Total Number of Credits: 3 Credits**			
Course Code	**Course Title**	**L**	**T**	**P**	**TC**
HSFS4041P	Search & Rescue Operation	3	0	0	3

HSFS4042P	Explosive Safety	3	0	0	3
CIVL4085P	Wastewater Engineering	3	0	0	3
CSEG4031P	Modelling and Simulation	3	0	0	3
HSFS4043P	Safety in Engineering Industry	3	0	0	3
HSFS4044P	Fire Toxicology and Forensic	3	0	0	3
				Total Credits	**3**

11.0 Programme Structure

Semester I:

Cat	Course Code	Course Title	L	T	P	TC	Prerequisites
	SLSG0102	Critical Thinking	2	0	0	2	
	SSEN0101	Environment Sustainability & Climate Change	2	0	0	2	
	MATH1051	Engineering Mathematics I	3	1	0	4	12th level Mathematics
	PHYS1002	Physics	3	1	0	4	12th level Physics
	MEPD1003	Workshop Practices	1	0	1	2	
	PHYS1102	Physics Lab	0	0	1	1	Basic knowledge on practical Physics (12th level) for understanding and performing experiments.
	MECH1001	Engineering Graphics	1	0	1	2	The knowledge of simple geometrical theorem and procedures is essential.
	CSEG1008	Object Oriented Programming	3	0	0	3	Knowledge of the English Language
	CSEG 1108	Object Oriented Programming Lab	0	0	1	1	Basic Knowledge of Computer Science
						Semester Credits	

Semester II:

Cat	Course Code	Course Title	L	T	P	TC	Prerequisites
	SLLS0101	Living Conversations	2	0	0	2	
	SSEN0102	Environment Sustainibility & Climate Change (Living Lab)	0	0	2	2	
	MATH1051	Engineering Mathematics II	3	1	0	4	Engineering Mathematics-I
	CHEM1013	Chemistry	3	0	0	3	12th level Chemistry
	MECH1008	Basic of Mechanical Engineering	2	0	0	2	Physics, Mathematics and Engineering Mechanics
	MECH1002	Engineering Mechanics	3	0	0	3	Basic Knowledge of physics and Mathematics
	ECEG1004	Basic Electrical and Electronics Engineering	3	0	0	3	Physics, Chemistry and Mathematics
	CHEM1113	Chemistry Lab	0	0	1	1	
	ECEG1104	Basic Electrical and Electronics Engineering Lab	0	0	2	1	
						Semester Credits	

Semester III:

Cat	Course Code	Course Title	L	T	P	TC	Prerequisites
	SLLS0201	Design Thinking	2	0	0	2	Knowledge of analyzing society problems and product usage problems
	SLLS2001	Social Internship	0	0	0	0	Knowledge of Basic English
		Exploratory 1	3	0	0	3	
	MECH2066	Fluid Mechanics	2	0	0	2	Physics, Mathematics and Engineering Mechanics
	MECH2067	Thermodynamics & Analytical Instruments	2	1	0	3	Basic knowledge of Physics and

							Mathematics (Trigonometry and Calculus)
	HSFS2022	Fundamentals of Fire Engineering	3	0	0	3	Basics of Thermo-Dynamics & Heat Transfer
	HSFS2003	First Aid and Emergency Procedure	2	0	0	2	Basic knowledge of Physics, Chemistry and Biology
	MECH2123	Fluid Mechanics Lab	0	0	2	1	Knowledge of Fluid Mechanics
	HSFS2023	Behavior Based Safety	2	1	0	3	Basics of Safety Engineering, Awareness on right communication
	CSEG2049	Programming in Python	0	0	2	1	Basic Computer Knowledge
						Semester Credits	

Semester IV:

Cat	**Course Code**	**Course Title**	**L**	**T**	**P**	**TC**	**Prerequisites**
	SLLS0202	Working with Data	2	0	0	2	
		Exploratory 2	3	0	0	3	
	HSFS 3004	Occupational Safety and Industrial Hygiene	3	0	0	3	Basic Knowledge of First-Aid and Industrial Safety
	MECH2068	Strength of Material	2	0	0	2	Basic Knowledge of Mechanics
	HSFS2024	Planning and Design of Fire Protection Systems	2	1	0	3	Fundamentals of Fire Engineering
	HSFS2117	Safety Engineering Lab	0	0	2	1	Basic knowledge of safety engineering
	HSFS2118	Industrial Hygiene Lab	0	0	2	1	Basic knowledge of occupational health and safety

	MECH2168	Strength of Material Lab	0	0	2	1	Basic Knowledge of Engineering Mechanics
		Specialization-I	3	0	0	3	
	HSFS2025	Principles of Engineering Design	2	0	0	2	Basic Knowledge of Mechanics and Engineering Graphics
	CIVL2035	Problem Solving using MATLAB	0	0	2	1	
						Semester Credits	

Semester V:

Cat	Course Code	Course Title	L	T	P	TC	Prerequisites
	SLLS0103	Leadership & Teamwork	2	0	0	2	
		Exploratory 3	3	0	0	3	
	HSFS3045	Unit Operations in Chemical Engineering	2	0	0	2	Basic Knowledge of Law of physics, mathematics, and chemistry.
	HSFS3129	Fire Engineering Lab	0	0	2	1	Basic knowledge of Process and its Types.
	HSFS3047	Legal Aspects of Environment, Health & Safety	2	0	0	2	Basic knowledge of legal jurisdiction.
	HSFS3046	Structural Fire Protection Design	2	1	0	3	Basics of science and engineering
	HSFS3128	Fire Safety Field Training	0	0	2	1	Basics of Fire Engineering
		Specialization-II	3	0	0	3	
	PROJ3149	Capstone -I	2	0	0	2	
						Semester Credits	

Semester VI:

Cat	Course Code	Course Title	L	T	P	TC	Prerequisites

	SLSG0205	Start your Start-up	2	0	0	2	Basic knowledge about having an idea to start with
		Exploratory 4	3	0	0	3	
	HSFS3010	Environmental Eng. & Management	2	1	0	3	Basic knowledge of physics, chemistry, and natural resources
	HSFS3110	Environmental Eng. Lab.	0	0	2	1	Basic Knowledge on Physics, Chemistry, and environment
	INDT3105	Industrial Visit				1	
	HSFS3049	Construction Safety and Management	3	0	0	3	Fundamental safety at the workplace and basic knowledge legal laws related to safety
	HSFS3050	Hazard Identification and Risk Analysis	2	1	0	3	Principles of safety management
		Specialization-III	3	0	0	3	
						Semester Credits	

Semester VII:

Cat	Course Code	Course Title	L	T	P	TC	Prerequisites
		Technologies of the future	3	0	0	3	
		Meta 101	0	0	4	2	
		Exploratory 5	3	0	0	3	
	HSFS4018	Electrical System Safety and its Design	3	0	0	3	Basic Knowledge of Electrical Circuits and Physics
	CHEM4022	Chemical Technology & Reaction Eng.	2	0	0	2	Knowledge of Unit Operations, Mass, and Energy Balance

	HSFS4034	Fire Risk Assessment & Planning	2	1	0	3	Knowledge of the basics of fire engineering
		Specialization-IV	3	0	0	3	
						Semester Credits	

Semester VIII:

Cat	Course Code	Course Title	L	T	P	TC	Prerequisites
		Exploratory 6	3	0	0	3*	
	ECEG4039	Process Instrumentation & Control Engineering	2	0	0	2	Knowledge of partial differential equations and transfer function
	HSFS4030	Safety in Transportation Sector	2	0	0	2	Brief Idea of Transportation Engineering and Rail Engineering.
	HSFS4022	Leadership in Safety	0	0	2	1	Knowledge of behavioural based safety and presentation skills
		Specialization-V	3	0	0	3	
	PROJ4141	Research Project-II	0	0	16	8	Fire Safety, Occupational Health and Safety and Environment related Subjects
						Semester Credits	

Specialization Tracks

The student must complete a minimum of 15 credits in the chosen area of specialization.

The students enrolled in B. Tech. Fire & Safety Engineering (4 year) would have an option to specialize in one the following emerging areas:

List of elective courses in specialization tracks

Major Elective 3 Credits						
Specialization-I						
Cat	Course Code	Course Title	L	T	P	TC
	SUEN2009P	Sustainability Engineering	3	0	0	3

Major Elective 3 Credits						
Specialization-II						
Cat	Course Code	Course Title	L	T	P	TC
	HSFS3048P	Process Safety and Security	3	0	0	3

Major Elective 3 Credits						
Specialization-III						
Cat	Course Code	Course Title	L	T	P	TC
	HSFS3051P	Water Security, Refugee Health and Sanitation	3	0	0	3
	HSFS3052P	Shelter and Settlement in Disaster	3	0	0	3
	HSFS3053P	Environmental Surveillance and One Health	3	0	0	3
	HSFS3054P	Environment Toxicology and Risk Assessment	3	0	0	3
	HSFS3055P	Human Factors Engineering	3	0	0	3
	CSEG3013P	Modelling and Simulation	3	0	0	3

Major Elective 3 Credits						
Specialization-IV						
Cat	Course Code	Course Title	L	T	P	TC
	HSFS4035P	Emergency Response and Disaster Management Plan	3	0	0	3
	HSFS4036P	Natural and Man-Made Disasters	3	0	0	3
	HSFS4037P	Environmental Monitoring and Assessment	3	0	0	3
	HSFS4038P	Environmental Impact Assessment	3	0	0	3
	HSFS4039P	Fluid Power Safety	3	0	0	3

	HSFS4040P	Probability and Reliability Engineering	3	0	0	3
Major Elective 3 Credits						
Specialization-V						
Cat	**Course Code**	**Course Title**	**L**	**T**	**P**	**TC**
	HSFS4041P	Search & Rescue Operation	3	0	0	3
	HSFS4042P	Explosive Safety	3	0	0	3
	CIVL4085P	Wastewater Engineering	3	0	0	3
	CSEG4031P	Modelling and Simulation	3	0	0	3
	HSFS4043P	Safety in Engineering Industry	3	0	0	3
	HSFS4044P	Fire Toxicology and Forensic	3	0	0	3

FSE Minor course requirement list

Students from other departments in the university have the option to take a minor degree from the Mechanical stream. The list of course requirements to obtain a Fire & Safety minor degree is as follows. Total credit for minor requirement is minimum 18.

Mandatory Courses- 18 Credits*			
Course Code	**Course Name**	**credit**	**Prerequisite**
	Behavior Based Safety	3	
	Process Safety and Security	3	
	Planning and Design of Fire Protection Systems	3	
	Structural Fire Protection Design	3	
	Construction Safety and Management	3	
	Fire Risk Assessment & Planning	3	
	Research Project	3+3 = 6	
*If a student has completed 'n' number of equivalent credits among the above three courses, as a part of major curriculum then 'n' number of credits should be taken extra from the optional courses			
Optional Courses- XX Credits**			
	Refrigeration and air conditioning		Thermodynamics
**Equivalent courses in the student's major discipline will not be counted towards minor requirement. Apart from these equivalent courses, the student has to complete optional course requirement			

12.0 List of Electives

A. Programme Electives

- **Specialization in Risk Analysis**

List of specializations:

1. Sustainability Engineering
2. Process Safety and Security
3. Human Factors Engineering
4. Modelling and Simulation
5. Fluid Power Safety
6. Probability and Reliability Engineering
7. Safety in Engineering Industry
8. Fire Toxicology and Forensic

- **Specialization in Disaster Management**

List of specializations:

1. Sustainability Engineering
2. Process Safety and Security
3. Water Sequrity, Refugee Health and Sanitation
4. Shelter and Settlement in Disaster
5. Emergency Response and Disaster Management Plan
6. Natural and Manmade Disaster
7. Search & Rescue Operation
8. Explosive Safety

- **Specialization in Disaster Management**

List of specializations:

1. Sustainability Engineering
2. Process Safety and Security
3. Environmental Surveillance and One Health
4. Environment Toxicology and Risk Assessment
5. Environmental Monitoring and Assessment
6. Environmental Impact Assessment
7. Wastewater Engineering
8. Modelling and Simulation

- **<u>Minor</u>**

  List of specializations:

1. Behavior Based Safety
2. Process Safety and Security
3. Planning and Design of Fire Protection Systems
4. Structural Fire Protection Design
5. Construction Safety and Management
6. Fire Risk Assessment & Planning
7. Research Project

B. University Electives

- **<u>Signature Courses- School for Life Courses/ Life Skill Courses</u>**

  Below is the list of courses offered as Signatory courses.

1. Critical Thinking and Writing
2. Environment Sustainability & Climate Change (Living Lab)
3. Environment Sustainability & Climate Change
4. Living Conversations
5. Technologies of the Future
6. Design Thinking
7. Meta 101
8. Working with Data
9. Leadership & Teamwork
10. Start your Start-up

- **<u>Exploratory Courses</u>**

  If the student takes up courses from different baskets, that is regarded as an exploratory course.

  List of Exploratory courses to be included below.

1. Exploratory 1
2. Exploratory 2
3. Exploratory 3
4. Exploratory 4
5. Exploratory 5
6. Exploratory 6

- **Open Elective**

  List of open elective courses to be included below.

1. EDGE-SoftSkills
2. EDGE – Advance Communication
3. EDGE – Advance Communication II
4. Social Internship

13.0 Course Syllabus/ Course Plans

Sample Course plan template-

SEMESTER I

Course Code	Course Name	L	T	P	C
SLLS 0101	Critical Thinking and Writing	2	0	0	2
Pre-requisites/Exposure	--				
Co-requisites	Not any				

Course Objectives

The objectives of this course are:

I. To introduce the essential tools and approaches of critical thinking.

II. To realize how several factors hinders the process of critical thinking and how to overcome them.

III. To understand and the various components and conventions of critical writing and create appropriate documents.

Course Outcomes:

Knowledge & Understanding:

After completing this course, you will be able to:

CO-1: Understand the importance of Critical Thinking in the process of decision making.

CO-2: Differentiate amongst the various tools and approaches of critical thinking; look at the world around objectively and critically.

CO-3: Critically analyze any text and communicate the inferences drawn after analysis; introspect and reflect on their thought processes; draw logical conclusions and identify the errors in reasoning.

CO-4: Articulate written documents demonstrating critical approaches with clear, structured and quality writing.

CO-5: Apply critical thinking to any provided information. Identify, understand and define the various arguments in different contexts

Catalog Description:

The ability to think clearly and rationally is important in whatever we choose to do. Critical thinking is the ability to think clearly and rationally about what to do or what to believe and includes the ability to engage in reflective and independent thinking. Critical Thinking and Writing skills are important to help one progress in their professional and personal life effectively. This course aims to introduce the various tools and methods available to develop critical thinking. It will equip students to utilize critical thinking concepts and strategies in learning, and apply those skills for effective written communication, thus developing the ability to think critically and communicate effectively.

Course Content

Unit I Food for Thought: What is Critical Thinking? 02 lecture hours

Introduction to the course, its importance and its application in life. Focus is given on the Trolly problem and how it can never be solved.

Unit II Learning how to learn: Cognition and Metacognition 02 lecture hours

The highlight of this unit would be learning strategies and the development of Bloom's Taxonomy. This leacture based class will focus on education and learning challenges faced by students across South Asia and how to overcome them.

Unit III How to not judge a book by its cover: Cognitive biases 02 lecture hours

Flagging the problems with assumptions in our everyday functioning, this class will highlight the various kinds of biases and how it effects our understanding of issues when it comes to problem solving.

Unit IV Writing to read 08 lecture hours

Introduction to various aspects of writing and highlighting how one is different from the other. Understanding of capital letters and syntaxes will be another focus of these classes.

Unit V The Social, The Historical, and the Political Aspects of Reasoning 02 lecture hours

Introduction to inductive and deductive reasoning and its relevance when understanding how information is passed on to.

Unit VI Explanation, Justification, Persuasion 04 lecture hours

Explanation, Justification, Persuasion are three distinct critical thinking tool to convey information, support arguments, or influence others in various contexts.

Unit VII Fact, Truth, and Misinformation **02 lecture hours**

Based in accuracy and reliability of information, this unite with focus on assertion of statement that can be objectively verified and proven to be true or false depending upon the situation. It is important to be critically evaluate information to differentiate one from the other.

Unit VIII Critical Consumption **02 lecture hours**

Focusing on critical media consumption, this unit focuses on the contemporary forms of information consumption. It involves being actively aware if potential biases, misinformation, and the credibility of sources in the age of digital media.

Unit IX POV: Perspective Taking **02 lecture hours**

This unit focuses on the Cognitive and empathetic process in which an individual tries to understand and empathise with the thoughts, feelings, beliefs, and experiences of the other person or group from their point of view. Perspective taking is an important aspect of empathy and interpersonal communication aiding critical thinking

Unit X Ethical Dilemma **02 lecture hours**

The focus of this unit will be on the complex moral decision that involves conflicting values, principles, or interests. In such instances there is no clear or obvious choice to arrive at a conclusion

Text Books / Reference Books:

Textbooks

1. Vaughn, Lewis (2005). The Power of Critical Thinking: Effective Reasoning About Ordinary and Extraordinary Claims. New York: Oxford University Press USA.
2. Hughes, William (2015). Critical thinking: an introduction to the basic skills. Tonawanda, NY: Broadview Press. Edited by Katheryn Doran & Jonathan Allen Lavery.
3. West, Andrew (2014). Ubuntu and Business Ethics: Problems, Perspectives and Prospects. Journal of Business Ethics 121 (1):47-61.

Journals and Articles (Will Be Uploaded On Lms)

1. Yu, Shiyang & Zenker, Frank (2020). Schemes, Critical Questions, and Complete Argument Evaluation. Argumentation 34 (4):469-498.
2. Davies, Richard (2020). In Defence of a Fallacy. Studia Semiotyczne 34 (2):25-42.
3. Lumer, Christoph (2019). Recognizing Argument Types and Adding Missing Reasons. In Bart J. Garssen, David Godden, Gordon Mitchell & Jean Wagemans (eds.), Proceedings of

the Ninth Conference of the International Society for the Study of Argumentation (ISSA). [Amsterdam, July 3-6, 2018.]. Amsterdam (Netherlands): pp. 769-777.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class writing assignment and participation	Quiz 1	Quiz 2	Writing assignment
Weightage (%)	10	30	30	30

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	-	1	-	1	1	-	-	-	-	-	-	-	-
CO2	2	2	1	-	-	1	1	-	-	-	-	-	-	-	-
CO3	2	1	1	-	-	-	1	-	-	-	-	-	-	-	-
CO4	2	-	1	-	-	1	1	-	-	-	-	-	-	-	-
CO5	3	2	-	2	-	-	-	-	-	-	-	-	-	-	-
Avg	2	1.2	1	1.2	-	1	1	-	-	-	-	-	-	-	-

1 = Weakly Mapped, 2 = Moderately Mapped, 3 = Strongly Mapped

Course Code	Course Name	L	T	P	C
SLLS 0102	Life Skill 2 (Learning How To Learn)	2	0	0	2
Pre-requisites/Exposure	--				
Co-requisites	Not Any				

Course Objectives:

I. To facilitate the process of inquiry through a need to know and explore a wide variety of subject matter that may or may not be linked to the learners chosen specialism or area of interest.

II. To analyze and understand how learning takes place using both cognitive and motor skills.

III. To appreciate that the learning process is as important as the content.

IV. To develop the knowledge and skills of becoming a competent learner.

Course Outcomes:

Knowledge & Understanding:

After completing this course, you will be able to:

CO-1: Define the basic qualities of a life-long learner.

CO-2: Understand the process and elements of inquiry-based learning.

CO-3: Identify, contextualize and discuss the learning tools needed to be a lifelonglearner of diverse subjects and self-driven goal-oriented learning.

CO-4: Respond to new learning content and develop concepts using the understandingof the learning process and tools.

Skills and Attributes:

CO-5: Use a range of basic inquiry-based techniques to draw on appropriate sources inthe development of a response to a problem.

CO-6: Choose and employ appropriate practice tools in the execution of a project/coursework.

CO-7: Critique and articulate responses to project work undertaken by self and byothers.

Catalog Description:

This course explores and attempts to equip learners to become conscious about the learning process beyond the cognitive functions of knowledge, understanding and application ofsubject content. It aims at enabling students to consciously use curiosity, deductive reasoning,inquiry, perspective and argument in exploring a variety of diverse subjects and theories thereby developing a lifelong learning habit.

Course Content

Unit I LEARNING THROUGH INQUIRY 8 lecture hours

Elements of inquiry based learning: question, investigate, use evidence (to describe, explain, and predict), evaluation and response/findings.

Types of inquiry: Confirmation inquiry, Structure enquiry, Guided inquiry andOpen inquiry.

Unit II THE LEARNING PROCESS 6 lecture hours

Interactive components of the learning process: attention, memory, language,processing and organizing, writing and synthesizing.

Unit III LEARNING TOOLS 6 lecture hours

Basic tools that help learning: reading, writing/annotating, exploring, experiencing, experimenting, applying, practicing, memorizing.

Exploring learning tools: Focused modes of thinking, Chunking, Recall,Pomodoro Technique, Journaling

Unit IV COLLABORATIVE LEARNING 6 lecture hours

Learning through peer and self-exploration of diverse and challenging subject

Developing the lifelong learner, Self-driven goal oriented learning

Unit V PROJECT AND E- PORTFOLIO SUBMISSION 4 lecture hours

Text Books / Reference Books:

1 Stanley, J. (2011). ***Know How.*** Oxford University Press. ISBN: 9780199695362**.**

2 Oakley, B. (2017). ***Mindshift: Break Through Obstacles to Learning and DiscoverYour Hidden Potential.*** TarcherPerigee (Amazon/Kindle Ed.)

Reference Books

1. Kosslyn, S.M., & Rosenberg, R.S. (2007). **Psychology in Context**. Pearson. ISBN:

9780205507573

2. Minskey, M. (1986). **The Society of the Mind.** Simon & Schuster. ISBN: 978-0671657130

Journals and Articles (Will be uploaded on LMS)

https://www.emeraldgrouppublishing.com/sites/default/files/2020-01/ejournal-subject-brochure-HRLOS_0.pdf

Web Sources

TED Talks:

1. The Life Long Learner – Bernie Dunlap
2. The Nerd's Guide to Learning Everything Online – John Green
3. How to learn a new language: 7 secrets from TED Translators

Modes of Evaluation: Quiz +e-portfolio + project

Examination Scheme:

Components	QUIZ	E-PORTFOLIO	PROJECT	Total
Weightage (%)	20%	30%	50%	100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1						-			-			3			
CO2						3			3			3			
CO3						3			3			3			
CO4						3			3			3			
CO5						3			3			3			
CO6						3			3			3			
CO7						3			3			3			
Avg						3			3			3			

1 = Weakly Mapped, 2 = Moderately Mapped, 3 = Strongly Mapped

Course Code	Course Name	L	T	P	C
MATH 1050	Engineering Mathematics I	3	1	0	4
Pre-requisites/Exposure	Mathematics up to class XII				
Co-requisites	Not Any				

Course Objectives

I. To enable the students apply matrix theory in engineering problems.
II. To help the students develop the skills related to multivariate calculus.
III. To enable the students understand the application of vector calculus in engineering problems.
IV. To enable students approximate the function of one variable by infinite series.

Course Outcomes

On completion of this course the students will be able to

CO-1: Find the solution of a system of linear equations.

CO-2: Apply the techniques to handle the functions of several variables for calculus.

CO-3: Demonstrate the basic concepts of vector calculus with relevant applications.

CO-4: Find the infinite series approximation of a periodic and non-periodic function of one variable.

Catalog Description

Mathematics is a natural complementary discipline for learning, understanding and appreciating many fundamental science and engineering concepts. It helps us to develop logical thinking and also to find the right way to solve problems. The purpose of this courseis to provide participants with the skills, knowledge required to perform fundamental mathematical procedures and processes for solution of engineering problems, particularly the use of matrices, multivariable calculus, vector calculus. The approximation techniques for periodic and non-periodic functions using infinite series are important for engineering disciplines while matrices are foundations for computer science.

Course Content

Unit I MATRICES **12 Lectures hours**

Elementary transformation, Inverse of matrix, linearly independent vectors, rank of a matrix, solution of system of linear equations, Eigenvalues and Eigenvectors, characteristic equation, Cayley-Hamilton Theorem, Diagonalization of matrices, Orthogonal transformation and quadratic to canonical forms.

Unit II MULTIVARIABLE CALCULUS **15 Lectures hours**

Partial derivatives, Euler's Theorem and its Applications, total derivative, Jacobians, extrema of functions of two variables, Method of Lagrange multipliers. Beta and gamma function, Multiple Integration: double and triple integrals, change of order of integration, change of variables, Applications: areas, volumes, center of mass and Gravity (constant and variable densities).

Unit III VECTOR CALCULUS **18 Lectures hours**

Vector and scalar functions and fields, Gradient of a scalar field, Directional derivative; Divergence and curl of a vector field. Line Integrals, Path Independence of Line Integrals; Surface Integral; Volume Integral, Applications of Green's theorem, Gauss' divergence theorem & Stoke's theorem.

Text Books

1. E. Kreyszig, Advanced Engineering Mathematics, Wiley Publications. ISBN: 9788126531356.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2000. ISBN: 8174091955
3. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publications. ISBN: 9788184875607.
4. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill. ISBN: 9780071070089.

Reference Books

1. N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2010. ISBN : 978-81-318-0803-0
2. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", Pearson, 2002. ISBN: 978-0201531749

3. T. Veerarajan, “Engineering Mathematics”, McGraw-Hill, New Delhi, 2008. ISBN: 978-0-07-061678-3
4. D. Poole, “Linear Algebra: A Modern Introduction”, Brooks/Cole, 2005. ISBN: 978-1285463247
5. V. Krishnamurthy, V. P. Mainra and J. L. Arora, “An introduction to Linear Algebra”, Affiliated East-West press, 2005. ISBN: 9780071070591

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	IA	MID SEM	End Sem	Total
Weightage (%)	30	20	50	100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	-	-	-	-	-	-	1	-	-	-
CO2	3	3	2	1	1	-	-	-	-	-	-	1	-	-	-
CO3	3	3	2	1	1	-	-	-	-	-	-	1	-	-	-
CO4	3	3	2	1	1	-	-	-	-	-	-	1	-	-	-
Avg	3	3	2	1	1	-	-	-	-	-	-	1	-	-	-

1. Weak 2. Moderate 3. Strong

Course Code	Course Name	L	T	P	C
PHYS 1020	Physics I	3	1	0	4
Pre-requisites/Exposure	12^{th} level Physics				
Co-requisites	12^{th} level Mathematics				

Course Objectives

I. To understand the concepts of Interference, Diffraction and Polarization and apply these concepts in performing measurements using optical devices such as grating, Newton's rings, etc.

II. To understand the fundamentals of LASER and its use as a light source as well as its applications in optical fiber communication, holography and sensing.

III. To apply the Maxwell equation to learn various properties of dielectric and magnetic materials.

IV. To construct a quantum mechanical model to explain the behavior of a system at the microscopic level.

Course Outcomes

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

CO-1: To recognize various optical phenomena such as interference, diffraction and polarization, and apply the knowledge in identifying and understanding optics based devices such as lasers and its significance in optical fiber communication.

CO-2: Understand the properties of dielectric and magnetic materials under the influence of electric and magnetic fields.

CO-3: To apply the fundamentals of Quantum Mechanics to understand behavior of microscopic objects.

Catalog Description

Almost all disciplines of engineering and technology have origins in basic principles of physics. In this course we will try to address the one of the most fundamental question i.e. what is light? This question will be treated in both classical and quantum framework along with their implications as well as limitations. The wave nature of light as well as some of its important applications such as polarization, lasers, optical communication etc. will be studied in first unit. The second unit deals with very important class of engineering materials namely di-electric and magnetic materials along with their wide range of application. In third unit the focus will be to develop an understanding of the origin of transverse and longitudinal waves. In the last part of the course we will systematically study the development of ‘modern physics’, more specifically the quantum mechanics. The theoretical development of wave mechanics their limitations along with their contribution to revolutionize the modern world will also be studied as part of the course.

Course Content

Unit I OPTICAL PHENOMENA AND TECHNOLOGIES 20 lecture hours

Diffraction: Introduction to interference and example; concept of diffraction, Fraunhoffer and Fresnel Diffraction, Fraunhoffer diffraction at single slit and multiple slits; diffraction grating, characteristics of diffraction grating and its applications. Polarization: Introduction Polarization by reflection, polarization by double refraction, scattering of light, circular and elliptical polarization, optical activity. Fiber Optics: Introduction, Optical Fiber as a dielectric wave guide, total internal reflection, numerical aperture and various fiber parameters, losses associated with optical fibers, step index and graded index fibers, applications of optical fibers. Lasers: Introduction to interaction of radiation with matter, principle of working of laser: population inversion, pumping, population inversion, types of lasers, application of lasers

Unit II FUNDAMENTALS OF ELECTROMAGNETISM 20 lecture hours

Laws of electrostatics, electric current and the continuity equation, laws of magnetism. Ampere’s Faraday’s laws. Maxwell’s equations. Polarisation, permeability and dielectric constant, polar and non-polar dielectrics, internal fields in a solid, Clausius-Mossotti equation, applications of dielectrics. Magnetisation, permeability and susceptibility, classification of magnetic materials, ferromagnetism, magnetic domains and hysteresis, applications.

Unit III EXPLORING QUANTUM PHYSICS 20 lecture hours

Introduction to quantum physics, black body radiation, explanation using the photon concept, photoelectric effect, Compton effect, de Broglie hypothesis, wave-particle duality, Born’s interpretation of the wave function, verification of matter waves, uncertainty principle, Schrodinger wave equation, particle in box, quantum harmonic oscillator, hydrogen atom.

Textbooks

1. Mehta N., (2009) Text Book of Engineering Physics Part-1. PHI Learning Pvt. Ltd. ISBN: 9788120333611.
2. Beiser A., Mahajn S., Chaudhury S. R., (2009) Concepts of Modern Physics, 6th ed. McGraw Hill Education Pvt. Ltd. ISBN: 9780070151550.
3. Vasudeva A.S., (2010) Modern Engineering Physics (Revised Edition), S. Chand & Company Ltd. ISBN: 9788121917575.
4. Jain A. K, Malik H. K., (2016) Engineering Physics, Tata McGraw-Hill Education Pvt. Ltd. ISBN: 9780070671539.

Reference Books

1 Griffith D.J. (2012) Introduction to Electromagnetics, PHI Learning, 4th edition, ISBN: 9780138053260

2. Pillai S.O., (2009) Solid State Physics, 6th ed. New Age International Pvt. Ltd. ISBN: 9781906574109.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	IA	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Program Outcomes (POs), Program Specific Outcomes and Course Outcomes (COs)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-	1	-	-	-
Avg	2.67	1.5	-	-	-	-	-	-	-	-	-	1	-	-	-

1=weakly mapped 2= Moderately mapped 3=Strongly mapped

Course Code	Course Name	L	T	P	C
ECEG-1004	Basic Electrical & Electronics Engineering	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	Not Any				

Course Objectives

I. Understand the characteristics of the basic electronic components like diode and transistor

II. Develop the application based circuits like switch, Rectifier by using Diode and transistor and also by logic gates.

III. Design DC-Power supply by using Rectifiers and Adders& Subtractors by using Logic Gates.

IV. Apply laws to solve the DC & AC Circuits.

V. Study the Constructional features, operation and characteristics of Electrical Machines

Course Outcomes

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

CO-1: Employ electronic and electrical components and devices to solve the Engineering problems.

CO-2: Analyze and make simple circuits and systems of Electrical and Electronics Engineering.

CO-3: Design the electrical system with discrete components and to understand the specifications of industrial equipment's.

CO-4: Design the electronics system with discrete components and to understand the specifications of industrial equipment's

Catalog Description

Electrical & Electronics is the integral part of life. The basic circuits used in day to day life are studied in this course. In this course, the main focus will be on the designing of basic electrical and electronics circuits like AC to DC converter by using diode, half adder, full adder etc. in Electronics and three phase system circuits in electrical. Students will learn how to use diode, transistor, Integrated circuit, AC machine and DC Machine in real time and develop circuits buy using them. Classroom activities will be designed to encourage students to play an active role in the construction of their own knowledge and in the design of their own learning strategies. We will combine traditional lectures with other active teaching methodologies, such as practical sessions, group discussions, and cooperative group solving problems. Class participation is a fundamental aspect of this course. Students will be encouraged to actively take part in all practical sessions to apply the devices and design the basic circuits.

Course Content

Unit I DIODES: CHARACTERISTICS AND APPLICATIONS 6 Lecture hours

Fundamental Characteristics of diode: Formation of P-N junction, I-V characteristics, half-wave rectifier circuits, full-wave rectifier circuits Zener and Avalanche breakdown; diode applications in voltage regulation clipper and clamper.

Unit II ELECTRICAL BASICS AND CIRCUITS 8 Lecture Hours

Resistance, inductance and capacitance, open circuit and short circuit, electrical power and energy; Voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with DC excitation. Superposition Thevenin and Maximum Power Transfer theorem.
Switch Fuse Unit (SFU), MCB, ELCB, MCCB; Types of Wires and Cables, Earthing; Elementary calculations for energy consumption, and battery backup.

Unit III TRANSISTOR AMPLIFICATION AND BIASING 8 Lecture Hours

Construction and operation, Transistor amplifying action, Amplification factors; Limits of operation, Applications of transistor DC-Biasing: Fixed bias DC-Biasing: Emitter bias, Voltage divider bias

Unit IV AC CIRCUITS AND POWER ANALYSIS 7 Lecture Hours

Representation of sinusoidal waveforms, peak and RMS values, phasor representation. Elementary analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations. Real power, reactive power, apparent power, power factor. Resonance Three-phase balanced circuits, voltage and current relations in star and delta connections.

Unit V DIGITAL LOGIC FUNDAMENTALS 8 Lecture Hours

Number system and codes Minimization techniques: Boolean logic operations,

Basic laws of Boolean algebra De Morgan's Theorems; Logic gates: AND, OR, NAND, NOR.

Adder and subtractor.

Unit VI TRANSFORMERS AND ELECTRIC MOTORS 8 Lecture Hours

Construction, Working Principle and Classification; Ideal and practical transformer, losses in transformers & efficiency; Classification of motors (AC), Classification of motors (DC), characteristics & applications of DC Motors

Text Books

1. Electrical & Electronics Engineering by K R Nazi, Genius Publication. ISBN: 9788188870137
2. Basic Electrical and Electronics Engineering, by J B Gupta S K Kataria and Sons.3rd Ed.

Reference Books

1. Basic Electrical Engineering by Chakrabarti, Tata McGraw Hill. ISBN: 9781259083365
2. Basic Electrical Engineering byU.A.Bakshi, V.U.Bakshi, ISBN: 9788184316940
3. A Text Book of Electrical Machines by Rajput, L P Publications. ISBN: 9788131804469
4. Basic Electronics By Santiram Kal,(2013): PHI
5. Digital Circuits & Logic Design By Salivahanan: Vikas Publishing House. ISBN 978-9325960411
6. Electronics Devices and Circuits By Boylestad & Nashelsky 10th ED : PEARSON: ISBN 978-8131727003

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	IA	MID SEM	End Sem	Total
Weightage (%)	30	20	50	100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	3	1	-	-	-	-	-	-	-	1	2	1	
CO 2	2	2	2	1	1	-	-	-	-	-	-	1	1	2	
CO 3	3	3	2	-	1	-	-	-	-	-	-	1	1	3	
CO4	3	3	2	-	1	-	-	-	-	-	-	1	1	3	
Avg	2.5	2.5	2.25	1	1	0	0	0	0	0	0	1	1.25	2.25	

1= Weakly mapped 2= Moderately mapped 3=Strongly mapped

Course Code	Course Name	L	T	P	C
PHYS-1122	Physics Lab	0	0	1	1
Pre-requisites/Exposure	Basic knowledge on practical Physics (12th level) for understanding and performing experiments.				
Co-requisites	Data interpretation and basic knowledge on graphical analysis.				

Course Objectives

I. To impart hand-on skills in performing experiments, data acquisition and interpretation of the data.

II. To design the circuits and study about various experimental procedures involved.

III. Significance of the experimental results to understand and verify theoretical formulation and prediction.

IV. To develop curiosity and creative ability through experimentation and investigation based on the virtual experiments.

Course Outcomes

CO-1: At the end of this course student should be able to

CO-2: Demonstrate the dual nature of light by verifying the various phenomena associated with it.

CO-3: Apply the concepts of electromagnetics to study the various electrical and magnetic properties of Materials.

CO-4: Evaluate and compare the universal constants by using the principle of modern physics.

CO-5: Design virtual Physics based experiments to illustrate the Hysteresis.

Catalog Description

The laboratory practice has been an important part of professional and engineering undergraduate education, an ideal platform for active learning. The purpose of the Physics practical sessions are to give students hands-on experience with the experimental basis of engineering physics and, in the process, to deepen their understanding of the relations between experiment and theory. The focus of this course is to improve the skills of the students in collecting, analyzing, interpreting and presenting findings and data.

Course Content

Experiment No: 01 SONOMETER

Aim: To determine the frequency of AC mains by using a sonometer.

Experiment No: 02 HALL EFFECT

Aim: To study the Hall effect and hence determine the Hall coefficient (R_h) and carrier density (n) of a given semiconductor material.

Experiment No: 03 FARADAY’S LAWS

Aim:

a. To study the induced emf as a function of velocity of the magnet passing through the coil (Faraday’s Law).
b. To study the charge delivered due to electromagnetic induction.

Experiment No: 04 CIRCULAR COIL

Aim: To study the variation of magnetic field with distance along the axis of a current carrying circular coil and hence estimate the radius of the coil.

Experiment No: 05 PHOTOELECTRIC EFFECT (VIRTUAL LAB)

Aim: To study the characteristics of photocurrent vs voltage at different frequency.

Experiment No: 06 NEWTON’S RINGS

Aim: To determine the wavelength of a given light by forming Newton’s Rings.

Experiment No: 07 DIFFRACTION GRATING

Aim: To determine the wavelength of a given light by using a Diffraction grating in its normal incidence position.

Experiment No: 08 OPTICAL FIBRE

Aim: To determine the Numerical Aperture of an optical fibre and study about the bending losses.

Experiment No: 09 PLANCK'S CONSTANT

Aim: To find the Planck's constant by using LEDs.

Experiment No: 10 PRESENTATION

Aim: Presentation related to any science concept.

Text Books

1. H. Singh, Practical Physics, S. Chand & Company LTD., ISBN: 8121904692.
2. S. L. Kakani, S. Kakani, Applied Physics-Theory & Practicals, Viva Books, ISBN: 9788130924892.
3. C. L. Arora, Practical Physics, S. Chand & Company LTD., ISBN: 9788121909099, 8121909090.

Reference Books

1. Gupta, Kumar, Practical Physics, Pragati Prakashan, ISBN: 9789386633569.
2. I. Prakash, R. Krishna, A. K. Jha, Practical Physics, Kitab Mahal, ISBN: 8122504167, 9788122504163
3. P. R. Sasi Kumar, Practical Physics, Prentice Hall of India Pvt Ltd, ISBN: 9788920344341

Modes of Evaluation: File /Viva-voce / presentation

Examination Scheme: Continuous Evaluation

Components	Continuous Assessment	Total
Weightage (%)		100

Relationship between the Program Outcomes (POs), Program Specific Outcomes and Course Outcomes (COs)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	-	-	-	-	-	-	-	-	1	-	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-	1	-	-	-
CO3	2	3	1	-	-	-	-	-	-	-	-	1	-	-	-
CO4	2	3	1	-	-	-	-	-	-	-	-	1	-	-	-
Avg	2	3	1	-	-	-	-	-	-	-	-	1	-	-	-

1. Weak Mapped 2. Moderate Mapped 3. Strong Mapped

Course Code	Course Name	L	T	P	C
Course Code ECEG 1104	Basic Electrical and Electronics Engg. Lab	0	0	2	1
Pre-requisites/Exposure					
Co-requisites	Not Any				

Course Objectives

I. Understand the characteristics of the basic electronic components like diode and transistor

II. Develop the application based circuits like switch, Rectifier by using Diode and transistor and also by logic gates.

III. Design DC-Power supply by using Rectifiers and Adders& Subtractors by using Logic Gates.

IV. Apply laws to solve the DC & AC Circuits.

V. Study the Constructional features, operation and characteristics of Electrical Machines

Course Outcomes

CO-1: Experimentally verify the basic circuit theorems

CO-2: Study the characteristics of different components, semiconductor devices and circuits used in electrical and electronics engineering applications.

CO-3: Create resonance condition in R-L-C series and parallel circuit and learn how to draw phasor diagram for the circuit.

CO-4: Develop the logic using digital circuits

Catalog Description

Electrical & Electronics is the integral part of life. The basic circuits used in day to day life are studied in this course. In this course, the focus will be on the designing of basic electrical and electronics circuits like AC to DC converter by using diode, half adder, full adder etc. in Electronics and single phase system circuits analysis in electrical. Students will learn how to use semiconductor devices like diodes and transistors and apply their knowledge in finding the applications of all devices. Class participation is a fundamental aspect of this course. Students will be encouraged to participate actively in all practical sessions to apply the devices and design the basic circuits.

Course Content

List of Experiment

Experiment No: 01 RESISTOR COLOR CODE (CO2)

To study Resistor Color Code and measure the values using multimeter and ammeter voltmeter connection in simple electrical circuit.

Link: https://www.allaboutcircuits.com/tools/resistor-color-code-calculator/

Experiment No: 02 VERIFYING CIRCUIT THEOREM (CO1)

To verify Thevenin's Theorem.

Link: http://vlabs.iitb.ac.in/vlabs-dev/labs_local/network_lab/labs/exp2/index.php

Experiment No: 03 VERIFYING CIRCUIT THEOREM (CO1)

To verify Superposition Theorem

Link: http://vlabs.iitb.ac.in/vlabs-dev/labs_local/network_lab/labs/exp1/index.php

Experiment No: 04 VERIFYING CIRCUIT THEOREM (CO1)

To verify the Maximum Power Transfer Theorem

Link: http://vlabs.iitb.ac.in/vlabs-dev/labs_local/network_lab/labs/exp3/index.php

Experiment No: 05 SINGLE PHASE CIRCUIT ANALYSIS (CO3)

To study the phenomenon of resonance in L-C-R series circuit

Link: https://vlab.amrita.edu/?sub=1&brch=75&sim=330&cnt=1

Experiment No: 06 SINGLE PHASE CIRCUIT ANALYSIS (CO3)

To study the phenomenon of resonance in LCR parallel circuits.

Link: https://vlab.amrita.edu/?sub=1&brch=75&sim=325&cnt=1

Experiment No: 07 ELECTRONICS COMPONENTS (CO2)

To study various electronic components (diode, resistor, transistor, capacitors, ICs, etc).

Link:

1. http://vlabs.iitkgp.ernet.in/be/exp1/index.html
2. http://vlabs.iitkgp.ernet.in/be/exp2/index.html
3. http://vlabs.iitkgp.ernet.in/be/exp3/index.html
4. http://vlabs.iitkgp.ernet.in/be/exp4/index.html

Experiment No: 08 ELECTRONICS COMPONENTS (CO2)

To plot V-I characteristics of PN junction diode.

Link: http://vlabs.iitkgp.ernet.in/be/exp5/index.html

Experiment No: 09 ELECTRONICS CIRCUITS (CO2)

To study half-wave and full-wave rectifier circuit.

Link: http://vlabs.iitkgp.ernet.in/be/exp6/index.html

Experiment No: 10 ELECTRONICS COMPONENTS (CO2)

To study the characteristics of NPN transistor in CE configuration.

Link: http://vlabs.iitkgp.ernet.in/be/exp11/index.html

Experiment No: 11 ELECTRONICS COMPONENTS (CO2)

To study the characteristics of NPN transistor in CB configuration.

Link: http://vlabs.iitkgp.ernet.in/be/exp12/index.html

Experiment No: 12 DIGITAL CIRCUITS (CO4)

Implementation of Half and Full Adder digital circuits.

Link:
http://hecoep.vlabs.ac.in/Experiment1/Theory.html?domain=ElectronicsandCommunications&lab=Hybrid%20Electronics%20Lab

Text Books:

1. Electrical & Electronics Engineering by K R Niazi, Genius Publication.ISBN:9788188870137
2. Basic Electrical and Electronics Engineering, by J B Gupta S K Kataria and Sons.3rd Ed.

Reference Books:

1. William H. Hayt, Jr. Jack E. Kemmerly, "Engineering Circuit Analysis" McGraw Hill Publication.
2. N.C. Jagan, "Network Analysis", BS Publication, Hyderabad, Second Edition.
3. Basic Electronics By Santiram Kal,(2013): PHI

Modes of Evaluation:

Examination Scheme:

Components	Continuous Evaluation
Weightage (%)	100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	-	-	3	2	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	2	2	-	-	-	-	-	-	-	-	3	-	-
CO3	-	-	3	1	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	2	-	-	-	-	-	-	-	-	3	-	-
Avg	-	-	2.75	1.75	-	-	-	-	-	-	-	-	3	-	-

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course Code	Course Name	L	T	P	C
CSEG 1108	Object Oriented Programming	3	0	0	3
Pre-requisites/Exposure	Knowledge of the English Language				
Co-requisites	Knowledge of Word processing using MS Word, basic IT skills				

Course Objectives

I. To help the students to understand and identify the functional units of a Computer System.

II. To enable students to understand the concepts of procedure oriented programming using C Language.

III. To empower students with the expertise of experimentation using C programming skills.

IV. To expose students with the ability to design programs involving decision structure, loops and functions.

V. To equip students with necessary engineering skills such as solving engineering problems through implementing concepts of arrays, pointers, structures and union in C programming language.

Course Outcomes

CO-1: At the end of this course student should be able to

CO-2: Comprehend the fundamentals of Computers with concepts of algorithm, flowcharts and develop efficient algorithms for solving a problem.

CO-3: Interpret the Control of flow statements and decision constructs with C programming techniques.

CO-4: Identify the various concepts of Programming like Arrays, Structures and Unions and Strings.

CO-5: Apply concepts of functions and pointers to resolve mathematical problems.

CO-6: Analyze the real life problem and write a program in ‘C’ language to solve the problem.

Catalogue Description

To enable students to understand the concepts of procedure oriented programming using C Language and empower students with the expertise of of experimentation using C programming

Course Outcome

Unit I FUNDAMENTALS OF COMPUTER SYSTEMS 9 Lecture hours

Introduction – Generation and classification of computers, Basic computer organization, Number system (Binary, Octal, Decimal, Hexadecimal conversion problems), Need for logical analysis and thinking, Algorithm, pseudocode, flowchart.

Unit II C PROGRAMMING FUNDAMENTALS 10 Lecture hours

C Programming Basics – Problem formulation, Problem Solving, Introduction to C Programming fundamentals, Structure of a C Program, Compilation and Linking processes, Constants, Variables, Data types – Expressions using operators in 'C', Managing input and output operations, Decision making and branching, Looping statements, solving simple scientific and statistical problems.

Unit III ARRAYS, STRINGS, AND COMMON OPERATIONS 8 Lecture hours

Arrays and Strings: Arrays – initialization, Declaration one dimension and two dimensional arrays. String and string operations, string arrays, simple programs – sorting, searching, matrix operations.

Unit IV FUNCTIONS AND POINTERS 8 Lecture hours

Functions and Pointers – Functions – definition of function, Declaration of function, Pass by value, Pass by reference, Recursion. Pointers – Definition, Initialization, Pointers arithmetic, Pointers and arrays.

Unit V ADVANCED DATA TYPES AND FILE HANDLING 10 Lecture hours

Structure and Union – Introduction - need for structure data type, Structure definition, Structure declaration, Structure within a structure, Array of Structures, Self-referential structure, notion of Linked List. Union, Storage class Specifiers, Preprocessor Directives, File Handling.

Textbooks

1. E.Balagurusamy,"Programming in ANSI C",Tata McGraw Hill Edition Pvt. Ltd.,15th Edition.
2. Thareja Reema, "Computer Fundamentals & Programming in C", Oxford Press.
3. Kanetkar Yashwant, "Let Us C", BPB Publications.

References

1. Schildt Herbert, “The Complete reference C”.
2. Gottfried Byron, “Programming with C”, Schaum’s Series.
3. Venugopal K.R. and Prasad S. R., “Mastering ‘C’”
4. http://learn.upes.ac.in Blackboard – LMS

Note: Also refer to the Web-links/Resources in Blackboard and NPTEL videos.

Modes of Evaluation: Online Discussion/Quiz/Assignment/Blog/Listening, speaking, reading, writing examination.

Examination Scheme:

Components	IA	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Program Outcomes (POs), Program Specific Outcomes and Course Outcomes (COs)

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	1		1	-	-	-	-	-	-	-	-	-	-
CO3	-	-	1	1		-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-
CO5	1	2					-	-	-	-	-	-	-	-	-
AVG.	1.5	1.5	1	1	1	1	-	-	-	-	-	-	-	-	-

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course Code	Course Name	L	T	P	C
CSEG 1108	Object Oriented Programming Lab	0	0	2	1
Pre-requisites/Exposure	Basic Knowledge of Computer Science such as fundamentals & logic for solving programs				
Co-requisites	Basic Knowledge of Mathematics.				

Course Objectives

I. The overall objective of the modules is that the student should be able to understand basic computer fundamentals and functional units of computers with basic skills development in C Programming.

Course Outcomes

CO-1: Identify the functional units of computer system.

CO-2: Understand the concepts of procedure oriented programming using C.

CO-3: Implement the basic concepts of C programming language.

CO-4: Design programs involving decision structures, loops and functions.

CO-5: Implement the concepts of arrays, pointers, structures in C programming language.

Catalog Description

Knowledge about the C programming knowledge is the building block of the students to build their programming skills. And enable the students to enhance the programming skills of the students and make them comfortable to adopt the new language for programming in future.

List of Experiments

Sl. No.	Experiment	Contents
1.	Experiment-1 and 2	Basic understanding of Linux/Unix commands
2.	Experiment-3 and 4	Basics of flow charts, Algorithms
3.	Experiment -5 and 6	Understanding introduction to C programming
4.	Experiment- 7 and 8	Control Statements using if.. if.. else, switch… case

5.	Experiment- 9 and 10	Looping using while,do..while and for
6.	Experiment- 11 and 12	Array
7.	Experiment- 13 and 14	Strings
8.	Experiment- 15 and 16	Functions
9.	Experiment- 17 and 18	Pointers
10.	Experiment- 19 and 20	Structure and union
11.	Experiment- 21 and 22	File handling

Text Books / Reference Books

1. Balagurusamy, E (2007), *ANSI C*, New Delhi: TMH
2. Introduction to Computers, Peter Norton, TMH, fifth Ed.
3. Programming in ANSI C, E Balaguruswamy, TMH
4. Let us C Yashavant Kanetkar, Ninth Ed. BPB

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	IA	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	-	-	-	1	-	-	-	-	-	-	-	-	-
CO2	-	-	2		1	-	-	-	-	-	-	-	-	-	-
CO3	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-
CO5	2	1	-	-	-	-	-		-	-	-	-	-	-	-
Avg.	1.5	1	1.5	1	1	1	-	-	-	-	-	-	-	-	-

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

SEMESTER II

Course Code	Course Name	L	T	P	C
SLLS 0103 (Life Skill-3))	Living Conversations	2	0	0	2
Pre-requisites/Exposure	**--**				
Co-requisites	Not Any				

Course objectives:

The objectives of this course are:

I. Formulate and articulate a personal point of view about the meaning of leadership and teamwork, and why they are important.
II. Encourage critical self-reflection to develop empathy and clarity of expression for the exchange of individual and organizational ideas and information.
III. Enable qualities of deep listening and clear and concise communication skills.
IV. Apply and practice varied platforms and tools of communication both formal and informal.
V. Appreciate and practice collaborative communication in a given environment and context.

Course outcomes:

Knowledge & Understanding:

After completing this course, you will be able to:

CO-1: Understand the importance of being an empathetic communicator and the role of clarity in the expression.

CO-2: Use and Analyze communication strategies and theories, as well as how they are practiced in the professional and social environment. Build collaborative relationships that emphasize team building and problem solving.

CO-3: Demonstrate appropriate tools to improve one's ability to express, listen, and understand people in a given situation and context.

CO-4: Articulate responses both verbally and non-verbally for group and individual work undertaken by self and by others, in the execution of the project/coursework.

CO-5: Practice and Employ communication skills to engage ethically in independent and life-long learning in the broader context.

Catalog Description

Living Conversations is a life skill course that empowers and enables learners to exchange, empathize, express, ideate, create, and collaborate in any given situation - professional or personal. It aims to enable students to converse confidently and participate in a variety of discussions appropriately in different situational and cultural contexts, making them influential communicators.

Course Content

Unit I Basics of Communication **04 lecture hours**

Introduction to the course, Importance, use and its application in life (personal as well as professional), Basics of Communication with Practical Examples (need – principles - process – model), Introducing Types of Communication (Verbal & non-verbal), Types of non-verbal communication & its importance in overall communication.

Unit II Setting Communication Goals & Avoiding Breakdown **06 lecture hours**

Communication goals, creating value in conversations, Internal & external factors impacting our conversations, Communication breakdowns, and how to address them.

Unit III Listening for Improved Understanding **02 lecture hours**

Importance, Active & Passive listening, Barriers, Benefits, Features & Examples of Active Listening, Verbal and non-verbal signs of active listening skills, Tools & Tips for Practicing Active Listening.

Unit IV Non-verbal Communication **06 lecture hours**

Introduction to Non-Verbal Communication, Areas of nonverbal communication, Functions and influence of nonverbal communication, Basics of Body Language, Common Gestures, Body Language Mistakes, Improving Your Body Language, Voice Modulation.

Unit V Public Speaking and Presentation Skills **04 lecture hours**

Public Speaking vs. Presentations, The Essentials of Effective Presentation, Content Development, Confidence Building, Best Practices, Virtual Presentation.

Unit VI Communication Styles **02 lecture hours**

Recognizing your style and the styles of others, closing communication gaps, and being flexible without compromising one's identity.

Unit VII Cross-cultural Communication **02 lecture hours**

Developing greater sensitivity to cultural differences, Building greater accountability and trust on virtual teams, Uncovering hidden assumptions, and Recognizing filters in oneself and others.

Text Books:

Textbooks

1. Hargie, Owen (ed.) (2018). The Handbook of Communication Skills. Routledge. London.
2. Anderson, Peter & Guerrero, Laura. Handbook of Communication and Emotion. 1st Edition. Elsevier.
3. Bordia Crossman, Bretag. Communication Skills. Tata Macgraw Hill.
4. Tuhovsky, Ian. The Science of Effective Communication.
5. Murphy, Herta, Thomas, Jane P. Effective Business Communication. Tata MacGraw Hill

Reference Books:

1. Patterson, Kerry et al. (2011) Crucial Conversations Tools for Talking When Stakes Are High. MacMillan. Switzerland.
2. A Theory of Goal-Oriented Communication: https://www.researchgate.net/publication/220138297_A_Theory_of_Goal- Oriented Communication
3. Effective Communication http://www.free-management-ebooks.com/dldebk/dlcm-effective.htm
4. Active Listening http://www.free-management-ebooks.com/dldebk/dlcm-active.htm
5. TED Talks: https://www.ted.com/playlists/211/the_art_of_meaningful_conversa

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	-	1	-	1	1	1	1	-	-	-	-	-	-	-	-

CO2	-	2	1	-	2	1	1	-	-	-	-	-	-	-	-
CO3	-	1	1	-	2	-	1	1	-	-	-	-	-	-	-
CO4	-	-	1	-	2	1	1	1	-	-	-	-	-	-	-
CO5	-	2	-	2	3	-	-	1	-	-	-	-	-	-	-
Avg	-	**1.2**	**0.6**	**0.6**	**2**	**0.6**	**0.8**	**0.6**	-	-	-	-	-	-	-

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course Code	Course name	L	T	P	C
SLSG 0101	Critical Thinking and Writing (Signature-1) School Of Life Courses	2	0	0	3
Pre-requisites/Exposure					
Co-requisites	Not Any				

Course Objectives

The objectives of this course are:

I. To introduce the essential tools and approaches of critical thinking.
II. To realize how the fallacies and biases hinder the process of critical thinking and how to overcome them.
III. To understand and the various components and conventions of critical writing and create appropriate documents.

Course Outcomes

On completeing this module, the student should be able to:

CO-1: identify, understand and define the various arguments in different contexts
CO-2: to draw logical conclusions
CO-3: introspect and reflect on their thought processes
CO-4: identify the errors in reasoning
CO-5: listen, read and write critically

Catalog Description

The ability to think clearly and rationally is important in whatever we choose to do. **Critical thinking is the ability to think clearly and rationally about what to do or what to believe a**nd includes the ability to engage in reflective and independent thinking. Critical Thinking and Writing skills are important to help the one progress in their professional and personal life effectively. This course aims to introduce the various tools and methods available to develop their critical thinking. It will equip students to utilize critical thinking concepts and strategies in learning, and apply those skills for effective written communication, thus developing the ability to think critically and communicate effectively

Course Content

Unit I PROCESS OF CRITICAL THINKING **11 Lecture hours**

- What is critical thinking: definition and theories
- Importance of Critical Thinking
- Critical thinking Structures
- Metacognitive skills; understanding our minds

Unit II BARRIERS TO CRITICAL THINKING **11 Lecture hours**

- The critical thinking model
- Information Literacy
- Cognitive Biases
- Logical Fallacies

Unit-III APPROACHES FOR CRITICAL THINKING **11 Lecture hours**

- Arguments and Rationality
- Reasoning and Persuasion
- Six Thinking hats
- Simplification

Unit-4 CRITICAL THINKING AND WRITING **12 Lecture hours**

- Critical thinking and clear writing
- Presenting and communicating ideas

Text Books / Reference Books

1 Lewis Vaughn, The power of critical thinking, effective reasoning about ordinary and extraordinary claims, second edition, Oxford University Press

2 Walter Sinnott Armstrong and Robert Fogelin, Understanding Arguments: An Introduction to Informal Logic. 8th Ed., Wadsworth Cengage Learning.

3 Edward de Bono, Six Thinking Hats, ISBN 0-316-17831-4

4 Richard Paul and Linda Elder, The miniature guide to critical thinking, concepts and tools, the foundation for critical thinking

5 Encourage critical thinking with 3 questions: https://www.youtube.com/watch?v=0hoE8mtUS1E

6 Wile E Coyote Into- Introduction to critical thinking: https://www.youtube.com/watch?v=xOjl3jm-GrA

7 Psychologist Diane Halpern on Critical Thinking: https://www.youtube.com/watch?v=rn_7aJP5BTw

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	QUIZ	E-PORTFOLIO	PROJECT	Total
Weightage (%)	20%	30%	50%	100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1									2	2		3			
CO2									2	2		3			
CO3									2	2		3			
CO4									2	2		3			
CO5									2	3		3			
Avg									2	2.25		3			

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course Code	Course Name	L	T	P	C
MATH 1026	Engineering Mathematics II	3	1	0	3
Pre-requisites/Exposure					
Co-requisites	Not Any				

Course Objectives

I. To help the students master the techniques to solve ordinary differential equation.
II. To help the students understand the basic theory of function of a complex variable.
III. To make the students apply the theory of contour integration using residue calculus.
IV. To enable the students solve specific classes of partial differential equations.

Course Outcomes

CO-1: On completion of this course the students will be able to
CO-2: Apply techniques to solve linear ordinary differential equations.
CO-3: Explain the concept of analyticity and integration of a complex function.
CO-4: Find the series representation of a complex function and to evaluate special integrals using calculus of residues.
CO-5: Solve homogeneous partial differential equations with constant coefficients and its applications in one-dimensional heat and wave equations.

Catalog Description

This course covers the ordinary differential equations, partial differential equations and complex analysis. In differential equations student equips with the fundamental tools to solve ordinary differential equations, glimpse of nonlinear ordinary differential equations of special forms and partial differential equations. Lagrange's method ensures the solution of first order nonlinear partial differential equations and separation of variables method useful to solve the one dimensional wave and heat equations. In addition, this course introduces the calculus of complex functions of a complex variable. It turns out that complex differentiability is a very strong condition and differentiable functions behave very well. Integration is along paths in the complex plane. The central result of this spectacularly beautiful part of mathematics is Cauchy's Theorem guaranteeing that certain integrals along closed paths are zero. This striking result leads to useful techniques for evaluating real integrals based on the 'calculus of residues'.

Course Content

Unit I ORDINARY DIFFERENTIAL EQUATIONS 15 lecture hours

Exact differential equation and equations reducible to exact, Linear Differential Equations with Constant Coefficients, Cauchy-Euler Differential Equations, Solution of Second Order Differential Equations (when a part of complementary function is known, by reduction to Normal Form, by changing the Independent Variable and by Variation of Parameters).

Unit II COMPLEX VARIABLES-I 15 lecture hours

Functions of a complex variable, Notion of limit, continuity and differentiability, Analytic function, Necessary & sufficient conditions for analyticity (Cauchy-Riemann equations), Harmonic function, harmonic conjugate and orthogonal families, construction of an analytic function, Milne Thomson method, Line integral and independence of path, Cauchy's theorem, Cauchy-Goursat theorem for simply and multiply connected domain, Cauchy's integral formula and its applications.

Unit III COMPLEX VARIABLES-II 15 lecture hours

Power series, Taylor's and Laurent's series, Zeros and singularities of a function, residues, Cauchy Residue Theorem, Evaluation of definite integral $\int_0^{2\pi} F(\cos\theta, \sin\theta)\,d\theta$, Evaluation of improper integrals $\int_{-\infty}^{\infty} \frac{p(x)}{q(x)}dx$ and $\int_{-\infty}^{\infty} \frac{p(x)}{q(x)}e^{iax}dx$; evaluation of $\int_{-\infty}^{\infty} \frac{p(x)}{q(x)}dx$ and $\int_{-\infty}^{\infty} \frac{p(x)}{q(x)}e^{iax}dx$ with poles on real axis (semicircular contour), Conformal mapping, Linear mapping, inversion, Bilinear transformation.

Unit IV PARTIAL DIFFERENTIAL EQUATIONS 15 lecture hours

Formation of partial differential equation (PDE) and classification of PDEs, Lagrange's Method, Solution of homogeneous linear PDE with constant coefficients, method of separation of variables, solution of one dimensional heat and wave equation.

Text Books

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, ISBN: 9788184873221.
2. E. Kreyszig, Advanced Engineering Mathematics, Wiley Publications, ISBN: 9780470458365.
3. M. D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand Publications. ISBN: 9789385676161.
4. M. D. Raisinghania, Advanced Differential Equations, S. Chand Publications. ISBN: 9788121908931.

Reference Books

1. D. G. Zill, Advanced Engineering Mathematics, Jones and Bartlett Learning, ISBN: 9789384323271.
2. S. L. Ross, Differential Equations, Wiley Publications. ISBN: 9788126515370
3. D. G. Zill and P. D. Shanahan, A first course in Complex Analysis with Applications, Jones &
Bartlett Learning, ISBN: 9789380108193.
4. I. N. Sneddon, Elements of Partial Differential Equations, McGraw-Hill Book Company.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	IA	MID SEM	End Sem	Total
Weightage (%)	30	20	50	100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	-	-	-	-	-	-	1	-	-	-
CO2	3	3	2	1	1	-	-	-	-	-	-	1	-	-	-

CO3	3	3	2	1	1	-	-	-	-	-	-	1	-	-	-
CO4	3	3	2	1	1	-	-	-	-	-	-	1	-	-	-
Average	3	3	2	1	1	-	-	-	-	-	-	1	-	-	-

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course Code	Course Name	L	T	P	C
CHEM 1011	Chemistry I	3	1	0	4
Pre-requisites/Exposure	12th level Chemistry				
Co-requisites	Not Any				

Course Objectives

Objectives of the course are:

I. To make students familiar with the fundamental concepts of chemistry.
II. To make the students understand the various basic chemical reactions, related calculations and reasoning.
III. To prepare the students for studying advanced subjects with required knowledge of chemistry

Course Outcomes

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

CO-1: Choose and develop the appropriate fuel for commercial and domestic application with respect to socio-economic and environment concern.

CO-2: Apply the concepts of reaction dynamics for the improvement of chemical reactions involved in general chemical processes.

CO-3: Explain the mechanism, theories and preventive measurements, of corrosion, with the help of electrochemical concepts.

CO-4: Analysis and enhance the water quality

CO-5: Explain preparation method, properties and application of polymeric and nanomaterials.

Catalogue Description

Chemistry is present everywhere around us. It is existing in everything we see, feel or imagine. It is one of the very fundamental basics behind every structure, building, bridge, refinery and industry. In this course, focus will be on firming the basic knowledge of students about chemistry. Students will learn how to use the concepts correctly through prescribed syllabus. They will be taught various types of fuels. Different processes used to improve the quality of fuels in refineries will be discussed. Combustion calculations related to oxygen or air required will help them to get an effective fuel: O_2 ratio to result in proper and complete combustion. Water chemistry will make the students understand various parameters of water quality and the treatments to improve it. Chemical dynamics will help them to understand the mechanism of reaction. This knowledge will make them able to control the factors to move the reaction in desired direction. Corrosion is based on electrochemical cells. For any engineer, it is quite mandatory to have an understanding to select the suitable metal and also the methods to protect it from decaying. They will also be discussed about various types of polymers and nanomaterials so that they can correlate their properties to their various application areas. Course delivery will be made by classroom teaching, Blackboard, presentations, videos and tutorial classes.

Course Content

Unit I FUELS & THERMOCHEMISTRY 10 lecture hours

Prerequisite: Enthalpy of formation, Enthalpy of neutralization and Enthalpy of combustion, Hess's law of constant heat summation and its application, bond energy

Contents: Fuels - Introduction, Classification, Important properties of a good fuels, Calorific value, Determination of calorific value by Bomb calorimeter, Analysis of coal- proximate, Ultimate analysis, Combustion and its calculations, Distillation of crude oil, composition of petroleum, Important reactions for petroleum industries (isomerization, dimerization, aromatization, cracking), Octane number, cetane number, renewable energy sources: biodiesel, biogas, bioethanol. Hydrocarbons chemistry: Basic concepts for preparation strategy, chemical properties and reactivity of aliphatic (alkanes, alkenes, alkynes, cycloalkanes) and aromatic hydrocarbons.

Unit II REACTION DYNAMICS 9 lecture hours

Prerequisite: Rate of reaction and rate constant, factors affecting rate of a reaction, order and molecularity of a reaction, Rate expression for zero and first order

Contents: Pseudo first order reaction, Second (2A & A+B) and third (3A) order reaction, Methods of determining order of a reaction: Hit and trial method, half-life period method, graphical method, Von't Hoff method (ratio variation method), differential method andOstwald isolation method. Concept of energy barrier and activation energy, Collision theory, Kinetics of complex reactions- reversible, parallel, consecutive and chain reaction, Steady state approximation, Lindemann theory. Equilibrium and equilibrium constant, Kp, Kc, Kx. Homogeneous and heterogeneous equilibrium, Le-chatelier principle.

Unit III ELECTROCHEMISTRY AND CORROSION 6 lecture hours

Prerequisite: Galvanic cell, Single electrode potential

Contents: Nernst equation, Nernst Equation based concept and complex problem in electrochemistry, ECS and its applications. Conductance and its types, Variation of conductance with dilution, Kohlrausch law, conductometric titrations, application of electrochemistry in corrosion. Corrosion: Introduction, dry theory, Wet theory, acid theory, types, Factors, prevention.

Thermodynamic functions: Definitions of free energy and entropy. Derivation of Nernst equation for single electrode potential, Electrochemical energy systems: Reference electrodes: Introduction, construction, working and applications of Calomel electrode. Ion-selective electrode –Definition construction and principle of Glass electrode and determination of pH using glass electrode.

Energy storage systems**:** Introduction, classification -primary, secondary and reserve batteries. Construction, working and applications of Ni-MH and Li-ion batteries

Unit IV WATER CHEMISTRY 6 lecture hours

Contents: Introduction, hardness of water, measurement of hardness, alkalinity, water, softening- lime-soda process, zeolite process, ion exchange process.

Unit V POLYMERS 6 lecture hours

Contents: Classification, Types of polymerization techniques: Bulk, solution, suspension and, emulsion, mechanism of polymerization (cationic, anionic and free radical), vulcanization, average molecular weight of polymers, conducting polymers, plastic used in daily life, applications viz. making of tyres,ropes, electrical fittings, contact lenses, credit cards, air tight containers, cookwares, cold drink bottles.

Unit VI NANOMATERIALS **3 lecture hours**

Contents: Introduction, Methods of preparation: precipitation, co-precipitation, sol-gel, hydrothermal, microemulsion. Introduction to various characterization techniques viz. XRD, SEM, TEM, BET, UV-VIS for nanomaterials. Properties: optical and surface properties. Application of nanomaterials. Size dependent properties (Surface area, Electrical, Optical Catalytic and Thermal properties). Nanoscale materials: Fullerenes, Carbon nanotubes and graphenes-properties and applications.

Text Books

1.Bapna, Renu, Engineering Chemistry - New Delhi MacMillan 2010 – 431, ISBN:0230330762.

2.Text book of Engineering Chemistry, By: Chawla, Shashi Book Publisher**:** Delhi: Dhanpat Rai, 2014. ISBN 13: 123456755036.

3.Engineering Chemistry, By: Krishnamoorty, P, Publisher: New Delhi: McGraw Hill, 2012, Edition: 1.ISBN: 9780071328753.

Reference Books

1. Encyclopedic dictionary of organic chemistry, By Milton, Jules K., Publisher: New Delhi Pentagon Press 2004 Description: 208p., ISBN: 818274167--X; 9788182741676.

2. Crude oil chemistry, By: Simanzhenkov, Vasily, BookPublisher: New York: Marcel Dekker, 2003 Description: 409 p. ISBN: 082474098.

3. Atkins' physical chemistry, By: Atkins, Peter, Paula, Julio De, BookPublisher: New Delhi Oxford University Press 2014, Edition: 10th. ISBN: 9780198728726; 0198728727.

4. Essentials of Physical Chemistry by Bahl & Tuli, Publisher: S. Chand & Co., ISBN 13: 978-8121929783.

5. Organic Chemistry for engineers, By: Mallick, Abhijit, Book Publisher: New Delhi: Viva Books, 2012, ISBN: 9788130920580.

Modes of Evaluation: Class tests/Assignment/Tutorial Assessment/Written Examination:

Components	IA	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	2.8	2	1	1	-	-	-	-	-	-	-	-	-	-

1=Weakly mapped 2=Moderately mapped 3=Strongly mapped

Course Code	Course Name	L	T	P	C
MECH1008	Basic of Mechanical Engineering	2	0	0	2
Pre-requisites/Exposure	Physics, Mathematics and Engineering Mechanics				
Co-requisites	Not Any				

Course Objectives

I. To help the students learn how to apply their analytical and mathematical skills for solving problems of mechanical engineering.

II. To help students develop the ability to analyse and model real life problems of mechanical engineering.

III. To enable students acquire skills for designing and improving various mechanical systems for their profession.

Course Outcomes

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

CO-1: Understand the basic principles of mechanical engineering.

CO-2: Analyze engineering applications using basic principles of mechanical engineering.

CO-3: Apply the principles of Fire & Safety Engineering in real life applications.

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

POs/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	1	-	1	1	1	-	-	1	3	2
CO2	3	3	3	2	1	-	1	1	1	-	-	1	3	2
CO3	3	3	3	2	1	1	1	1	1	-	-	1	3	2
Avg.	3	3	3	2	1	1	1	1	1	-	-	1	3	2

Course Content

Unit I INTRODUCTION TO SYSTEM OF FORCES 6 lecture hours

Force Systems, Basic concepts, Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Resultant of Force System, Equilibrium of System of Forces, Free body diagrams. Power transmission system: belt and pulley, chain, gear.

Unit II BEAMS AND TRUSSES **6 lecture hours**

Beams and types. Types of beam supports, simply supported and over-hanging beams, cantilevers. Type of loads: point, uniformly distributed load, varying distributed load. Application of beams. Trusses and their applications for load bearing.

Unit III MANUFACTURING PROCESSES **6 lecture hours**

Materials and its classification. Stress-strain diagram, mechanical properties of metal, Various metal forming processes: Casting and molding, Metal cutting: Single and multi-point cutting, Joining processes: Arc welding, brazing and soldering, Gas welding, Spot and seam welding.

Unit IV THERMODYNAMICS **6 lecture hours**

Thermodynamic System, Properties, Process, Cycle, Thermodynamic Equilibrium, Zeroth Law of thermodynamics, First Law of Thermodynamics, Second law of thermodynamics: Kelvin-Planck and Clausius statements, Working of refrigeration system.

Unit V ENERGY CONVERSION **6 lecture hours**

Basic working principle of heat exchangers, Turbines. Working of Diesel and Petrol engines: 2-stroke and 4-stroke IC engines, centrifugal pumps and hydraulic turbines.

Text Books:

1. Mechanics of Materials by Pytel.
2. Strength of Materials by Ryder.
3. Engineering Thermodynamics by P.K. Nag, McGraw-Hill Education.
4. Thermodynamics- An Engineering Approach by Yunus Cengel & Boles, McGraw-Hill Education.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

1=weakly mapped 2= moderately mapped 3=strongly mapped

Course Code	Course Name	L	T	P	C
MECH 2032	Engineering Mechanics	3	0	0	3
Pre-requisites/Exposure	• Basic Knowledge of physics. • Basic Knowledge of Mathematics				
Co-requisites	--				

Course Objectives

I. To enable students to develop in the engineering student the ability to analyze any problem in a simple and logical manner and to apply to its solution a few.

II. To enable students to analyze system of forces in statics.

III. To enable students to understand the effect of friction on various engineering applications.

IV. To enable students to analyze the dynamics of a body under the action of various types of forces.

V. To enable students to compute the kinematics of connected bodies.

Course Outcomes

CO-1: On completion of this course, the students will be able to

CO-2: Apply basic engineering mechanics concepts.

CO-3: Analyze static structures using good free-body diagrams and accurate equilibrium equations.

CO-4: Analyze various types of loading and support conditions that act on structural systems.

CO-5: Analyze the pin joint structure.

CO-6: Understand the concepts of centroid and moments of Inertia.

CO-7: Apply the concepts of friction in engineering problems.

CO-8: Understand the laws of motion of particles.

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSOs) and Course Outcomes (COs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	3	-	-	-	-	-	2	-	-	-	1
CO2	3	3	2	-	3	-	-	-	-	-	2	-	-	-	1
CO3	3	3	2	-	3	-	-	-	-	-	2	-	-	-	2
CO4	3	3	3	3	3	-	-	-	-	2	3	-	-	-	2
CO5	3	3	2	-	3	-	-	-	-	2	2	-	-	-	2
CO6	3	3	2	-	3	-	-	-	-	-	-	-	-	-	2
CO7	3	3	2	-	3	-	-	-	-	-	-	-	-	-	1
Avg.	3	3	2.1	3	3	-	-	-	-	2	2.2	-	-	-	1.6

Catalog Description

The course covers the fundamental knowledge in the statics and dynamics of rigid bodies, with a special emphasis on applications of laws of rigid body mechanics, as relevant to engineering sciences in general and automotive engineering in particular. The course begins with a description of basic laws of mechanics, equilibrium conditions of forces in single plane under collinear and non collinear conditions. This course will help to develop ability to analyze and solve various problems in a simple and logical manner by utilizing various principles of engineering mechanics. This course also helps to comprehend and analyze pinned joint structure and dynamics of bodies. Students will learn to understand the concepts of dealing problems with friction like belt, wedge and ladder friction. The understanding of centre of gravity and moment of inertia and its calculations are also explored in this course. Since, course is more oriented towards analytical problems solving skill pertaining to static and dynamic condition of various engineering systems and subsystems. The effective use of commercial software packages to answer engineering questions.

Course Content

Unit I COPLANAR FORCES **10 lecture hours**

Basic Concept and Principles of Mechanics, Types of force system, Composition and Resolution of Forces, Moments, Couple, Varignon's Theorem, Equivalent Force System ,Type of body constraints, structural loads & supports , Free body diagrams, Condition of Equilibrium, Resultant and Equilibrium of Co0planner forces. Support reaction of simple & compound beams, Principle of virtual work

Unit II CENTROID & MOMENT OF INERTIA **04 lecture hours**

Introduction, Centroid and Moment of Inertia of composite plane figures

Unit III Pin-JOINTED STRUCTURE **06 lecture hours**

Introduction, perfect & imperfect frame, analysis of perfect frame by method of joint, method of section and graphical method

Unit IV FRICTION & LIFTING MACHINE **09 lecture hours**

Introduction, Law of friction, simple contact friction on horizontal and inclined plane, Screw and Nut friction, Ladder, belt and wedge friction, Friction in journal collar bearings, Lifting Machines.

Unit V KINEMATICS **10 lecture hours**

Kinematics of Particle in Cartesian, polar and path co-ordinates, under uniform and non-uniform acceleration, Motion under gravity, Projectile Motion, Rotational motion Kinematics of rigid bodies in two and three dimension, Instantaneous center of rotation.

Unit VI KINETICS **06 lecture hours**

Kinetics of Particle, Motion under constant force, Momentum and Energy principles, D-Alembert's principle, Impulses and angular momentum, Motion under constant torque, Collision of Elastic bodies. Kinetics of general plane motion of body.

Textbooks:

1. Tayal, A. K. *"Engineering Mechanics Statics and Dynamics"* 14th Edition, Umesh Publications

2. Bhavikatti, S. S. (2008) *"Engineering Mechanics"* New Age International (P) Limited, Publishers.

Reference Books

1. Timoshenko, S., Young, D. H. and Rao, J. V. (2007) *"Engineering Mechanics"* Tata McGraw Hill Publishing Company Limited, New Delhi
2. Beer, F. P., Johnston, E. R., Mazurek, D. F., Cornwell, P. J., Eisenberg, E. R. and Sanghi, S. (2011) *"Vector Mechanics for Engineers: Statics and Dynamics"* 9th Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi
3. Shames, I. H. and Rao, G. K. M. (2006) *"Engineering Mechanics: Statics and Dynamics"* 4th Edition, Pearson Education Inc.

Modes of Evaluation: Quiz/Assignment / Written Examination

Examination Scheme:

Components	IA	MSE	ESE
Weightage (%)	30	20	50

1=Weakly mapped 2=Moderately mapped 3=Strongly mapped

Course Code	Course Name	L	T	P	C
CHEM 1114	Chemistry lab	0	0	3	1
Pre-requisites/Exposure	Basic Knowledge of Physics and Chemistry				
Co-requisites	Not Any				

Course Objectives

I. To help the students familiar with the fundamental concepts of practical chemistry

II. To make the students able to prepare standard solutions and few commercial materials

III. To make the students able to determine the strength of the solutions using basic instrumental and classical methods.

Course Outcomes

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

CO-1: Demonstrate the kinetics of chemical reaction and the synthesis of polymeric material like resins.

CO-2: Analyze efficiency/quality of different fuels/water samples for commercial and domestic application.

CO-3: Apply different types of titrations for various quantitative analysis.

Catalog Description

Chemistry is present everywhere around us. It is existing in everything we see, feel or imagine. It is one of the very fundamental basics behind every structure, building, bridge, refinery and industry. In this lab course, focus will be on firming the basic knowledge of students about chemistry. Students will learn how to use the concepts correctly through prescribed syllabus and will perform related experiments in the Chemistry lab. They will be taught to find the more effective fuel using proximate analysis and sulfur present in fuel through gravimetric analysis. fuels. Different processes used to improve the quality of fuels in refineries will be discussed. Water chemistry will make the students understand various parameters of water quality and the treatments to improve it. Kinetics experiments help them to find order of reaction in lab. They learn to prepare polymers also at lab scale. Lab activities include lab instructions, hands on experience, maintaining lab record and viva-voce.

List of Experiments

1. To determine the strength of given solution of NaOH by titrating it against standard oxalic acid solution using phenolphthalein.
2. To determine the percentage of moisture, volatile matter, ash content and fixed carbon in a given coal sample by proximate analysis.
3. To estimate sulfur content in a given sulfate solution of sodium sulphate gravimetrically.
4. To determine the rate constant and order of the reaction of the hydrolysis of an ester (ethyl acetate) at 25ºC in the presence of 0.5N hydrochloric acid.
5. To determine the strength of given solution conductometrically.
6. To determine the strength of the given solution pH-metrically
7. To determine the total hardness of the given hard water sample by EDTA method
8. To determine the alkalinity of a given water sample.
9. To prepare Urea-Formaldehyde (UF) resin.
10. To determine the strength of a given solution of alkali by titrating it against various standard acid solutions using suitable indicator using virtual lab.
    Link http://vlab.amrita.edu/?sub=2&brch=193&sim=352&cnt=4

Text Books / Reference Books

1. Practicals in Physical Chemistry: A Modern Approach by Sindhu, P.S., Publisher: Delhi Macmillan India, ISBN: 1403929165
2. Theory and Practicals of Engineering Chemistry by Chawla, Shashi, Publisher: New Delhi Dhanpat Rai & Co., ISBM: 9788177000405, 8177000403
3. Practical Physical Chemistry by B. Viswanathan, Publisher: Viva Books, ISBML 9788130920696

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Modes of Evaluation: Continuous Evaluation Pattern.

Components	Continuous evaluation
Weightage (%)	100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	1	-	-	3	2	3	-	-	-	1	-
CO2	3	-	-	-	1	1	-	3	2	3	-	-	-	1	1
CO3	3	-	-	-	1	1	-	3	2	3	-	-	-	1	1
Average	3	-	-	-	1	1	-	3	2	3	-	-	-	1	1

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course Code	Course Name	L	T	P	C
MECH 1005	Engineering Graphics	2	2	0	2
Pre-requisites/Exposure	The knowledge of simple geometrical theorem and procedures is essential.				
Co-requisites	Not Any				

Course Objectives

I. To increase ability to communicate with people.
II. To enhance knowledge, imagination and drawing skill.
III. To learn basics of design software Solid works skills.
IV. To draw the accurate and precise line drawing.
V. To prepare the student for future Engineering positions.

Course Outcomes

CO-1: At the end of this course student should be able to

CO-2: Remember the conventions of engineering graphics such as types of lines, dimensioning, method of projection etc.

CO-3: Demonstrate understanding of fundamental concepts of engineering graphics.

CO-4: Apply knowledge of orthographic and isometric projections to solve problems related to points, lines, planes and solids.

CO-5: Develop and model basic mechanical components.

Catalogue Description

Engineering graphics builds the foundation of analytical capabilities for solving a great variety of engineering problems involving diagrams. It also has numerous real time application in almost all branches of engineering. This subject helps the student to enhance their knowledge, imagination and drawing skill. The purpose of the study of the engineering graphics is to develop the ability to visualize an object with physical and dimensionalconfigurations. With its extensive coverage, the step-by-step approach and handy drawing tips. The subject support for students to draw the accurate and precise line drawing.

Course Content

Unit I FUNDAMENTAL OF ENGINEERING GRAPHICS 06 Lecture hours

Introduction to drawing instruments, sheet layout and sketching, Lines, Lettering and Dimensions. Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Unit II PROJECTION OF POINT 03 Lecture hours

Introduction to orthographic Projection, Projection of points situated in 1^{st}, 2^{nd}, 3^{rd} and 4^{th} quadrant.

Unit III PROJECTION OF LINE 03 Lecture hours

Line parallel to one or both the planes, line perpendicular to one plane and parallel to other, line inclined to one of the planes.

Unit IV PROJECTION OF PLANES 03 Lecture hours

Types of plane, Projection of planes parallel to one of the references. Projections of planes inclined to one of the reference plane and perpendicular to the other.

Unit V PROJECTION OF SOLIDS 03 Lecture hours

Introduction and types of solid, Projections of solids in simple positions, Inclined to oneplane. Projections of spheres and problem solving.

Unit VI PROJECTION OF SOLIDS 03 Lecture hours

Introduction and Section of prisms, Pyramids, Cylinder, Spheres, Cones.

Unit VII SECTION OF SOLIDS 03 Lecture hours

Introduction of isometric axes, lines and planes, Isometric drawing of different objects.

Unit VIII PERSPECTIVE PROJECTION 03 Lecture hours

Methods of development, Developments of lateral surfaces; Principle of perspective projections, Definition of perspective elements.

Unit IX COMPUTER GRAPHICS 03 Lecture hours

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing;

Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM).

Text Books

1. Bhatt, N. D. (2014) *"Engineering Drawing"*, Charol Publication
2. Gill, P. S. (2009) *"Engineering Drawing"*, Kataria Publication
3. Dhawan, R. K. (2011) *"Engineering Drawing"*, S Chand.

Reference Books

1. Morling, K. *"Geometric and Engineering Drawing"***,** Third Edition, Elsevier 32 Jamestown Road London NW1 7BY 30 Corporate Drive, Suite 400, Burlington, MA 01803, USA.

Modes of Evaluation: Quiz/Assignment/ Written Examination

Examination Scheme:

Components	IA	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSOs) and Course Outcomes (COs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	-	-	-	-	2	-	1	-	2	-
CO2	3	3	3	2	3	-	-	-	-	2	-	1	-	1	-
CO3	3	3	3	2	3	-	-	1	-	2	-	1	-	3	-
CO4	3	3	3	2	3	-	-	1	2	2	-	1	-	1	-
Avg	3	3	3	2	3	-	-	1	2	2	-	1		1.75	

1=Weakly mapped 2=Moderately mapped 3=Strongly mapped

SEMESTER III

Course Code	Course name	L	T	P	C
SLLS 0201	Design Thinking (Life Skills 4)	**2**	**0**	**0**	**2**
Pre-requisites/Exposure	Knowledge of analyzing society problems and product usage problems and a zeal to improve the current situation, in addition to knowing to using laptop/computers, internet, social media interaction, file sharing and uploading, email and communication etiquettes.				
Co-requisites	Not any				

Course Objectives

I. To enable students to acquire knowledge, imagination and be more assertive on opinions on problems in society.

II. To enable students to learn basics of research, data collection, analysis, brainstorming to find solutions to issues.

III. To make them understand Design Thinking methodologies to problems in field of study and other areas as well.

IV. To help students to understand future Engineering positions with scope of understanding dynamics of working between inter departments of a typical OEM.

Course Outcomes

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

CO-1: Understand the concepts of design thinking as a human-centered approach for problem solving in everyday life.

CO-2: Use and Analyze primary market research, product ideation, prototyping, and fidelity mapping.

CO-3: Demonstrate the ability and openness to innovate, experiment, and generate ideas for solving complex problems.

CO-4: Learn how to incorporate user feedback into iterations to refine and enhance designs and how to embrace an iterative mind-set for design improvement.

CO-5: Practice and Employ design-led strategy for mitigating day-to-day problems.

Catalog Description

The evolution of design has transformed it from a discipline confined to a singular, specific domain into a versatile tool for tackling intricate, nonlinear challenges. Design thinking has emerged as a skill that empowers individuals to confront uncertainty, complexity, and failure. By introducing theoretical principles and analyzing real-world industry examples, the course explores design thinking as a process that involves understanding the context (the thinking phase), creating tangible prototypes (the making phase), and testing potential solutions (the breaking phase). The course further emphasizes the productive value of iterating through this process rapidly and frequently (the repeating phase) to enhance ideas and cultivate fresh insights.

Course Content

Unit I: Innovation through Design: Think, Make, Break, Repeat 12 Lecture hours

Introduction to design thinking, its importance and application in life through theory and real-life examples from industry and different walks of life.

Unit II: The Design Thinking Approach 10 Lecture hours.

Exploring the principles, mind-set, and process of design thinking. Understanding the importance of empathy and placing the user at the centre in the design process and learning techniques for conducting user-centered research for creating solutions that address users' needs and pain points.

Unit III: Problem Framing **10 Lecture hours**

Techniques for identifying and framing the right problem to solve through Design Thinking. Strategies for generating creative ideas and facilitating effective brainstorming sessions to explore a wide range of possibilities.

Unit IV: The Designer Mentality **10 Lecture hours.**

Understanding the iterative design process and exploring prototyping methods and techniques for rapidly building and testing prototypes to gather feedback, iterate on designs, refine and improve solutions. Applying Design Thinking principles to create intuitive and delightful user experiences.

Text Books

1. Burnett, B., & Evans, D. (2023). Designing your new work life. Vintage.
2. Burnett, B., & Evans, D. (2022). Designing your life: How to build a well-lived, joyful life. Alfred A. Knopf.
3. Burnett, W., & Evans, D. J. (2020). Designing your work life how to thrive and change and find happiness at work. Chatto & Windus, an imprint of Vintage.

Additional Reading/Viewing

1. https://www.interaction-design.org/literature/topics/design-thinking
2. https://www.interaction-design.org/literature/article/what-is-design-thinking-and-why-is- it-so-popular
3. https://online.hbs.edu/blog/post/what-is-design-thinking
4. https://mitsloan.mit.edu/ideas-made-to-matter/design-thinking-explained

WEB SOURCES

1. https://www.ideou.com/blogs/inspiration/what-is-design-thinking
2. https://www.ideou.com/pages/design-thinking
3. https://www.nngroup.com/articles/design-thinking/
4. https://www.youtube.com/watch?v=_r0VX-aU_T8&ab_channel=Sprouts
5. https://www.youtube.com/watch?v=s-89tphpznU&ab_channel=IndiaUIUX

Modes of Evaluation: Coursera Quiz + Classroom Participation + Course Quiz

Examination Scheme:

Components	Coursera Quiz	Classroom Participation	Course Quiz	Total
Weightage (%)	30	20	50	100%

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSOs) and Course Outcomes (COs)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	2	1	-	-	-	-	-	-	-	-	-	-	-
CO2	-	1	1	-	1	-	-	-	-	-	-	-	-	-	-
CO3	-	1	1	2	-	-	-	-	-	-	-	-	-	-	-
CO4	-	1	1	2	1	-	-	-	-	-	-	-	-	-	-
Avg.	-	1	1.25	1.25	0.5	-	-	-	-	-	-	-	-	-	-

1= Weakly mapped 2= Moderately mapped 3=Strongly mapped

Course Code	Course Name	L	T	P	C
SLLS 2001	Social Internship	0	0	1	0
Pre-requisites/Exposure	Knowledge of Basic English				
Co-requisites	Knowledge of Basic Computer Skills				

Course Objectives

I. To familiarize the students on the concept 'giving back to the society'.
II. To familiarize the students on the issues faced by marginalized communities.
III. To provide an experiential platform to the students on any one or two issues as an internship.

Course Outcomes

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

CO-1: To understand the concept of social responsibility through an internship.

CO-2: To acquire hands on experience in 'giving back to the society' using creative technology through an internship.

Catalog Description

Along with Intelligent Quotient, it is important for students to enhance their Emotional Quotient as well. The Social Internship offers an opportunity to the student to be empathetic towards social issues facing our society. To help and support the affected community / cause through a field internship is the essence of the course in 'giving back to society'.

Course Content

Unit I: GLOBAL AND INDIAN SOCIETAL CHALLENGES 4 Lecture hours

Introduction to the course. A brief on social issues facing the society with both global and Indian examples.

Unit II: COMMUNITY ENGAGEMENT AND SOCIAL IMPACT 4 Lecture hours

10 hours of field work on a social issue and helping the marginalized/affected community/cause with photographs and testimonies.
Discussion Questions

Unit 3: REFLECTION AND FINAL REPORT **4 Lecture hours**

Submission of individual reflection on the social service rendered. Major Assignment -Final Report Submission.

Plan of Work

1. Reading on social issues facing the society with both global and Indian examples.
2. Selecting an issue where the student wishes to contribute and wants to make a difference.

Areas - The internship may be broadly completed by getting in touch with NGO in your city / town / Police / Municipal Corporation / Local Gram Pradhan / Medical Officer of Government Hospital / State Health Department / Women & Child Development Centre / Secretary of your residential society / Your University CSR Department / CSR departments of Corporates / Your alma mater school / Old Age Home / Orphanage / Literacy Drive / Aanganwadi Centres / etc.

A few examples at Dehradun city on potential internships are given below. Similar could be explored in your city / town of residence.

- Working in collaboration with "Bhojan Mata" and support the teachers in the remote rural areas for better quality education (workshops, remedial classes for subjects, winter special classes on art, Awareness on Digital India, Training on computers, crafts, etc..)
- Support the police in actively participating in the new initiative launched by ADG-Traffic (Mr. Kewal Khurana) in providing assistance to reduce the traffic congestion in the city with additional support from students (9 to 12^{th}) from different schools).
- Support the health drive initiated by the State Health department, wherein the doctors from Government hospitals/clinic are on a mission to provide MMR vaccination to students from class 5 to 12. Our students can provide them with administrative & operational support in carrying out the activity successfully.
- Work on the Swaach Bharat mission by supporting M.A.D (a society working on environmental & Hygiene Issues).
- The students can approach people like Dr. Anil Joshi (Social activist & Director HESCO) in village shuklapur who is working on Rural development and creating an awareness on environmental issues alongside generating self-employment for people living in nearby

villages (e.g, Thakurpur, Premnagar, Selaqui, Rajawala etc.) or even remote hill areas of state of Uttarakhand.

- Skills development is One of the most happening initiative from GoI, spread awareness in the remote hill areas (especially in areas like tourism related opportunities, Organic farming etc.) they can visit the farm of "The Mushroom Girl" – Ms. Divya Rawat from Mothrowala, as she has also been awarded "Nari Shakti Samaan" by the President of India.

Online Discussion – Through discussion, students elaborate their preferred area of work with reference to the Global Scenario and India. Reason for choosing that area also needs and resources of the people in their area of Social Internship and also submit the testimonials, which include signature of the authority where students initiated their work, or the signature of the authority in whose area students are currently working or photographs of work (photographs must include students working).

Final Report Submission - Submission of the Testimonials include signatures of the authorities you have worked with, or the signature of the authority in whose area you have worked or photographs of your work (photographs must include you working). Students' accomplishment in their area of operation along with the major successes student experienced and major challenges faced.

Students will submit the complete elaborated report along with testimonials and completion certificate in the form of signed Template

- The registration for all students will open twice, during winter and summer breaks. They may enroll for the internship in either of the two breaks.
- The student will have to submit a continuous record of their 10 to 15 days internship in the form of photographs and testimonies (wherever required).

The Blackboard will provide submission modules on each of the 10 to 15 days internship done by the student.

Mode and Scheme of Online Evaluation:

Modes of Evaluation: Online – Quiz / Assignment / Discussions / Case Studies

Examination Scheme:

Components	MSE(Discussion Questions + Initiating Internship Template)	MSE III (Detailed Assignment – Report Submission + Testimonials Photographs/Videos)Student Experience Sharing Video	**ESE**

Weightage (%)	30%	70%	100%

Relationship between the Program Outcomes (POs), Program Specific Outcomes and Course Outcomes (COs)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	1	-	2	-	-	-
CO2	-	-	-	-	-	1	-	-	-	1	-	1	-	-	-
Avg.	-	-	-	-	-	1	-	-	-	1	-	2	-	-	-

1. Weak Mapped 2. Moderate Mapped 3. Strong Mapped

Course Code	Course Name	L	T	P	C
SLSG 0201 **(Signature-2)**	Ethical Leadership in the 21st Century (Signature-2) School of Life Courses	2	0	0	2
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives:

The objectives of this course are to:

1. To explore and define the concepts of integrity and ethics.
2. To develop an understanding of the varied culture specific values in society.
3. To appreciate ideas of values, ethics, and morality in a multicultural context
4. To explore a deeper understanding of values and ethics based on case studies.
5. To articulate and defend a preferred position on the relationship between ethics and society while appreciating its limitations.

Course Outcomes:

After completing this course, Students will be able to:

CO-1: Understand the concepts and challenges of ethical practices related to everyday life involved in aligning Ethics, Law, and Morality through interactions and discussions.

CO-2: Recollect concepts necessary for ethical practices and leadership through objective exercises to evolve as a global citizen.

CO-3: Apply ethical concepts to challenging situations faced in a personal, community and national context through direct observation and discussions.

Catalog Description:

The course aims at developing values and ethics as an inherent part of individuals development in the social and professional context as a global citizen. This course providing holistic perspective to the students towards life, profession and happiness based on value-based living.

Course Content

Unit I: INTRODUCTION TO THE CONCEPTS AND DEFINITIVE THEORY OF INTEGRITY AND ETHICS

- Define the concepts of integrity and ethics.
- major theoretical approaches in integrity and ethics
- ethical dilemmas
- the concept of personal integrity

Unit II: ETHICS AND UNIVERSAL VALUES

- Human rights
- Gender Equality
- Values, ethics, and morality in a multicultural context

Unit III: ETHICS AND SOCIETY

- Define the concept of society.
- The relationship between ethics and society
- Social Values, Moral Values and Ethics

Unit IV: ETHICAL LEADERSHIP

- Defining Ethical Leadership
- Responsibilities of Ethical Leadership
- Scope and limitations of Ethical Leadership
- Effective Ethical Leadership

Unit V: ETHICS, DIVERSITY, AND PLURALISM

- Define diversity, tolerance, and pluralism.
- Value of cultures, identities, histories, and points of view other than one's own
- Case studies/role models of values of tolerance and pluralism
- Diversity, identity, and subcultures

Unit VI: CHALLENGES OF ETHICAL LIVING IN THE 21ST CENTURY

- Ethics and Business
- Media Integrity and Ethics
- Public Integrity and Ethics
- Gender and Ethics
- Professional practice and Ethics

Textbooks

1. R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2
2. R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics – Teachers Manual, Excel books, New Delhi, 2010

Reference Books

1. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008
2. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati
3. A.N. Tripathy, 2003, Human Values, New Age International Publishers.

Relevant websites, movies and documentaries:

1. Value Education websites, http://uhv.ac.in, http://www.uptu.ac.in
2. Story of Stuff, http://www.storyofstuff.com
3. Al Gore, An Inconvenient Truth, Paramount Classics, USA
4. Charlie Chaplin, Modern Times, United Artists, USA
5. IIT Delhi, Modern Technology – the Untold Story
6. Gandhi A., Right Here Right Now, Cyclewala Productions

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Formative Assessment Methods

Type	Description (Online Portfolio & Project Presentation)
Class & Online Discussions and practice sessions	• Interim Reviews • Reflective Blog/ Journal (on-line – LMS or physical) • Discussion Forum (on-line - LMS) • Quiz

Summative Assessment Methods This indicates the type and weighting of assessment elements in the course		
Weightage	**Type**	**Description**
20%	• Quiz	To evaluate understanding of the definitive theory of learning processes
30%	• Portfolio	Compilation of work done through the semester in the course.
50%	• Group Project	Composite exercise/s using different media/platforms that demonstrate the understanding and application of learning methods and tools

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
Avg.															

1 = weakly mapped, 2 = moderately mapped, 3= strongly mapped

Course Code	Course name	L	T	P	C
	Exploratory - 1	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

Course Outcomes

Catalog Description

Course Content

Unit 1 – Heading – 22 Lectures

Unit 1 Detail content

Unit 2 – Heading – 23 Lectures

Unit 1 Detail content

Textbooks / Reference Books

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	IA	MID SEM	End Sem	Total
Weightage (%)				100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1															
CO2															
CO3															
Average															

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course Code	Course Name		L	T	P	C
MECH 2023	Fluid Mechanics		2	0	0	2
Pre-requisites/Exposure	• Basic knowledge of physics and mathematics • Engineering Mechanics					
Co-requisites	--					

Course Objectives

The course will enable the students:

I. To present various concepts and impart proficiency in basic fluid mechanics concepts.
II. To identify, formulate, and solve real fluid engineering problems.
III. To design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
IV. To use techniques, skills, and modern engineering tools necessary for engineering.

Course Outcomes:

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

CO-1: Understand the properties and applications of fluid mechanics.

CO-2: Compute problems related to hydrostatics and kinematic forces.

CO-3: Solve problems related to hydrodynamic forces.

CO-4: CO-4: Implement dimension analysis on prototype and models.

Catalog Description

Subject of Fluid Mechanics occupies an important position in many engineering disciplines. It deals with the flow of fluid, which is present all around. Fluid Mechanics also laid down the foundation for other subjects like water resources engineering, hydraulic structures, etc. This subject is also filled with advanced mathematics especially calculus. Students will be dealing with the topics like laminar and turbulent flow. Flow around Submerged bodies, Boundary layer flow, Non-uniform flow and the hydraulic machines. It requires mathematical aptitude and sharp mind as the analysis carried out is going to large implications on real life applications.

Unit 1 FLUID PROPERTIES AND STATICS 8 lecture hours

Fluids, shear stress in a moving fluid, viscosity, Newtonian and non-Newtonian fluids, viscosity in liquids and gases. Fluid statics: pressure, variation of pressure in a static fluid, absolute and gauge pressure, measurement of gauge pressure, hydrostatic forces on plane and curved surfaces, center of pressure, buoyancy and stability of submerged and floating bodies, metacentric height.

Unit 2 KINEMATICS OF FLUID FLOW 7 lecture hours

Eulerian and Langrangian approaches, classification of fluid flow as steady and unsteady flow, uniform and non-uniform flow, laminar and turbulent flow, path line, stream line, streak line and stream tube, one, two, and three dimensional flow, velocity and accelerations in steady and unsteady flow, ideal fluids, equations of continuity in the differential form, rotational and irrational flow, circulation and vorticity, stream function, velocity potential, one dimensional flow along a stream line.

Unit 3 BASIC HYDRODYNAMICS 5 lecture hours

Bernoulli`s equation and its limitations, measurement of velocity, pitot tube and pitot -static tube, venturi meter, orifice meter, flow nozzles, notches and weirs.

Unit 4 STEADY FLOW OF INCOMPRESSIBLE FLUIDS IN PIPES 5 lecture hours

laminar and turbulent flows, critical Reynolds number, hydraulic radius, general equation for friction, laminar flow in circular pipes, Darcy weisbach equation, friction factor, equivalent pipes, minor losses in pipes, development of boundary layer.

Unit 5 DIMENSIONAL ANALYSIS & SIMILITUDE 5 lecture hours

Rayleigh’s method, Buckingham’s Pi theorem, non-dimensional parameters in fluid mechanics and machinery-principles of similitude- geometric, kinematic and dynamic similarities- model studies. Physical meaning of important dimensional groups of fluid mechanics and the practical use.

TEXTBOOKS

1. Das, M. M. (2010). Fluid mechanics and turbomachines. New Delhi, India: PHI Learning.
2. Davidson, P. A. (2004). Turbulence: an introduction for scientists and engineers. Oxford: Oxford University Press. 532.0527 DIT 015186.
3. Som S.K. and Biswas G. (2010). Introduction to Fluid Machines, 2nd Edition, Tata McGraw-Hill Publishers Pvt. Ltd.
4. Bansal R.K. (2012). Fluid Mechanics and Hydraulic Machines, New Delhi, India.

REFERENCE BOOKS

1. Davidson, P. A. (2011). Voyage through turbulence. Cambridge: Cambridge University Press.
2. Modi P.M. and Seth S. M. (2008). Hydraulics and Fluid Mechanics, Standard Book House.

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	50	20	30

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	3	2	3
CO2	3	-	3	-	2	-	-	2	-	-	-	-	-	2	-

CO3	3	-	-	-	3	-	-	2	-	-	-	-	-	-	3
CO4	2	-	3	-	3	-	-	-	-	-	-	-	3	-	-
Avg.	2.5	-	1.5	-	2	-	-	1					1.5	1	1.5

1=Weakly mapped, 2=Moderately mapped, 3=Strongly mapped

Course Code	Course Name	L	T	P	C
HSFS 2001	Thermodynamics & Analytical Instruments	2	1	0	3
Pre-requisites/Exposure	Basic knowledge of Physics and Mathematics (Trigonometry and Calculus)				
Co-requisites	Fluid Mechanics				

Course Objectives

I. To help the students understand relevance of thermodynamics in the broader context of engineering sciences in general, and fire safety engineering in particular.
II. To apply laws of thermodynamics and use thermodynamics functions to solve engineering problems.
III. To learn the principle of various measuring instruments and their functions.
IV. To understand the operation of various control equipment and their usage in process industry.
V. To understand the various modern methods of chemical analysis and explain the structures of metals, polymers and ceramics.

Course Outcomes

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

CO-1: Comprehend thermodynamic systems and surrounding.
CO-2: Understand modern methods of chemical analysis and describe the structure of metals, polymers and ceramics.
CO-3: Explain the basics of controllers.
CO-4: Design and explain the heat engines, heat pumps and refrigeration systems.
CO-5: Apply laws of thermodynamics to solve practical engineering problems.

Catalog Description

The present course aims to introduce the principles of Thermodynamics and Analytical Measuring Instruments and illustrate their application to thermodynamics systems. The content comprises the fundamental laws of thermodynamics, the estimation of volumetric and key thermodynamic properties of real fluids and mixtures, phase, and chemical reactions. Students will also learn about various analytical measuring instruments – level, pressure, flow, volume, and temperature. Students are also taught about various controllers and their application in process industries. Applications are emphasized through extensive problem work relating to practical cases. Further, being a rigorous course on problem-solving, it will acquaint students with engineering problem-solving approaches.

Course Content

Unit 1: FUNDAMENTALS OF CHEMICAL THERMODYNAMICS 09 lecture hours

Introduction to Chemical Engineering, Chemical thermodynamics, first law, entropy and second law, Carnot cycle, thermodynamic functions, Maxwell relations, Joule - Thomsons's expansion.

Unit 2: CHEMICAL REACTION AND KINETICS 09 lecture hours

Thermodynamics of chemical reactions, enthalpy change, entropy change and free energy change, equilibrium constant. Le-Chatelier's principle elementary reaction kinetics, order of reactions, effect of temperature in reaction ratio, type of chemical reactors.

Unit 3: INSTRUMENTATION AND MEASUREMENT TECHNIQUES 09 lecture hours

Instrument technology, measurement of flow, primary or quantity methods, secondary or rate devices- measurement of pressure gravitational types, bellows, measurement of high pressure, measurement of low pressure- McLeod vacuum gauge-temperature - thermometers, bimetal thermometers, pyrometers, resistance thermometer, thermocouples. Measurement of level and volume.

Unit 4: FORCE MEASUREMENT AND PROCESS CONTROL 09 lecture hours

Measurement of force, strain gauge and load cells, Introduction to transducers, automatic control, controllers, proportional derivative, integral and combined modes, final control elements and computer control.

Unit 5: ADVANCED CHEMICAL ANALYSIS TECHNIQUES **09 lecture hours**

Modern methods of chemical analysis, visible spectroscopy, UV spectroscopy, vibrational spectroscopy, nuclear magnetic resonance, mass spectrometry, X-ray diffraction, structure of metal, polymer and ceramics.

Text Books

1. Cengel, Y. A., & Boles, M. A. (2002). *Thermodynamics: an engineering approach (Vol. 5)*. New York: McGraw-Hill.
2. Austin, E., & Fribance. (1985). *Industrial Instrumentation Fundamentals*. John Wiley and Sons.

Reference Books

1. Abbott, M. M., Smith, J. M., & Van Ness, H. C. (2001). *Introduction to chemical engineering thermodynamics*. New York: McGraw-Hill.
2. Sonntag, R. E., Borgnakke, C., Van Wylen, G. J., & Van Wyk, S. (2003). *Fundamentals of thermodynamics* (Vol. 6). New York: Wiley.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/ CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C O 1	3	3	2	3	-	-	2	-	-	-	2	-	3	2	1
C O 2	2	2	-	-	2	-	-	-	-	-	-	-	2	-	2
C O 3	-	-	3	-	-	-	-	-	3	-	2	-	3	-	-

CO4	-	-	-	2	3	-	-	-	-	2	-	2	2	-	-
CO5	-	-	2	3	-	2	-	-	-	-	-	2	-	2	-
Avg.	1	1.17	1.67	2	1.67	1.33	1.5	1.33	2	2	2.5	2.67	1.83	1	1

1=Weakly mapped 2=Moderately mapped 3=Strongly mapped

Course Code	Course Name	L	T	P	C
HSFS 2015 (Version 3.2)	Fundamentals of Fire Engineering	3	0	0	3
Pre-requisites/Exposure	• Basics of Thermo-Dynamics & Heat Transfer • Basic Mathematics • Basics of Chemistry				
Co-requisites	NA				

Course Objectives:

The objectives of this course are as follows:

I. To inculcate an elaborate understanding of fire/combustion science relevant to current industrial requirements and research

II. To make students understand the concepts of fire protection/suppression engineering principles & systems currently followed by industries.

III. To brief the legislation requirements/international codes/ standards from a fire & and safety perspective

IV. To inculcate the students to the latest advancements in fire and combustion science and excel in performing fire calculations to enhance the safety of infrastructure.

Course Outcomes:

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

CO-1: Summarize the concepts of Fire and the behaviour of fire under varying atmospheres.

CO-2: Examine various problems pertaining to fire accidents and provide advisory on fire suppression.

CO-3: Investigate the real-time occurrence of fire accidents and recognize the root cause.

CO-4: Assess the fire and decide on relevant control measures by fulfilling legal compliance.

Catalog Description

In the modern era of industrialization and globalization, human race not only is enjoying the benefits of development, but also experiencing huge loss of life due to exposure to different sets of hazards in day to day life. Among these hazards, fires became one of the commonest and severe ones. Hence, national/local governments formulating, enforcing and updating legislations for ‘Being Fire Safe’ everywhere. However, without understanding the fundamental concepts, achieving the same would be difficult. Thus, this subject aimed to imparting knowledge to and development of skills for students, by giving a strong base for industrial and building fire safety.

UNIT 1: INTRODUCTION   9 Lecture hours

Introduction- Fire, Classifications of fires, temperature, heat, specific heat, Fire Causation theories, Theory of Fire extinguishment, Governing equations for calculation of heat flux of a fire.

Combustion Science of Solids, Liquids & Gases: flash point, fire point, ignition, combustion; Ignition- pilot ignition, spontaneous ignition, ignition sources; Types of combustion-rapid, spontaneous, explosion; Diffusion flames-zones of combustion, smouldering combustion, characteristics of diffusion flame; Premixed flames-burning velocity, limits of flammability, characteristics of premixed flame; Nature of common fuels, Basic stoichiometry.

UNIT 2:   COMBUSTION AND ITS BY PRODUCTS   9 Lecture hours

Development of fire-incipient, smoldering, flame and heat stages; Products of combustion-flame, heat, smoke, fire gases; Smoke – constituents of smoke, quantity and rate of production of smoke, quality of smoke, smoke density, visibility in smoke; Toxicity of smoke- effect of harmful agents preventing escape and causing injury or death - CO, CO_2, HCN, SO_2, NH_3, Nitrogen oxide. Effect of heat exposure to human body, the body burns.

UNIT 3: FIRE SUPPRESSION & PROTECTION-1   8 Lecture hours

Introduction, Definitions, Water as an extinguishing agent, Basic Components of a Fire Protection system, Fire water supply systems, Design philosophy acc. to OISD, Foam, DCP & other gaseous extinguishing agents, Advantages and disadvantages; Sustainable Fire extinguishment agents. Classification of fire protection systems-Active & Passive: Active FPS-Definitions, classifications- Water Based (Vs) Non water based & Fixed (Vs) Portable/Mobile, Types:- Fire Extinguishers, Fire hydrants, Sprinklers, standpipe systems, Fire detectors, water spray systems - definitions, types, operation, applications & limitations, selection, installation & maintenance as per relevant national and international standards (IS, OISD, NFPA etc)

UNIT 4 FIRE SUPPRESSION & PROTECTION-2 — 7 Lecture hours

Passive FPS- Fire Resistance: Basic Concepts (philosophy), Materials used & their Fire Resistance ratings, Fire Resistance tests; Fire Proofing: Introduction, materials used in coatings & paintings, concrete as a fire proofing material; Exit & Egress Arrangements: Basic definitions- Exit, Means of Egress system, Exit door, Refuge area, Safe area & other related as per NFPA codes & NBC.

UNIT 5 EXPLOSION SCIENCE — 12 Lecture hours

Classification of Explosion, Explosion and expansion ratios, deflagration and detonation, Explosion- physical explosion, chemical explosion; Special kinds of combustion- Flash fire, Pool fire, Deep-seated fire, Spillover, Boil over, Dust explosion, BLEVE, UVCE; Classification of fire based on material; Hazards in Flammable liquid storage tanks: Types of storage tanks according.to NFPA, API & other national/ international standards, Classification of liquids- based on flammability, toxicity & reactivity; Safety, Fire and health hazards of materials being stored- Static Electricity, Reactivity with water/air, dependence of Flammability range on Temperature & Pressure, Relative vapor density, etc., Fire Safety in Flammable liquid storage tanks: Prevention of failure, fire prevention measures, Grounding & Bonding, Purging of storage tanks, Hydrants & other Fixed/portable fire protection measures.

Textbooks:

1. Das, A. K. (2014). Principles of fire safety engineering and management (understanding fire & fire protection) (1st ed.).
2. Gupta, R. S. (2005). Handbook of fire technology.
3. Schroll, R. C. (2002). Industrial fire protection (2nd ed.).
4. Society of Fire Protection Engineers. (2015). Fire protection handbook (5th ed.).

Reference books

1. Davis, E. N. (2002). Fundamentals of fire engineering.

2. Grimwood, P. J., & Springe, W. D. (2013). Fire engineering: Principles and practice.
3. Smith, R. L. (2010). Fire fighting and rescue techniques.
4. Cote, A. E. (2006). Fire safety in buildings.

Modes of Evaluation: Quiz/Assignment/ Class Test/ Tutorial

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSOs) and Course Outcomes (COs)

POs/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	- -	-	1	-	-	1	-	-	1	-	1	3	1	-
CO2	1	-	-	1	-	-	1	-	-	1	-	2	1	2	1
CO3	-	-	-	1	-	-	2	-	-	2	-	2	2	3	2
CO4	1	-	-	1	-	-	3	-	-	2	-	1	3	3	2
AVG.	0.75			1			1.75			1 . 5		1 . 5	2.25	2.25	1.25

1=Weakly mapped 2=Moderately mapped 3=Strongly mapped

Course Code	Course Name	L	T	P	C
HSFS 2011	First Aid & Emergency Procedures	2	0	0	2
Pre-requisites/Exposure	• Basic knowledge of physics and chemistry • Basic knowledge of biology				
Co-requisites	--				

Course Objectives

I. To help the students understand the fundamentals and relevance of first aid and Deal with emergency situations.
II. To enable students to understand Know the limits of basic first aid and Legal perspective of First Aid, Safety at the workplace and highlights of accident prevention.
III. To empower students with the expertise of experimentation, in Know the limits of basic first aid.
IV. To expose students to a wide range of duties of the employer as a First Aider.
V. To equip students with necessary engineering skills to Understand and demonstrate essential lifesaving skills.

Course Outcomes

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

CO-1: To recall and describe fundamental principles of first aid and emergency procedures, including the ABCs (Airway, Breathing, Circulation), common emergency situations, and the correct sequence of actions.

CO-2: To demonstrate and understand the physiological basis of various medical emergencies, such as the signs and symptoms of cardiac arrest, stroke, and allergic reactions, and explain why specific first aid interventions are necessary in these situations.

CO-3: To apply their knowledge to assess and administer appropriate first aid and emergency procedures in simulated scenarios.

CO-4: To critically evaluate the effectiveness of different first aid and emergency response strategies.

CO-5: To design and implement a comprehensive emergency response plan for various settings, such as home, workplace, or public events.

Catalog Description

This course is designed to provide opportunities to learn and practice the basic first aid skills necessary to become a citizen responder for many emergencies, including adult Cardiopulmonary Resuscitation (CPR) with Automated External Defibrillator (AED), choking, shock, neck-spinal injuries and others. Participants may earn Adult CPR with AED and First Aid Responding to Emergencies after successfully completing the course; which has their test included. The course begins with a description of different Identification of the most important action that a student as a first aider can take in a life-threatening emergency and major structures of the respiratory, circulatory, nervous, and musculoskeletal systems including the emergency action steps/principles in any emergency.

Course Content

UNIT I: INTRODUCTION TO FIRST AID PRINCIPLES AND HUMAN ANATOMY

6 Lecture hours

Aims and Objectives. First Aid principles-Role of the first aider-sequence of action on arrival at scene. Vital signs: Breathing, Pulse. Introduction to the body-basic anatomical terms: Body cavities, Head, Cranium, Thorax, Abdomen and Pelvis.

UNIT II: NEUROLOGICAL DISORDERS AND EMERGENCIES 6 Lecture hours

The nervous system: functions, components, brain, cerebrum, cerebellum, medulla oblongata, cerebrospinal fluid, spinal cord. Autonomic Nervous System. Unconsciousness, causes, level of consciousness, Management of unconsciousness, Casualty problems of unconsciousness. Fainting: Recognition-management-aftercare. Diabetes: hypoglycemia, hyperglycemia-management. Seizures (epileptic fits, convulsions): features, management. Stroke. Head injuries, fractures of the base vault and sides of skull.

UNIT III: RESPIRATORY, CIRCULATORY, AND SHOCK EMERGENCIES

6 Lecture hours

The respiratory system: Respiratory failure, Asphyxia, Abdominal thrust in Heimlich maneuver. Chest injuries: Types, Fractured ribs, Pneumothorax, Hemothorax. The circulatory system: Heat attack, Chest compression, Cardiopulmonary Resuscitation (CPR). Shock: Causes, Signs and Symptoms, Management of Shock.

UNIT IV: EYE INJURIES, WOUNDS, AND BANDAGES 6 Lecture hours

Eye: Eye injuries, foreign body in eye, Eye trauma, Corrosive chemical in eye, Arc eye. Wounds: Bleeding, Classification. Types of wounds, Case of wounds, Bleeding from special sites. Bandages: Broad and Narrow fold Bandages, Hand Bandages, Slings.

UNIT V: FRACTURES, SKIN INJURIES, POISONING, AND OCCUPATIONAL HEALTH 6 Lecture hours

Fractures: Classification of fractures, Principles of immobilization, Sprains & Dislocation. The skin: Burns, Rule of nines, Pure thermal burns, Electric burns, Chemical burns, Radiation burns, Cold burns. Poisoning, Occupational health, Dermatitis, Noise, Physical fitness. Lifting: casualty handling, Use of stretchers.

Text Books

1. American Red Cross First Aid-Responding to Emergencies, 4th Ed. (2007).
2. Internet Access: Access and usage instructions will come from; http://paris.mcgrawhill.com/sites/0077349695/student_view0

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSOs) and Course Outcomes (COs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	2	-	-	-	-	-	2	-	-	-	1	2	2	-	2
CO2	1	3	3	-	-	-	2	-	-	-	-	1	-	3	1
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	3	-
CO4	3	-	3	-	-	-	-	-	-	-	3	1	-	-	1
CO5	3	-	-	-	3	-	-	-	3	-	3	2	-	2	2
AVG	2.4	0.6	1.2		0.6		0.8		0.6		1.4	1.2	1	1.6	1.2

1=Weakly mapped 2= Moderately mapped 3=Strongly mapped.

Course Code	Course Name	L	T	P	C
MECH 2123	Fluid Mechanics lab	0	0	2	1
Pre-requisites/Exposure	Knowledge of Fluid Mechanics				
Co-requisites	--				

Course Objectives

1. To provide practical knowledge in verification of principles of fluid flow and its characterization.
2. To impart knowledge in measuring pressure, discharge and velocity of fluid flow.
3. To understand Major and Minor Losses in pipe flow.
4. To investigate the critical parameters between laminar and turbulent flows.

Course Outcomes

CO-1: Calibrate flow measuring devices used in pipes, channels, and tanks.
CO-2: Determine types of fluid and flow properties.
CO-3: Classify laminar and turbulent flows.
CO-4: Compute the various losses in pipe flow.

Catalog Description

The material in this course will provide the student with a fundamental background in the statics and dynamics of fluids. The basic conservation laws of mass, momentum and energy are analyzed in control volume and differential form. It is expected that student will be able to correctly apply the lecture course content to evaluate potential industrial applications. Real life applications of these fundamental concepts will be introduced. Interpretation of results from experiments and numerical simulation of fluid flows will also be emphasized.

List of Experiments

1. To verify the Bernoulli's equation using the Venturimeter (Law of Conservation Of Energy).

2. To determine the Coefficient of discharge C_d, Velocity C_v and Contraction C_c of various types of Orifices and Mouthpieces.
3. To study the Reynolds number in different flow conditions.
4. To determine the discharge coefficients of V-notch and Rectangular Notch (U).
5. To verify Darcy's law and to find out the coefficient of permeability of the given medium.
6. To study the variation of friction factor, 'f' for turbulent flow in smooth and rough commercial pipes
7. To determine the minor head loss coefficient for different pipe fittings.
8. To calibrate an Orifice meter and study the variation of coefficient of discharge with Reynolds number
9. To calibrate a Venturimeter and to study the variation of coefficient of discharge with the Reynolds number

Textbooks:

1. Kumar, K.L. (2014). Engineering Fluid Mechanics, Multicolor revised edition, S. Chand and Co, Eurasia Publishing House, New Delhi.
2. Bansal, R.K., (2013), A text book of Fluid Mechanics and Hydraulic Machines, Laxmi Publications, New Delhi.
3. Modi P.N. and Seth S.M. (2011), Hydraulics and Fluid Mechanics,18th Edition, Standard Book House, New Delhi.

Reference Books:

1. Fox, R.W., Pritchard P.J. and McDonald, A.T., (2009) Introduction to Fluid Mechanics, 7th Edition, John Wiley, New York.
2. White, F.M. (2013), Fluid Mechanics McGraw Hill Publishing Company Ltd, New Delhi.
3. Som, S.K. and Biswas G. (2010), Introduction to Fluid Machines, 2nd Edition, Tata McGraw-Hill Publishers Pvt. Ltd.

Modes of Evaluation: Continuous Evaluation

Continuous lab evaluation is there to assess the students' performance in the lab

Components	Presentation	Viva	File	Total

Weightage (%)	30	30	40	100

Relationship between Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	-	2	-	-	-	3	3	3	-	-	2	-	-
CO2	-	3	-	2	-	-	-		3	3	-	-	2	-	-
CO3	-	3	-	2	-	-	-	3	3	3	-	-	2	-	-
CO4	-	3	-	2	-	-	-		3	3	-	-	2	-	-
Avg.	-	3	-	2	-	-	-	3	3	3	-	-	2	-	-

1. Weak Mapped 2. Moderate Mapped 3. Strong Mapped

Course Code	Course Name	L	T	P	C
Course Code: HSFS 2009	Behavior Based Safety	2	1	0	3
Pre-requisites/Exposure	• Basics of Safety Engineering • Awareness on right communication				
Co-requisites	NA				

Course Objectives

I. To illustrate the importance and need for safety engineering associated with multiple hazards and risks.

II. To understand the concepts of global scenario of BBS and promote safety behaviors in the workplace that could create safe working environment.

III. To create a workplace environment where safety is valued and everyone is committed to working safely.

IV. To analyze the gaps between reference standards & pertinent conditions of safety and to work towards reducing accidents in the work place

Course Outcomes

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

CO-1: Understand the concepts and the steps involved in a behavior-based safety program and organizational and procedural requirements for effective safety management.

CO-2: Apply the human factors engineering design concepts and principles to enhance workplace safety.

CO-3: To perform accident investigation and apply systematic procedure to identify the root cause of the incidents.

CO-4: Evaluate the workplace to determine the safety performance and implement right BBS concepts to enhance the safety culture.

Catalog Description

BBS, it is important for the students to have knowledge about basic safety in the company. Health, safety, and environment issues are very critical in the industrial operations in the current scenario. It helps the students how hazards lead to an immediate or sudden accidents like an injury, fire, explosion, or toxic release. How the safety issues and safety management come in the picture of top and bottom Management It provides basic knowledge of HSE efforts of many organizations that are driven by statutory requirements, and they do whatever minimum is required to avoid litigation and fines.

Course Content

UNIT 1: BASICS OF SAFETY MANAGEMENT **7 Lecture hours**

Defining safety, Safety management systems, PDCA approach, Accidents, Concept of near miss, Causes of accidents- Unsafe acts vs conditions. Hazard vs risks, Safety Pyramids, Cost of accident, Safety policy, Safety organization. Hierarchy of control. Duties of safety officer.

UNIT 2: BEHAVIOR-BASED SAFETY **7 Lecture hours**

Behavioral-based safety – overview –, BBS vs Traditional Safety, psychology of behavior management – focus on behavior to manage the risk – leadership- behavior safety Programme for employees- measure safety Programme – ABC model – BBS - case studies

UNIT 3: ACCIDENT INVESTIGATION **8 Lecture hours**

Types and Severity of Accidents, Accident Classification, Accident- Objectives & Methodology of conducting accident investigation. Accident Reports, Legal Compliances of Accident reporting, Root cause analysis techniques, Incident Recall Techniques.

UNIT 4: SAFE SYSTEM OF WORK **7 Lecture hours**

Work permit system- objectives, hot work and cold work permits. Typical industrial models and methodology. Entry into confined spaces. 5 S & Housekeeping. Plant safety inspection types, and inspection procedure. Job Safety Analysis and safety sampling techniques. Safety surveys, Safety audits; Safety Inventory Technique.

UNIT 5: SAFETY EDUCATION AND TRAINING **9 Lecture hours**

Importance of training-identification of training needs-training methods – programmes, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety diSpecializationays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

UNIT 6: MONITORING AND MEASURING SAFETY **7 Lecture hours**

Monitoring and Reporting, Leading and lagging indicators, IS 3786, Frequency rate, severity rate, incidence rate, Cost of accidents-Computation of Costs- Utility of Cost data, Safety t Score.

Textbooks

1. Daalmans, J. (2012). Human behaviour in hazardous situations. Butterworth Heinemann.
2. Reese, C. D. (2018). Occupational health and safety management: A practical approach (3rd ed.). CRC Press.
3. Roughton, J. E., & Mercurio, J. J. (2012). Developing an effective safety culture. Butterworth Heinemann.

Reference books

1. Heinrich, H. W. (1980). Industrial accident prevention. McGraw-Hill Company.
2. Ridley, J. (1983). Safety at work. Butterworth and Co.
3. Blake, R. B. (2000). Industrial safety. Prentice Hall, Inc.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	1	1	2	-	1	-	-	3	-	2	-	2
CO2	-	2	1	2	-	3	-	-	-	-	3	-	2		2
CO3	-	2		2	-	3	-	-	-	-	3	-	2		2
CO4	-	2	-	-	-	2	-	-	-	-	2	-	2	1	2
CO5	2	2	2	2	2	3	-	-	-	-	2	-	2		3
AVG.	1.5	2	1.5	1.75	1.5	2.6	-	1	-	-	2.6	-	2	1	2.2

1=Weakly mapped 2= Moderately mapped 3=Strongly mapped

SEMESTER IV

Course Code	Course Name	L	T	P	C
SLLS0202	Working with Data (Life Skill 5)	2	0	0	2
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

The objectives of this course are:

I. To perform basic operations such as reading data into excel using various data formats, organizing and manipulating data, to some of the more advanced functionality of Excel.

II. To collate data, analyze that data, and present the decision-making process for their chosen organizational problem.

III. To collaborate with team members and execute group projects in a timely manner.

Course Outcomes

Knowledge & Understanding:

On completion of this course, the students should be able to:

CO-1: Understand the use and importance of data in our daily lives and business decisions.

CO-2: Apply mathematical and statistical operations on collected datasets using MS Excel.

CO-3: Analyze data collected from open source platforms to find hidden patterns.

CO-4: Develop a small project using analytical and visualization techniques on a real dataset using data analytical tool like MS Excel.

Skills and Attributes:

1. Use a range of basic operations to draw appropriate conclusions in the development of a decision to a problem that the team decided to solve.
2. Work Collaboratively.

Catalog Description:

This course provides an understanding of the essential spreadsheet functions to organize data in our day-to-day life, particularly at our workplace, and also to analyze data for decision-making. It focuses on enabling the students to consciously apply the acquired knowledge to grow to be an expert data-driven decision-maker.

Course Content

Unit 1: DECISION MAKING AND RISKS **2 lecture hours**

Informed decisions and Intuition

Unit 2: SOURCES OF DATA **4 lecture hours**

Data collection methods, Referencing, deriving interpretations, Decision-making process.

Unit 3: INTRODUCTION TO SPREADSHEETS **6 lecture hours**

Reading data into Excel using various formats, Basic functions in Excel, arithmetic as well as various logical functions, Formatting rows and columns, using formulas in Excel and their copy and paste using absolute and relative referencing

Unit 4: SPREADSHEET FUNCTIONS TO ORGANIZE DATA **4 lecture hours**

IF and the nested IF functions VLOOKUP and HLOOKUP, The RANDBETWEEN function

Unit 5: FILTERING, PIVOT TABLES, AND CHARTS **6 lecture hours**

VLOOKUP across worksheets, Data filtering in Excel, Use of Pivot tables with categorical as well as numerical data, Introduction to the charting capability of Excel

Unit 6: ADVANCED GRAPHING AND CHARTING **2 lecture hours**

Line, Bar and Pie charts, Pivot charts, Scatter plots, Histograms.

Unit 7: CAPSTONE PROJECT SUBMISSION & PRESENTATION **6 lecture hours**

Textbooks

1. **Hector Guerrero,18 Jan 2019**: Excel Data Analysis Modeling and Simulation, Springer

International Publishing ISBN: 9783030012786

2. **Ash Narayan Sah**, Data Analysis Using Microsoft Excel ISBN: 9788174467164, 8174467165

E-book Link:

1. https://www.google.co.in/books/edition/Excel_Data_Analysis/V3B_DwAAQBAJ?hl=en&gbpv=1&dq=data+analysis+with+excel&printsec=frontcover

2. https://www.google.co.in/books/edition/Data_Analysis_Using_Microsoft_Excel/IekT1py5WPUC?hl=en&gbpv=1&dq=data+analysis+with+excel&printsec=frontcover

3. https://www.google.co.in/books/edition/Microsoft_Office_Excel_2007_Data_Analysi/04sQhDOpDiAC?hl=en&gbpv=1&dq=data+analysis+with+excel&printsec=frontcover

Reference Books:

1. **Denise Etheridge, 2007:** Microsoft Office Excel 2007 Data Analysis Publishing, Wiley ISBN: 9780470132296, 0470132299

Web Sources

- https://excelwithbusiness.com/
- https://www.excel-easy.com/

Modes of Evaluation: (Capstone Project **{50%}** + Excel Quiz-1 **{30%}** + Excel Quiz-2 **{20%}**)

Examination scheme

Components	Quiz (Based on Weekly Exercises & Coursera)	Capstone Project	Coursera Course
Weightage (%)	50%(Quiz-1 {30%} {Week-1 to Week-4 + Coursera}+Quiz-2 {20%} {Week-6 to Week-9 + Coursera})	50%(30% Data Analysis +20%Data Visualization)	Audit Mode

Relationship between the Course Outcomes (COs) and Program Outcomes (POs):

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO1	PSO2	PSO3

CO1	1	1	1	1	1	1	-	-	1	1	1	1	-	-	-
CO2	1	2	1	1	1	1	-	-	1	1	1	1	-	-	-
CO3	1	1	1	1	1	1	-	-	1	1	2	1	-	-	-
CO4	1	1	2	1	1	1	-	-	2	1	2	1	-	-	-
Average	1	1.25	1.25	1	1	1	0	0	1.25	1	1.5	1	-	-	-

1 = Weakly Mapped, 2 = Moderately Mapped, 3 = Strongly Mapped

Course Code	Course name	L	T	P	C
SLSG 0202 **(Signature-3)**	Environment and Sustainability – Himalaya Fellowship (Signature-3) School of Life Courses	3	0	0	3
Pre-requisites/Exposure	Critical Thinking & Writing, Design Thinking, Ethical Leadership in the 21st century				
Co-requisites	Start your Start up				

Course Objectives

This course aims at sensitizing students to the environment and the balance of natural and manmade ecosystems. Develop empathy and concern for environment and evolve as conscious participants in resolving issues affecting local and global environment. The course seeks to build interdisciplinary approach and analytical skills, with an element of creativity towards achieving a sustainable future.

The objectives of this course are to:

I. Develop a critical understanding of the nature, cause and impact of human activities on the environment.
II. Critically engage with concepts of ecosystems, biodiversity and sustainability.
III. Research, analyze, identify problems, develop insights, and frame sustainable solutions, to living issues faced by the global and local communities.
IV. Learning by doing, engaging, exploring and experimenting.

Course Outcomes

Knowledge & Understanding:

After completing this course, you will be able to:

Co-1: Understand the concepts of ecology and environment related to everyday life

Co-2: Distinguish and relate different types of biodiversity and natural resource and their impact on sustainable development.

Co-3: Analyse various aspects of environment and adopt eco-friendly technologies to facilitate conservation and regeneration of natural resource

Skills and Attributes:

1. Use a range of basic reflective practice exercises, through self-reflection, experimentation and exploration.
2. Build environmental awareness through a wide range of curricular and co-curricular activities at the University and later in a professional/vocational practice.
3. Choose and employ appropriate practice tools in the execution of a project/coursework.
4. Critique and articulate responses to group and individual work undertaken by self and by others.

Catalog Description

This course aims at sensitizing students to the environment and the balance of natural and manmade ecosystems. Develop empathy and concern for environment and evolve as conscious participants in resolving issues affecting local and global environment. The course seeks to build interdisciplinary approach and analytical skills, with an element of creativity towards achieving a sustainable future.

Course Content

The teaching and learning experience follow a Hybrid blended learning model, which incorporates f2f modalities with online learning.

Range of modes of direct contact teaching and learning methods used on this course:

- Large and small group discussions
- Classroom exercises,
- Peer critiquing
- Direct observation
- Experimentation and reflections range of modes of online teaching and learning methods used on this course.
- Online tutorials (Generated with expert animated videos)
- Documentation and journaling
- Reading / reviewing Resources
- Reading / Reviewing & Commenting - Peer critiquing
- Writing reflections/ critique

36 hours (not including online learning)

15 weeks, 36 hours   15 hrs live   21 hrs a synchronous

Range of modes of other direct teaching and learning methods used on this course

Directed reading and research, Internet based resources and online prepared resources

Text Books:

Erach Bharucha (Environmental Science)

Reference Books:

1. Agarwal K.C, 2001, Environmental Ecology & Cunningham,
2. W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopaedia

13. **Formative Assessment Methods**

Type	Description (Project Presentation)
Classroom exercises, discussions, and practice sessions	• Interim Reviews • Reflective Blog/ Journal (on-line – LMS or physical) • Discussion Forum (on-line - LMS) • Quiz

14. Summative Assessment Methods

This indicates the type and weighting of assessment elements in the course.

Weightage	Type	Description
20%	• Mid Sem Quiz	To evaluate understanding of the definitive theory of learning processes
30%	• Continuous Evaluation of Weekly Class Activities	Composite exercise/s using different media/platforms that demonstrate the understanding and application of learning methods and tools
50 %	• End Sem Quiz	To evaluate understanding of the definitive theory of learning processes

Further information on assessment

The continuous evaluation is an important component. This will help assess the holistic nature of the level in question. It may be done under the guidance of the tutor.

The evaluation will be described in detail in the assessment brief.

Diagnostic /formative assessment

This indicates if there are any assessments that do not contribute directly to the final course mark

- Peer critiquing (do not contribute directly to the final mark)
- Presentations
- Tutor reviews
- Classroom exercise
- Practice Assignments

Week	Asynchronous	Synchronous
Week 1	**Multidisciplinary Nature of Environment Studies** Definition, scope and importance Need for public awareness	1. Introduction about the course- importance, scope and significance 2. Video :- India's Environmental Crisis www.youtube.com/watch?v=OeAyTLgWiH8 3. Story Time 4. Reflective Exercise
Week 2	**Ecosystems** Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession.	1. Track your carbon footprint for a day- use a web calculator 2. Activity : Mini-Dumps Aim: To learn that different materials decompose at different rates (and some don't decompose at all)
Week 3	Food chains, food webs and ecological pyramids Introduction, types, characteristic features, structure and function of the a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) case studies	Ecological Activity: Build your farm Aim: To learn how living things are connected in an ecosystem, as illustrated by Carmen's Farm.
Week 4	**Biodiversity and its conservation** Introduction – Definition: genetic, species and ecosystem diversity. Biogeographical classification of India Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values Biodiversity at global, National and local levels. India as a mega-diverse nation	Activity: Transects and Quadrats Aim: To census biodiversity and to compare it between different ecosystems
Week 5	**Natural resources and Management** Renewable and non-renewable resources	1. Identify 5 birds, 5 different types of soil, or 5 trees

	Natural resources and associated problems Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles	2. Activity: Gifts From the Earth Aim: To identify the natural source for the materials in common products
Week 6	**Environmental pollution and its control Methods** Cause, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards	Activity:- Map Out Litter Aim: To develop ideas for coping with pollution
Week 7	**Solid Waste Management:** Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies	Activity: Useful Waste Aim: To identify categories of waste that can be reused
Week 8	**Disaster management : floods, earthquake, cyclone and landslides**	Movie time: Wild Karnataka
Week 9	**Social Issues and the Environment** From Unsustainable to Sustainable development Urban problems related to energy Water conservation, rain water harvesting, watershed management Resettlement and rehabilitation of people; its problems and concerns. Case Studies	Field Visit
Week 10	***Environment Protection Act.*** Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act Wildlife Protection Act Forest Conservation Act Issues involved in enforcement of environmental legislation.	Discussion time in classroom- topic: Are the policies and laws on environmental conservation effective? Is our future secure?
Week 11	**Human Population and the Environment** Population growth, variation among nations. Population explosion – Family Welfare Programme. Environment and human health Role of Information Technology in Environment	Culmination of Project Street Plays, Flash Mobs, Performances
Week 12		Review of the course and discussion on presentations

Week 13Week 15		Presentations of the students

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	IA	MID Sem	End Sem	Total
Weightage (%)				100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
Average															

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course Code	Course name	L	T	P	C
	Exploratory - 2	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

Course Outcomes

Catalog Description

Course Content

Unit 1 – Heading – 23 Lectures

Unit 1 Detail content

Unit 2 – Heading – 22 Lectures

Unit 1 Detail content

Text Books / Reference Books

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	IA	MID SEM	End Sem	Total
Weightage (%)				**100**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

P O / C O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
Average															

1= Weakly Mapped, 2= Moderately Mapped, 3 = Strongly Mapped

Course Code	Course name	L	T	P	C
HSFS 3004	Occupational Safety and Industrial Hygiene	3	0	0	3
Pre-requisites/Exposure	• Basic Knowledge of First-Aid and Industrial Safety. • Basic Knowledge Safety & its implications in Work Places with special reference hydrocarbon industry. • Basic knowledge human physiology & the surrounding factors and its effects.				
Co-requisites					

Course Objectives

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

I. To inculcate the condition of the global scenario of health & safety at the workplace and its relevant consequences.

II. To analyze the gaps between reference standards & pertinent conditions of occupational health and safety in India and adapt the feasible solutions.

III. To solve complex human factors and ergonomics-related issues and develop a ergonomic work bench and advise on right methodology to perform a work.

IV. To understand the effects of various occupational hazards and their consequences on human health and advise on effective control strategies.

Course Outcomes

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

CO-1: Understand the different occupational hazards and their implications on the human body.

CO-2: Identify the root cause for the occupational hazards and adopt the standard global practices to control them.

CO-3: Apply an effective industrial hygiene program for the workplace and monitor its effectiveness.

CO-4: Develop an occupational health management plan to prevent the employees form the dangers arising due to occupational hazards in the workplace.

Catalog Description

Occupational safety and health , also commonly referred to as occupational health and safety (OHS), occupational health or workplace health and safety (WHS), is a multidisciplinary field concerned with the safety, health, and welfare of people at work. These terms of course also refer to the goals of this field, so their use in the sense of this article was originally an abbreviation of occupational safety and health program/department etc. Occupational safety and health programs aim to foster a safe and healthy work environment. Occupational health and safety may also protect co-workers, family members, employers, customers, and many others who might be affected by the workplace environment. This course is ideal for students who are interested in a career in OHS, or who are simply interested in learning more about how to create a safe and healthy workplace. OHS professionals play a vital role in protecting workers and ensuring that workplaces are safe and healthy.

Course Content

UNIT 1: PHYSICAL AND CHEMICAL HAZARDS **9 Lecture hours**

Recognition, Evaluation and Control of Physical Hazards- Noise and Vibration - Effects and Control Measures- Thermal Stress - Parameter Control, Radiation - Types - Source - Effect and Control- Illumination & Lighting. Recognition, Evaluation and Control of Chemical Hazards- Types - Dust-Fumes -Mist -Vapor-Fog etc., Air Contaminants- Evaluation - Types of Sampling-Air Sampling System-Method Analysis-Control Measures.

UNIT 2: INDUSTRIAL TOXICOLOGY **9 Lecture hours**

Concept and Spectrum of Health-Functional Units and Activities of Occupational Health Services-Occupational and Work Related Disease-Levels of Prevention of Diseases - Notifiable Occupational Diseases such as Silicosis- Asbestosis- Pneumoconiosis-- Aluminosis and Anthrax. Lead-Nickel, Chromium and Manganese Toxicity-Gas Poisoning (such as CO, Ammonia, Coal Dust etc.,) their effects and Prevention- Cardio Pulmonary Resuscitation- Audiology-Hearing Conservation Programme-Effects of Ultra Violet Radiation and Infrared Radiation on Human Systems

Industrial Toxicology-Local and Systemic and Chronic Effects Temporary and Cumulative Effects-Carcinogens Entry into Human System Ergonomics, Personnel Protective Equipment, Personnel Monitoring

UNIT 3: PERSONAL HYGIENE AND FIRST AID **13 lecture hours**

Hygiene Concepts-Correct and Clean Dresses-Clean Body - Washing - Good Habits-Oral and Stomach Hygiene-Cleaning - Compressed Air and Degreasing Agents-Long Hair and Nails and Torn and loosely Hanging Clothes-Smoking - Lavatories Maintenance- Living in Unhygienic Areas. First aid concept- -First Aid Boxes-Legal Requirements, Industrial Hygiene, Medical Surveillance, Medical Surveillance Program Development, Recommended Medical Programme, Emergency Treatment, Non-Emergency Treatment, Exposures to Hazardous Materials.

UNIT 4: RADIATION CONTROL **5 Lecture hours**

Radiation Shielding - Radiation Dose - Dose Measurements - Units of Exposure- Exposure Limits-Barriers for Control of Radioactivity Release, Control of Radiation Exposure to Plant Personnel, Health Physics Surveillance - Waste Management and Disposal Practices – Environmental Releases.

UNIT 5: BIOLOGICAL AND ERGONOMIC HAZARD **9 Lecture hours**

Classification of Bio-hazardous agents –bacterial agents, viral agents, fungal, parasitic agents, -infectious diseases; Biohazard control program, employee health program-laboratory safety program-animal care and handling; Ergonomics-Concepts, objectives, Work Related Musculoskeletal Disorders –Carpal Tunnel Syndrome CTS- Tendon pain disorders of the neck-back injuries, Ergonomic management program; Pandemic and Management with Case Study

Text Books

1. National Safety Council. (1982). Handbook of occupational safety and health. Chicago, IL: Author.
2. Koradecka, D. (2010). Handbook of occupational safety and health. Boca Raton, FL: CRC Press.

3. Stellman, J. M. (Ed.). (1998). Encyclopedia of occupational health and safety (Vols. 1-2). Geneva, Switzerland: International Labour Organization.
4. Plog, B. A., Quinlan, P. J., & Villareal, J. (2012). Fundamentals of industrial hygiene (6th ed.). Itasca, IL: National Safety Council.

Reference Books

1. Wegman, D. H., & McGlothlin, J. D. (2019). Occupational medicine (8th ed.). Lippincott Williams & Wilkins.
2. LaDou, J., Himmelstein, J. A., & Aschner, M. (2018). Occupational and environmental medicine (5th ed.). McGraw-Hill.
3. Plog, B. A., Quinlan, P. J., & Villareal, J. (2012). Fundamentals of industrial hygiene (6th ed.). National Safety Council.
4. Goldstein, B. D., Hilado, C. O., & Adams, R. N. (2014). Patty's industrial hygiene (6th ed.). John Wiley & Sons.
5. Proctor, N. H., Hughes, J. P., & Lemke, W. E. (2015). Proctor and Hughes' chemical hazards of the workplace (6th ed.). John Wiley & Sons.
6. American Conference of Governmental Industrial Hygienists. (2021). ACGIH industrial ventilation: A manual of recommended practices (29th ed.). ACGIH.
7. Heinrich, H. H. W. (1980). Industrial accident prevention (5th ed.). McGraw-Hill.
8. Reese, C. D. (2018). Occupational safety and health management (3rd ed.). CRC Press.
9. Yates, D. (2018). Safety professional's reference and study guide (6th ed.). Delmar Cengage Learning.
10. American Society of Safety Professionals. (2021). ASSP safety and health fundamentals: A complete guide to protecting people, property, and the environment (6th ed.). ASSP.
11. Yates, D. (2016). The occupational safety and health handbook (4th ed.). CRC Press.
12. Headley, G. C. (2010). The complete safety guide (6th ed.). Prentice Hall.
13. Conway, J. T. (2019). The safety officer's handbook (6th ed.). American Society of Safety Professionals.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Internal Assessment	MSE	ESE	Total
Weightage (%)	30	20	50	100

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	2	1		2	-	-	-	1	1	
CO2	2	3	1	-	-	-	-	2	-	-	-	-	2	1	
CO3	1	1	-	-		1	-	1	-	-	-	-	2	2	1
CO4	-	2	2	1	1	-	-	-	1	-	-	-	2	2	1
CO5	1	2	1	-	-	-	-	-	1	2	-	-	1	1	2
Avg	1.75	1.8	1.33	1	1	1.5	1	1.5	1.33	2	-	-	1.6	1.4	1.33

1 =Weakly mapped, 2 = Moderately mapped, 3 = Strongly mapped

Course Code	**Course name**	L	T	P	C
MECH 2018	Strength of Materials	2	0	0	2
Pre-requisites/Exposure	• Basic Knowledge of law of physics • Basic Knowledge of Mechanics				
Co-requisites	--				

Course Objectives:

The course will enable the students:

I. To recalling previous knowledge required to the course Strength of Materials.
II. To calculate and derive various equations required to assure strength of materials.
III. To design and solve material engineering problems.
IV. To analyse the strength of building structures subjected to point and continuous load.

Course Outcomes:

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

CO-1: Understand the concept of engineering mechanics for implication in Strength of materials.

CO-2: Analyze engineering problems using basic principles of stress and strain.

CO-3: Derive and apply stress and strain relationships in single and compound members subjected to axial force, bending moment and torque.

CO-4: Analyze failure of machine components, pressure vessels and joints under complex stress conditions.

CO-5: Generate input data required for designing of structural and mechanical components.

Catalog Description

Strength of materials, also called mechanics of materials, is a subject which deals with the behavior of solid objects subject to stresses and strains. The complete theory began with the consideration of the behavior of one- and two-dimensional members of structures, whose states of stress can be approximated as two dimensional and was then generalized to three dimensions to develop a more complete theory of the elastic and plastic behavior of materials. The study of strength of materials often refers to various methods of calculating the stresses and strains in structural members, such as beams, columns, and shafts.

Course Contents:

Unit – 1: SIMPLE STRESSES AND STRAINS 07 lecture hours

Normal stresses and strains; Various types of stresses and strains; Hook's Law; Elastic Constants; Generalized Hook's law; Axial load diagrams; Deformation in prismatic, stepped, linearly varying and composite members under axial load and self-weight; Stress and strain in Indeterminate member; Temperature stresses, working stress concept; Stress due to impact load using strain energy concept.

Unit – 2: SHEAR FORCE AND BENDING MOMENT DIAGRAMS 06 lecture hours

Relation between shear force, bending moment and loading, Shear force and bending moment diagram in cantilever, simply supported and compound beam with concentrated, distributed load and couples, overhanging beams, points of contra-flexure.

Unit – 3: STRESS IN BEAMS 06 lecture hours

Theory of bending, Flexural formula, Moment of resistance and section modulus, Skew Loading: Bending of symmetrical sections about axis other than axis of symmetry, Eccentric Loading:

Combined bending and direct stress, Shear stresses in beams, Shear stress formula, and Shear stress determination in symmetrical sections.

Unit – 4: TORSION 05 lecture hours

Introduction and theory of torsion, Shear stress in hollow and solid circular shafts due to torsion, Comparison of Hollow and Solid shafts, Composite shafts, Spring concept.

Unit – 5: AXIALLY LOADED COLUMNS AND COMBINED STRESS 06 lecture hours

Introduction, Buckling Effect, Euler's theory and Rankine's formula for axially loaded columns with different end conditions, Concept of equivalent length, Stresses due to eccentric and lateral loads, Core of sections.

Text Books:

1. Timoshenko, S. and Young, D. H., (2006) "Elements of Strength of Materials", DVNC, New York, USA.
2. Kazmi, S. M. A., (2001) "Solid Mechanics" TMH, Delhi, India.
3. Hibbeler, R. C. (2004). Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall.

Reference Books:

1. Crandall, S. H., N. C. Dahl, and T. J. Lardner (1979). An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill.
2. Ferdinand P. Beer, E. Russel Jhonston Jr., John T. Dewolf (2002) Mechanics of Materials - TMH.
3. Subramanian R. (2008) Strength of Materials, Oxford University Press, New Delhi.

Modes of Evaluation: Quiz/Assignment/ Class Test/ Tutorial

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	2	-	-	-	-	-	-	-	-	-	-	2	2	-	-
CO2	-	3	-	2	-	-	1	-	-	-	-	1	-	3	-
CO3	1	2		1	-	-	-	-	-	-	-		2	3	-
CO4	-	-	-	3	-	-	-	-	-	-	-		3	2	-
CO5	-	1	3	-	-	-	1	-	-	-	-	1	2	3	-
Avg	1.5	2	3	2	-	-	1	-	-	-	-	1.33	2.25	2.75	-

1=Weakly mapped 2= Moderately mapped 3=Strongly mapped

Course Code	Course Name	L	T	P	C
HSFS 2016	Planning and Design of Fire Protection System	2	1	0	3
Pre-requisites/Exposure	• Basics of Fire Engineering • Fluid Mechanics • Hydraulic Machines				
Co-requisites	Principles of Engineering Design				

Course Objectives:

I. To provide an in-depth in site of Fire Water Pumping Systems & different types of Fire Vehicles used in fire service.

II. To enumerate the accessories used in Fire Service:- Functions/Uses/Applications, Types, Maintenance & Safe Handling Procedures.

III. To provide a brief overview of Fire ground operations.

IV. To recognize the importance of fire prevention in buildings and how this is achieved in practice.

Course Outcomes:

At the end of this course student should be able to:

CO-1: Explain operation uses/functions, Applications & limitations of different types of fire pumps and fire vehicles used in fire service.

CO-2: Calculate pump discharge pressure and maximum flow capacity for a fire stream.

CO-3: Identify & elaborate about different types of hoses, nozzles, tools & ladders used in fire service.

CO-4: Demonstrate usage of different kinds of breathing apparatus and PPEs along with their functions and applications.

CO-5: Formulate a rough plan of action to deal with any given fire emergency.

Catalog Description

To serve in fire service field, one must understand not only the dynamics of fire but also the science and engineering of various firefighting appliances, dealing with fire related emergencies to bring the situation under control. Fire engineer's role is to design/select/use appropriate firefighting equipment effectively and efficiently to bring situation under control. To do so, basic knowledge of the equipment, engineering calculation of capacity, and how to use them, is required. Hence, this subject aims to inculcate knowledge and skills necessary for understanding, designing and utilizing various firefighting equipment such as fire pumps, vehicles, firefighter's tools, breathing aids and utilization of these in real-time firefighting operations to decide right course of action.

Course Content

Unit – 1: FIREFIGHTING VEHICLES **09 lecture hours**

Fire fighting vehicles and appliances:- Pumps, primers and cooling system - use, Layout of fire fighting Vehicles and appliances:- Crash tenders, rescue tenders, hydraulic platforms, turntable ladders, hose laying tenders, control vans, Rescue boats (SCUBA).

Unit – 2: FIRE SERVICE EQUIPMENT AND MAINTENANCE **09 lecture hours**

Fire Service Equipment: Use and maintenance, hydrants and standpipes. Hose reels hose fittings -coupling, Branches, Branch holders, Radial branches, Monitors, Nozzles, Collecting heads, suction, hose fittings, adopters and ramps.

Unit – 3: FIRE SERVICE ROPES AND LADDERS **10 lecture hours**

Ropes and Lines: Types-wire and rope lines used in fire service. Use and testing of lines, knots, Bends and hitches, General Rope work.
Ladders: features of Extension ladders, wheels escape, hook ladder, turntable, Snorkel, safety devices, uses and maintenance. Small gear and miscellaneous equipment's- General-purpose tools and equipment, Lamps and lighting sets.

Unit – 4: BREATHING APPARATUS **10 lecture hours**

Breathing apparatus and associated equipment, resuscitation apparatus, foam making equipment, hydraulic rescue equipment. Types and operational use of modern oxygen breathing apparatus, modern compressed air -breathing apparatus. Identification of cylinders used with their apparatus.

Unit – 5: FIRE GROUND OPERATIONS **07 lecture hours**

Fire ground operations - preplanning, action on arrival and control, methods of rescue, methods of entry. Personnel safety. Control procedure and use of other safety equipment. Ventilation and salvage operations. Investigations of fire - causes.

Textbooks:

1. Jain V.K. (2007), Fire Safety in Buildings, New Age International (P) Limited, New Delhi.
2. Freidman R. (1998) Principle of Fire Protection Chemistry and Physics, NFPA.
3. Paul Spurgeon (2012) Fire Service Hydraulics & Pump Operation, Fire Engineering Series, Penwell Publications.

Reference Books:

1. BIS (2016) National Building Code Part IV, Bureau of Indian Standards.
2. NFPA (2001) Fire Protection Handbook, National Fire Protection Association.
3. SFPE (2003) Handbook of Fire Protection Engineering, The SFPE Handbook of Fire Protection Engineering.

Modes of Evaluation: Quiz/Assignment/ Class Test/ Tutorial

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	2	1	-	1	-	-	-	-	2	2	-	2
CO2	1	2	-	2	2	-	2	-	-	-	-	3	2	-	1
CO3	1	1	-	1	2	-	-	-	-	-	-	2	2	-	2
CO4	1	2	-	2	1	-	-	-	-	-	-	2	2	1	2
CO5	2	2	3	1	2	-	-	-	-	-	-	2	2	1	1
Avg	1.4	1.8	3	1.6	1.6	-	1.5	-	-	-	-	2.2	2	1	1.6

1=Weakly mapped 2= Moderately mapped 3=Strongly mapped

Course Code	Course name	L	T	P	C
HSFS 2117	Safety Engineering Lab	0	0	2	1
Pre-requisites/Exposure	Basic knowledge of safety engineering				
Co-requisites	Planning and Design of Fire Protection Systems				

Course Objective

I. To apply fundamental knowledge of safety engineering to solve the safety engineering related problems.
II. To know the various Personal Protective Equipment's (PPE's) and their uses.
III. To impart training to the students how to conduct job safety analysis (JSA) and safety audit.
IV. To inculcate safety survey accident and investigation and use of AUTOCAD.

Course Outcomes

At the end of the course the student will be able to:

CO-1: Understand different technical and procedural requirements for effective safety management.

CO-2: Apply the required technical and procedural tools in the identified safety related problems.

CO-3: Analyze different safety related problems in the installation.

CO-4: Design plant layout, piping and instrumentation diagram with the help of AUTOCAD and development of training module on various safety issues.

Catalog Description

Safety Engineering is an engineering discipline which assures that engineered systems provide acceptable levels of safety. It is strongly related to industrial engineering and the subset system safety engineering. Safety engineering assures that a life-critical system behaves as needed, even when components fail. The main aim of this lab is to train personnel of scientific know-how and orientation in theory and practice in the area of safety.

List of Experiments:

Experiment No.-1 PPE's.

To study different types of PPE's

Experiment No-2. Job safety analysis

To conduct Job safety analysis – Exercises

Experiment No-3. Accident investigation and Analysis

To conduct accident investigation and analysis – Exercises

Experiment No-4. Work permits.

Preparation of work permits

Experiment No-5. Safety survey

To conduct Safety survey of a laboratory.

Experiment No6. Safety audit

To conduct safety audit of a laboratory.

Experiment No7. Risk/Safety assessment

To conduct risk/safety assessment in a construction site.

Experiment No8. Safety manual

To design and develop a training module on any topic of safety.

Experiment No9. Safety performance

Assessment of the safety performance in an industry and preparation of report.

Experiment No10. P&I diagram

Preparation of a P&I diagram using AUTOCAD.

Experiment No11. Layout of a chemical plant

Preparation of the layout of a chemical plant using AUTOCAD.

Experiment No12. Cost of accidents.

To calculate the cost of accidents.

Text Books and References

1. Jain, R.K. and Rao, S.S. (2000). Industrial Safety, Health Environmental Management System:, Khanna Publishers.
2. Blake R.B. (1973). “Industrial Safety” Prentice Hall, Inc., New Jersey.
3. Dan Petersen, (1981), “Techniques of Safety Management”, McGraw-Hill Company, Tokyo.
4. Heinrich H.W. (1980) “Industrial Accident Prevention” McGraw-Hill Company, New York.

Reference Books:

1. Lees, F.P., (1990). “Loss Prevention in Process Industries” Butterworth publications, London, 2nd edition, BIS, New Delhi.
2. “Accident Prevention Manual for Industrial Operations”, N.S.C. Chicago, 1982.
3. John Ridley, (1983) “Safety at Work”, Butterworth and Co., London.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components Continuous evaluation	Presentation	Viva	File	Total
Weightage (%)	30	30	40	100

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	2	1	-	1	-	-	-	-	2	2	-	2
CO2	1	2	-	2	2	-	2	-	-	-	-	3	2	-	1
CO3	1	1	-	1	2	-	-	-	-	-	-	2	2	-	2
CO4	1	2	-	2	1	-	-	-	-	-	-	2	2	1	2
CO5	2	2	3	1	2	-	-	-	-	-	-	2	2	1	1

Avg.	1.4	1.8	3	1.6	1.6	-	1.5	-	-	-	-	2.2	2	1	1 . 6

1=Weakly mapped 2= Moderately mapped 3=Strongly mapped

Course Code	Course name	L	T	P	C
HSFS 2118	Industrial Hygiene Lab	0	0	2	1
Pre-requisites/Exposure	Basic knowledge of occupational health and safety				
Co-requisites	--				

Course Objectives

I. To inculcate the knowledge and skills learned from the coursework to be proficient in the practice of occupational and/or environmental health.

II. To educate the student about occupational health hazards, a method to analyze it and recommend relevant control

III. To make students experience the industrial way of analyzing occupational hazards and solving the problems in a acceptable scientific way.

IV. To create awareness about the factors and legal requirements concerning occupational health in the dynamic industrial atmosphere.

Course Outcomes

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

CO-1: Understand and comprehend methodologies practiced in industries for industrial hygiene monitoring and having the skill to systematically record things.

CO-2: Apply the knowledge and skills learned from the theory to practice the relevant to and abiding by the principles of industrial hygiene.

CO-3: Evaluate the levels of exposure to various health hazards and suggest control measures.

CO-4: To analyze and develop the best occupational health practices to be followed in the industry and promote the health and well-being of the society.

Catalog Description

The Industrial Hygiene Lab course offers students the opportunity to study and apply industrial hygiene principles in a laboratory setting. Topics include sampling and measurement of workplace air contaminants, noise measurement and control, ergonomics and workplace safety, selection and use of personal protective equipment, and interpretation of industrial hygiene data. Students will learn how to use a variety of instruments and equipment for industrial hygiene and will have the opportunity to undertake their own experiments and projects. The course will also address the professional and ethical obligations of industrial hygienists.

List of Experiments:

Experiment No.1: Determination of illumination level using Lux meter of a workplace

Experiment No.2: Determination of microwave radiation Leakage in Owens and compare with the allowable range.

Experiment No.3: Assessment of heat stress using WBGT Index and recommend control measures.

Experiment No.4: Determination of various gas concentrations using portable multiple gas detector.

Experiment No.5: Determination of particulate matter exposure using a personal air sampler and compare with ethe acceptable level

Experiment No.6: Determination exposure to vibration of machines and recommend the safe level of exposure.

Experiment No.7: Determination of noise exposure using a noise dosimeter and find the compare with the allowable range

Experiment No.8: Determination of the effectiveness of ventilation using anemometer

Experiment No.9: Performing CPR using a manikin

Experiment No. 10: Study of Personal protective equipments.

Text Books

1. Stewart, J.H. (1999) Industrial-Occupational Hygiene Calculations: A Professional Reference, Millennium publication,1st edition,
2. Barbara, A.P., (2005) Fundamentals of Industrial Hygiene 6th Edition.

Reference Books:

1. Charles D Reese, (2018) “Occupational Health and Safety Management: A Practical Approach”, CRC Press, 3rd Edition.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components Continuous evaluation	Performance of experiments	Viva	File	Total
Weightage (%)	40	20	40	100

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-O1	PSO-O2	PSO-03
CO1	3	1	-	1	-	2	-	-	2	-	2	-	-	3	1
CO2	3	1	-	1	-	-	-	-	2	-	-	-	-	3	
CO3	2	2	-		-	-	-	-		-	-	-	-	1	
CO4	3	3	3	1	2	1	-	-	2	-	-	-	-	3	1
Average	2.75	1.75	3	1	2	1.5	-	-	2	-	2	-	-	2.5	1

1=Weakly mapped 2= Moderately mapped 3=Strongly mapped

Course Code	Course name	L	T	P	C
MEMA 2104	Strength of Material Lab	0	0	2	1
Pre-requisites/Exposure	Basic Knowledge of Engineering Mechanics				
Co-requisites	--				

Course Objectives

I. To use knowledge of strength of material for testing of properties of material in different methods.
II. To analyses the material testing results in effective manner.
III. To give detailed understanding of materials and their properties by conducting laboratory experiments
IV. To give exposure of various established material testing techniques.

Course Outcomes

At the end of this course student should be able to:

CO-1: Determine strength of various working sample based on tensile stress, compressive stress and shear stress.

CO-2: Calculate the value of impact loading based of CHARPY and Izod Impact.

CO-3: Find out Brinell hardness and Rockwell hardness for given specimen.

CO-4: Estimate Spring index and spring ratio using Wahl equation and value of deflation.

Catalog Description

History of engineering materials, Materials property chart, Crystal structure, Imperfections of solids, Mechanism of strengthening in metals, Hall-Patch effect, X-ray diffraction, Fracture: Ductile, brittle, fatigue. Griffith criterion, S-N curve, Creep, Phase diagram (binary), Iron-carbon system, Heat treatment of metals, Electrical properties, Thermal properties, Magnetic properties, Optical properties, Corrosion, Oxidation, Thermal stability ,Wear, abrasion, friction of materials, Characterization techniques: Optical microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy, Polymer and its characterization, Viscoelasticity, Nanomaterials and its important properties at nanoscale, Composites: Characterization of composites, Ionic polymer matrix composites, Shape memory alloy, Intelligent Multifunctional materials, Economics, Environment, and Sustainability In addition to the lectures, the course is associated with a laboratory session.

Course Content

Experiment No.1:

To determine the hardness of the given specimen using Rockwell Hardness Testing Machine.

Experiment No.2:

To determine the hardness of the given specimen using Brinell Hardness Testing Machine.

Experiment No.3:

To find the spring constant and Modulus of Rigidity of a given spring using spring testing Machine.

Experiment No.4:

To conduct the tensile test on a UTM and determine the ultimate tensile strength and percentage elongation for a steel specimen.

Experiment No.5:

To conduct Torsion test on Mild steel or cast-iron specimen to find out modulus of rigidity.

Experiment No.6:

To Conduct the Izod Impact test on Impact testing machine and find the impact strength and modulus of rupture of a given specimen.

Experiment No.7:

To conduct the Charpy Impact test on Impact testing machine and find the Impact strength of a given specimen.

Experiment No.8:

To analyze the performance of given specimen by shear test on UTM.

Experiment No.9:

To conduct the compression test on a UTM and determine the ultimate compressive strength for a given specimen (C.I, Brick, wooden)

Text Books

1. Laboratory Manual on Testing of Engineering Materials, New Age International Private Limited; First edition.

Reference Books

1. Material Testing Laboratory Manual For Quality Control, Standard Publishers and Distributors

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Presentation	Viva	File	Total
Weightage (%)	30	30	40	100

Relationship between the Program Outcomes (POs), Program Specific Outcomes and Course Outcomes (COs)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	2	-	-	-	1	3	-
CO2	-	-	-	-	-	-	-	-	2	-	-	-	1	3	3
CO3	-	-	-	-	-	-	-	-	2	-	-	-	1	3	2
CO4	-	-	-	-	-	-	-	-	2	-	-	-	1	3	-
Avg.	-	-	-	-	-	-	-	-	2	-	-	-	1	3	2.5

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course Code	Course name	L	T	P	C
HSFS 3002	Principles of Engineering Design	2	0	0	2
Pre-requisites/Exposure	• Basic Knowledge of Mechanics • Basic Knowledge of Engineering Graphics				
Co-requisites	--				

Course Objectives

The course will enable the students to:

I. To recalling previous knowledge required to the course engineering design.
II. To calculate and derive various equations required to design engineering components.
III. To solve and analyze the composite materials design problems.
IV. To gain the knowledge of limit state design for flexure, shear, torsion, bond and anchorage.

Course Outcomes:

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

CO-1: Incorporate Basic understanding of "Engineering mechanics" and "Strength of materials" with "Principle of Engineering Design.

CO-2: Classify, Explain, Identify and Recognize Suitable/capable/safe engineering tools for Practical work.

CO-3: Solve and interpret problems associated with engineering design of mechanical components.

CO-4: Execute/implement engineering design related solutions for real life use of mechanical equipment

CO-5: Relate and compare best engineering design solution for engineering elements (like, joints, springs, shafts, conveyors and power transmission system

Catalog Description

By engineering principles, we mean the ideas, rules, or concepts that need to be kept in mind when solving an engineering problem. However, there is no one specific list of engineering principles that can be written down or posted. That is because the concepts used to solve a problem will often be different depending on the type of problem encountered. This is something that engineers must remind themselves to do when they imagine very fancy complicated products that few people would really be able to use. On the other hand, simple designs can't always meet the needs of the customer. Another principle might be to "keep the target user in mind" when creating a product. If the user does not want a simple solution, then an engineer will have to make a choice between those two principles.

Course Content

Unit I: ENGINEERING DESIGN PRINCIPLES AND JOINTS 7 lecture hours

Introduction to design- steps in design- design factors- practical considerations in design- theories of failure- stress concentration - consideration of creep and thermal stress in design.

Detachable joints- design of screws- thread standards- thread stress- pre-loading of bolts- external load with pre-load -fatigue and shock loading- Types of keys- types of pins- design of cotter and pin joint.

Unit II: RIVETED AND WELDED JOINTS 8 lecture hours

Riveted Joints-stresses in riveted joints- design of riveted joints subjected to central & eccentric loads boiler and tank joints - structural joints.

Welded joints-types of welded joints- design of welded joints subjected to axial, torsion and bending loads.

Unit III: SPRINGS AND POWER SHAFTING DESIGN 9 lecture hours

Springs- stresses in helical spring- deflection of helical compression and extension Spring- springs subjected to fatigue loading- concentric and helical torsion spring - critical frequency of springs- leaf springs- design of automotive leaf springs.

Power Shafting- Design for static loads- combined stresses- design of shaft for strength and deflection- axial load on shaft.

Unit IV: PRESSURE VESSEL AND TANK DESIGN **6 lecture hours**

Design of cylindrical and spherical vessels for internal and external pressures- design of heads and enclosures- tall vessels- supports for vessels- nonstandard flanges- pipeline design. Design of storage tanks.

Textbooks:

1. Shigley, Mechanical Engineering design
2. Avallone, Handbook of Mechanical Design fluid
3. V B Bhandari, Design of Machine Elements

Modes of Evaluation: Quiz/Assignment/ Class Test/ Tutorial

Examination Scheme:

Components	IA	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	--	-	-	2	2	-	1	3	3	-	1	3	-	-
CO2	1	-	3	-	2	-	1	3	-	-	3	2	2	-	3
CO3	-	-	-	1	1	2	3	-	1	2	-	2	-	3	-
CO4	3	-	3	1	-	-	3	-	-	3	3	1	-	3	-
Avg.	2	-	3	3	1	-	1	2	-	3	1	-	-	-	2
	2	-	3	1.66	1.5	2	2	2	2	2.75	2.33	1.5	2.5	3	2.5

1. Weak mapped 2. Moderate mapped 3. Strong mapped

SEMESTER V

Course Code	Course name (LIFE SKILLS 6)	L	T	P	C
SLLS 0301	Persuasive Presence	2	0	0	2
Pre-requisites/Exposure	12^{th} level Knowledge of English Language				
Co-requisites	• Knowledge of Word processing using MS Word • Basic I.T Skills				

Course Objectives

I. To identify the role of personal brand and its communication in the media age.
II. To provide an understanding on the importance of how to present themselves to audiences through verbal and visual texts.
III. Analyzing the role of rhetoric in personal branding.
IV. To produce a body of work that reflects a personal brand.

Course Outcomes

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

CO-1: Define the role of Executive Presence in the media age.

CO-2: Demonstrate the importance of how to present themselves to audiences through verbal and visual texts.

CO-3: Evaluate the role of rhetoric in personal branding.

CO-4: Design a body of work that reflects a personal brand.

Catalog Description

Persuasive Presence examines the importance of developing a personal brand in today's scenario. By engaging in detailed self-assessment process through verbal and visual texts. With the exposure to the strategies of articulation and tools for brand building, helps Students to build a personal brand for persuasive presence in various mediums.

Course Content

Unit I: PERSUASIVE PRESENCE: WHY HOW WHAT

- Media Age and Communication: An Overview
- Media and Executive Presence

Unit II: QUINTESSENCE-CREATE YOUR AVATAR

- Identify Personal & Professional Values
- Create Interests & Skill Inventory
- Personality Traits for Professionalism

Unit III: REFLECT TO RECORD

- The 5R framework for reflection
- SEAL-**Situation, Effect, Action, and Learning**
- Visual thinking tools for reflections

Unit IV: ARTICULATION- SEQUENCING STORIES THAT STICK.

- Rhetoric and its role
- Scaffolding: Structures sets you free

Unit V: SCIENCE BEHIND STORIES-PERSUASIVE STORY TELLING.

- Text and Images
- Elements for Branding
- Image for branding
- Persuasion

Unit VI: GRAVITAS- INFLUENCE & PERSUADE WITH YOUR STORIES.

- AIMM
- Audience
- Intent
- Medium
- Message

Textbooks

1. Stand Out: How to Find your breakthrough Idea and Build a Following Around It by Dorie Clark, Network: Portfolio/Penguin,2015
2. Berger, A. A. (2012). *Seeing is believing,* an introduction to visual communication. (Fourth edition). New York: McGraw-Hill.
3. Borchers, T. A. (2002). *Persuasion in the Media Age.* New York: McGraw Hill
4. Aristotle,C. [1991]. *The Art of Rhetoric.* Trans. Hugh Lawson-Tancred. London: Penguin Books.

Reference Books

1. Bender, J.& Welberry,D.E. (1990).*The Ends of Rhetoric: History, Theory, and Practice.* Stanford: Stanford University Press.
2. Burke, K. (1950). A Rhetoric of Motives. New York: Prentice Hall.
3. Everybody Writes: Your Go-To Guide to Creating Ridiculously Good Content by Ann Handley, Hoboken: John Wiley & Sons, 2014
4. Reinventing You Define Your Brand, Imagine Your Future by Dorie Clark, Harvard Business Review Press,2017

Suggested Readings:

- Lencioni, P. M. (2002). Make your values mean something. Harvard Business Review, 80(7). (1) 97–106.
- Gardner, H. (2007). The Ethical Mind. Harvard Business Review, 85(3), 51 – 56.
- Goffee, R., & Jones, G. (2005). Managing Authenticity: The Paradox of Great Le George, B. (2007). Chapter 7: Building your support team. In True north: Discover your authentic leadership (pp. 117–131). San Francisco, CA: Wiley.
- Prahalad, C. K. (2010). The responsible manager. Harvard Business Review, 88(1/2).
- Kallasvuo, O-P., Jackson, G., Humer, F., Gensler, A., Petrov, S., Klapmeier, A., Cummings, A. B., et. al. (2007). Moments of truth: Global executives talk about the challenges that shaped them as leaders. Harvard Business Review, 85(1), 15 – 27.
- Morriss, A., Ely, R. J., & Frei, F. X. (2011). Stop holding yourself back. Harvard Business Review, 89(1/2).
- leadership. Harvard Business Review, 83(12), 86-94.
- Ibarra, H. (2015). The authenticity paradox: Why feeling like a fake can be a sign of growth. Harvard Business Review, 93(1/2), 52–59

- Groysberg, B., & Slind, M. (2012). Leadership is a conversation. Harvard Business Review, 90(6), 76-84.

Modes of Continuous Evaluation: Quiz/Discussion/Assignment

Examination Scheme:

Components	IA	ESE	Total
Weightage (%)	40	60	100%
Items	1 Discussion	Personal Profile Blog	100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Programme Outcomes**
CO1	Define the role of Executive Presence in the media age	**PO5**
CO2	Demonstrate the importance of how to present themselves to audiences through verbal and visual texts.	**PO5**
CO3	Evaluate the role of communication in personal branding.	**PO10**
CO4	Design a body of work that reflects executive presence.	**PO10 & PO 12**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or teamwork	Communication	Project management and finance	Life-long Learning
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	Persuasive Presence					3					3		3

1 = Weakly mapped, 2 = Moderately mapped, 3 = Strongly mapped

Course Code	Course name	L	T	P		C
SLSG 0301(Signature-4)	Start your Start-up (Signature-4) School of Life Courses	3	0	0		3
Pre-requisites/Exposure						
Co-requisites		--				

Course Objectives

Course Outcomes

Catalog Description

Course Content

Unit 1 – Heading – 22 Lectures Hour

Unit 1 Detail content

Unit 2 – Heading – 23 Lectures Hour

Unit 2 Detail content

Textbooks / Reference Books

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	IA	MID SEM	End Semester	Total
Weightage (%)				100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
Avg.															

1 = Weakly mapped, 2 = Moderately mapped, 3 = Strongly mapped

Course Code	Course Name	L	T	P	C
	Exploratory - 3	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Student to select from the available options.

Course Objectives

Course Outcomes

Catalog Description

Course Content

Unit 1 – Heading – 21 Lectures Hours

Unit 1 Detail content

Unit 2 – Heading – 24 Lectures Hours

Unit 2 Detail content

Textbooks / Reference Books

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	IA	MID SEM	End Sem	Total
Weightage (%)				100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
Avg.															

1 = Weakly mapped, 2 = Moderately mapped, 3 = Strongly mapped

Course Code	Course Name	L	T	P	C
HSFS 3026	**Chemical Engineering II (Unit Operations)**	2	0	0	2
Pre-requisites/Exposure	▪ Basic Knowledge of Law of physics. ▪ Basic Knowledge of mathematics and chemistry. ▪ Knowledge of thermodynamics.				
Co-requisites	--				

Course Objectives

I. To give student the knowledge of principles of mass and energy balance which are crucial for setting up any chemical process plant.

II. To familiarize the student with various unit operations used in chemical process plant and enable him to do related calculations.

III. To give student the knowledge of processes units used in chemical process plants.

Course Outcomes

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

CO-1. To understand and apply fundamental knowledge of the basic operations of chemical engineering.

CO-2. To explain material and energy balances, mass transfer, separation processes, and recovery and processing of raw materials and energy resources.

CO-3. To identify, formulate, and solve simple balances, separation operations and other unit operations.

CO-4. To apply knowledge that enable them to take measurements, calculations and similar work.

CO-5. To assess the impact of basic or unit operations of chemical engineering in sustainable development of the Company.

Catalog Description

The aim of this course is to deepen the students' knowledge of unit operations with a focus on distillation, absorption, absorption, heat exchange, etc. This provides an understanding of various unit operations and the associated hazards. The student will learn about the steps involved in doing mass and energy balance. Understand the principles of heat and mass transfer. Solve heat transfer problems in steady and transient heat transfer. Additionally, students will learn about Ceramics and polymers, kinetics of polymerization reaction's structure properties and applications - introduction to plastics and rubber processing - fiber reinforced plastics, adhesives, and surface coatings.

Course Content

Unit – I: FUNDAMENTALS OF CHEMICAL PROCESS ANALYSIS 5 lecture hours

Introduction to unit operations of Chemical Engineering, material balances without and with chemical reactions, heat balances.

Unit – II: HEAT TRANSFER AND THERMAL PROCESSING 5 lecture hours

Principles of steady state heat transfer, Fourier's law, heat transfer coefficient, plane walls in series and multilayer cylinders, overall heat transfer coefficient, heat exchangers, radiation heat transfer, principles of unsteady state heat transfer, thermal processing, and sterilization - Evaporation – Evaporators.

Unit – III: MASS TRANSFER FUNDAMENTALS 8 lecture hours

Principles of mass transfer, Fick's law of molecular diffusion, diffusion in gases, diffusion in liquids and solids, distillation, batch and continuous absorption, extraction leaching and crystallization, packed columns, and plate columns, packing materials, drying and dryers.

Unit – IV: PROCESSING AND HANDLING TECHNOLOGIES 8 lecture hours

Mechanical operations, filtration, different types of filters, setting and sedimentation, clarifiers and thickeners, centrifugal separation, cyclones, particle sizing, methods of size analysis, reduction equipment, storage, and transportation of bulk solids- types of conveyors and selection.

Unit – V: POLYMER SCIENCE AND ENGINEERING 4 lecture hours

Ceramics and polymers, kinetics of polymerization reaction’s structure properties and applications - introduction to plastics and rubber processing - fiber reinforced plastics, adhesives, and surface coatings.

Textbooks

1. McCabe, W. L., Smith, J. C., & Harriott, P. (1993). *Unit operations of chemical engineering (Vol. 5)*. New York: McGraw-Hill.
2. Peters, M. S., & Timmermans, K. D. (1991). *Plant design and economics for chemical engineers.* McGraw-Hill chemical engineering series.

Reference Books

1. Sinnott, R. K. (2006) *Chemical Engineering Design*, Coulson & Richardson's Chemical Engineering, vol 6., fourth edition.
2. Seider, W. D., Seader, J. D., & Lewin, D. R. (2009). *Product & process design principles: synthesis, analysis, and evaluation*. John Wiley & Sons.
3. D. W. Green y R. H. Perry (2008) *Chemical Engineers’ Handbook*, 8ª ed., McGraw-Hill, New York.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	-	3	-	-	-	2	-	-	-	2	-	2
CO2	-	3	2	3	-	-	-	-	2	-	-	-	-	3	2
CO3	-	-	-	-	-	-	-	-	2	3	-	2	-	2	-
CO4	-	-	-	2	-	3	2	2	3	2	3	-	2	2	-
CO5	3	-	2	-	-	-	-	-	-	-	2	-	2	-	-
Avg.	2.5	2.5	2.33	2.5	3	3	2	2	2.25	2.5	2.5	2	2	2.33	2

1. Weak mapped 2. Moderate mapped 3. Strong mapped

Course Code	Course Name	L	T	P	C
HSFS 3129	Fire Engineering Lab	0	0	2	1
Pre-requisites/Exposure	• Basic knowledge of Process and its Types. • Basic knowledge of Mathematics and chemistry.				
Co-requisites					

Course objectives:

I. Provide students with practical experience in conducting fire tests and experiments to understand the behavior of materials and structures under different fire conditions.

II. Teach students how to assess the performance of fire detection, suppression, and evacuation systems through real-world simulations and experiments.

III. Enable students to apply fire modeling software and analytical techniques to predict fire behavior, analyze fire protection strategies, and optimize safety measures.

IV. Train students to evaluate the fire resistance and performance of building materials and structural components, helping them make informed design and safety recommendations.

V. Simulate fire emergencies to enhance students' skills in incident command, firefighting, and evacuation procedures, ensuring they can effectively respond to real-life fire situations.

Course Outcomes (COs):

CO-1. To identify and analyze physical parameters of Fire Extinguishing Media.

CO-2. To determine the pH of types of Foam used in Foam type fire extinguisher.

CO-3. To Compare different various Firefighting appliances based on their effectiveness.

CO-4. To learn and understand about the Active & Passive fire protection system.

CO-5. To discuss the effectivity of various types of rescue operations and Mock drills done in case of emergency.

Detailed Syllabus:

Experiment No.1: To study and perform test on portable DCP type fire extinguisher.

Experiment No.2: To study and perform a test on portable CO_2 type fire extinguisher.

Experiment No.3: To study and perform test on portable Foam type fire extinguisher.

Experiment No.4: To study and perform test on portable Water type fire extinguisher.

Experiment No.5: Determination of flash Point, fire point and pour point of hydrocarbons.

Experiment No.6: To Study various types firefighting equipment's and accessories.

Experiment No.7: To study various types of Breathing apparatus and their testing methods.

Experiment No.8: To Determine the technique for the effective usage and generation of Foam.

Experiment No.9: To study and learn about the usage and methods of Active and passive fire protection systems.

Experiment No.10: To study film formation test of AFFF.

Experiment No.11: To test the non-combustibility of Building materials.

Experiment No.12: To fire knocking down property test.

Catalogue Description:

This Fire engineering lab module is designed to teach the students about preventive measures that will eliminate or minimize causes of fire or fire hazards in the workplace, and to understand them for various emergency and evacuation procedures in the event of a fire. The module aims to give the student a detailed knowledge and understanding of fire engineering in buildings including common and specialized fire protection systems. It also gives the student knowledge and understanding of the fundamental aspects of fire engineering in buildings from design to installation. It also creates the awareness of the student of the responsibility of the building services engineer in designing life safety systems & property protection for modern buildings.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Presentation	Viva	File	Total

Continuous evaluation				
Weightage (%)	30	30	40	100

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	3	-	3	2	2	2	2	2	2	-	2	3	3
CO2	2	-	-	-3	2	-	3	2	2	-	2	-	2	3	3
CO3	-	2	-	-	2	2	2		2	2	3	-	3	3	2
CO4	2	-	3	-	2	3	-	3	3	-	2	-	3	3	2
CO5	-	-	-	2	3	3	2	2	2	3	3	-	3	3	2
Avg.	2	2	3	2.5	2.4	2.5	2.25	2.25	2.25	2.3	2.4		2.6	3	2.4

1. Weak mapped 2. Moderate mapped 3. Strong mapped

Course Code	Course Name	L	T	P	C
HSFS 4020	Legal Aspects of Safety Health & Environment	2	0	0	2
Pre-requisites/Exposure	Basic knowledge of legal jurisdiction.				
Co-requisites	--				

Course Objectives

I. To create the awareness among students regarding the various legislations applicable to industries.

II. To introduce the definitions, concepts, requirements of various safety, health environment and welfare related acts and rules.

III. To explain the management of occupational health considering practical and legal aspects.

IV. To evaluate a systematic, critical appraisal of all potential hazards involving personnel, plant, services, and operation method.

Course Outcomes

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

CO-1. To demonstrate knowledge and understanding of basic terms and definitions as per different acts and rules.

CO-2. To understand the legal requirements concerning welfare, working hours and health, safety, and environmental requirements in industries.

CO3- Apply the legal requirements related to welfare, environmental aspects, license for storage, transportation, and usage of explosive and flammable substance as per various acts and rules.

CO4- Analyze the concept, provisions, and role of agencies per various safety, health, and environmental laws.

CO5- Evaluate the compliance legal and other requirements in a workplace.

Catalog Description

This module teaches systematic approaches and all the aspects of Health, Safety and Environmental laws for various industries. This module tells the students about the role and responsibility of the employer towards the workers and his employees. In this way the students can understand, explain how risks will be controlled and tell you who is responsible for this. It also talks about working with workers and their concern about their health and also tells about the roles and responsibilities of safety representatives in protecting everyone from harm in the workplace.

<u>Course Content</u>

Unit I: FACTORIES ACT **7 lecture hours**

Definitions, Preliminary, inspecting staff, Health, Safety, Provisions relating to hazardous processes, welfare, working hours of adults, Employment of young persons, Special provisions, Penalties, Supplemental.

Unit II: DOCK WORKERS ACT, BOCW ACT **7 lecture hours**

Powers of Inspectors, Power of Govt. to direct Inquiry, Obligation of Dock workers, General Provisions relating to rules and regulations. Dock workers (SHW) Rules- Definitions, Inspection Procedure, Inquiry into certain accidents, Advisory Committee, Inquiry in Public. Dock workers (SHW) Regulations- Definitions, Power of Inspectors. Penalties, Responsibilities, Safety Officers, Reporting of accidents, Emergency Action Plan, Safety Committee, and Occupational Health services for dock workers, various safety and health regulations in brief. BOCW Act major provisions.

Unit III: PESO REGULATIONS **6 lecture hours**

Explosives act: definitions, grant of license, notice of accidents, inquiry into ordinary and serious accidents, punishment for offences, extension of definition to other explosive substances. Petroleum act - definitions, control over petroleum import, transport, storage, production, refining and blending, need for license, exemption. Inspection and sampling for testing, notice of accidents and inquiries. Petroleum rules - definitions, brief idea on the rules relating to safety aspects in transport, storage, refining and blending of petroleum, notice of accidents.

Unit IV: LABOR LAWS **5 lecture hours**

Workmen's Compensation Act. ESI Act & Rules. Public Liability Act & Rules- Substantive provisions in the above Acts and Rules.

Unit V: ENVIRONMENTAL ACTS **5 lecture hours**

Water Act: Definitions, Powers and Functions of Central, State and Joint Boards, Provisions regarding prevention and control of water pollution, Penalties, Central & State Water Laboratories, Power to make rules, Power of supersession and overriding effect. Rules on Consent for Establishment. Air Act - Definitions, Power & Functions of Boards, Prevention & Control of Air Pollution, Penalties, Application for Consent as per Air Pollution Rules. Environment (Protection) Act- Definitions, general powers of central government, prevention, control, and abatement of environmental pollution. EP Rules-Definitions, standards for emission, prohibition and restrictions on siting and operation of industries. MSIHC Rules- Definitions, Duties of Authorities, Notification of Major Accidents Safety Reports, On-site & Off-site Emergency Plan, Giving safety information to public. Chemical Accidents (Emergency Planning, Preparedness and Response) Rules- Definitions, Constitution, functions & powers of various Crisis groups.

TEXT BOOKS

1. Health Safety and Environment (Safety Management) by Ganguly & Changeriya.
2. Factories Act,1948 by Dr. J.P. Sharma.
3. The Petroleum Act, 1934 © Universal Law publishing.

REFERENCE BOOKS

1. Sahu G. (2014), Environmental Jurisprudence and the Supreme Court: Litigation, Interpretation, Implementation.
2. Diwan S. and Rosencranz, A. (2001) Environmental Law and Policy in India– Cases, Materials and Statutes (2nd ed.).
3. Leelakrishnan, P., (2010). Environmental Law Case Book (2nd ed.)

4. Singh, G. (2016). Environmental Law in India (2nd ed).

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	1	1	2	-	1	-	-	3	-	2	-	2
CO2	-	2	1	2	-	3	-	-	-	-	3	-	-	-	2
CO3	-	2	-	2	-	3	-	-	-	-	3	-	-	-	2
CO4	-	2	-	-	-	2	-	-	-	-	2	-	-	1	2
CO5	2	2	2	2	2	3	-	-	-	-	2	-	2		3
Avg.	1.5	2	1.5	1.75	1.5	2	-	1	-	-	2.6	-	2	1	2.2

1 = Weakly mapped, 2 = Moderately mapped, 3 = Strongly mapped

Course Code	Course Name	L	T	P	C
HSFS 3027	Structural Fire Protection Design	2	1	0	3
Pre-requisites/Exposure	• Basics of science and engineering • Fundamentals of Fire Engineering • Fundamental of civil engineering				
Co-requisites	National Building code, IS Codes, NFPA				

Course Objectives

The course will enable the students:

I. To learn the fundamentals of building materials and their characteristics with respect to rise in temperature.
II. To know the various fire test methods and their application in structural fire safety.
III. To understand the concept of fire resistance & retardant which could be helpful in minimizing structural loses due to fire.
IV. To assist in planning & designing structural fire protection system requirements with an integrated engineering approach and in accordance with regulations.
V. To work as an assessor, consultant or fire investigator in assessing damage due to fire and recommend for damage control in a building.

Course Outcomes

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

CO-1: Explain the building's materialistic properties and their effect on fire.

CO-2: Use skill and potential in resolving structural fire safety issues or challenges.

CO-3: Include the most innovative practices in structural fire safety systems based on their analytical engineering approach.

CO-4: Evaluate workplace fire safety conditions for limiting the losses due to structural fire vulnerability.

CO-5: Design and develop a new methodology, process/ procedure, and framework for structural fire protection system.

Catalogue Description

Fire safety is an essential requirement for any building or industrial premises today. Globally, fire risk is a catastrophe, based on its level suitable techniques are being recommended which require to be taught, and people should be aware of. While talking about the minimization of losses due to fire, the material used in building plays an important role in terms of fire spread, intensity, and related destruction. Building material characteristics, their effect on the temperature and destruction capabilities along with the selection of best materials will be known to the students. Workplace-related fire hazards, planning & design of building compartments, fire resistance & retardant concepts will be major contents to be known to the students. Considering the fire safety challenges in the building or structural members, means and methods of ensuring the stability, integrity and isolation principles or their features will be known to the students. This will help them to apply their application of learning at the workplace to ensure a passive fire protection system at the workplace.

Course Content

Unit I: MATERIALS AND FIRE RESISTANCE IN CONSTRUCTION

12 lecture hours

Effect of temperature on the properties of materials: concrete, steel, masonry and wood. Combustibility of building materials and structures - Fire resistance of structural members - Fire resistance of buildings.

Unit II: FIRE RESISTANCE TESTING AND CALCULATIONS 10 lecture hours

Experimental determination of fire resistance, approximate method for calculating the fire resistance of structures. Fire resistance limits of structures, coefficient of fire resistance, fire duration.

Unit III: FIRE-RESISTANT DESIGN FOR BUILDING ELEMENTS AND STRUCTURES 8 lecture hours

Design of fire-resistant walls - ceilings-screens -local barriers- Roof separations and partitioned fire areas - Fire stopped areas in connecting constructions. Fire protection of building structures: Wooden structures, Steel structures, Reinforced concrete structures, Plastic structures.

Unit IV: FIRE AREA CALCULATIONS AND OPENINGS PROTECTION

8 lecture hours

Building fire areas -calculation of fire areas, subdivision of fire areas, Industrial, Residential and Public buildings, Fire transmission between buildings, and propagation of fire. Protection of openings: Openings for conveyors - opening for doors – low combustible doors – Non-combustible doors - Spark proof doors - suspension of doors - Air-tight sealing of doors - Windows.

Unit V: REHABILITATING FIRE-DAMAGED STRUCTURES: ASSESSMENT AND REPAIR **7 lecture hours**

Reparability of fire damaged structures: Assessment of fire severity - assessment of damage-concrete, steel, masonry, timber - feasibility of repair -Repair techniques: Columns, beams, floors, etc. - a case study on building reinstatement.

Textbooks

1. Purkiss and Yuan Li (2017), Fire Safety Engineering Design of Structures, London: CRC Press.
2. Gillie and Meacham (2004), Fire Safety Engineering: Design of Structures, Oxford: Elsevier.
3. Franssen and Vila (2010): Fire Design of Steel Structures, New Jersey: Willey Publication.
4. Yong Wang and C. G. Bailey (2012), Performance-Based Fire Engineering of Structures, London: CRC Publication.

Reference Books

1. BIS, NBC Part IV (2016), Fire and Life Safety", New Delhi: Bureau of Indian Standards.
2. Jain V K (2020), Fire Safety in Building, New Delhi: New Age Publication.
3. Thank Singh Sharma (2014), Fundamental of fire safety in building, New Jersey: Willey Publication.
4. T. Z Harmathy (2000), Fire Safety Science and engineering, London: ASTMINTL.
5. BIS, IS 2189:2008, Selection, Installation and Maintenance of Automatic Fire Detection and Alarm System – Code of practice, New Delhi: Bureau of Indian Standards.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	1	-	-	-	-	-	2	2	2	2	-	1
CO2	2	3	2	3	1	1	2	-	-	1	3	2	2	3	2
CO3	3	2	3	2	2	2	2	1	2	3	3	3	3	3	3
CO4	2	3	2	1	2	2	2	2	2	1	2	-	2	1	2
CO5	2	1	2	2	2	2	1	-	1	3	3	2	2	2	2
Avg.	2.2	2.25	2.25	1.8	1.75	1.75	1.75	1.5	1.66	2	2.6	2.25	2.2	2.25	2

1. Weak mapped 2. Moderate mapped 3. Strong mapped

Course Code	Course Name	L	T	P	C
HSFS 3128	Fire safety field training	0	0	2	1
Pre-requisites/Exposure	Basics of Fire				
Co-requisites					

Course objectives

I. Participants will learn to identify fire hazards and implement proactive measures to prevent fires in various environments.

II. Gain hands-on experience in operating firefighting equipment and applying effective suppression techniques during fire emergencies.

III. Develop the ability to respond swiftly and efficiently to fire incidents, focusing on safety, teamwork, and incident command.

IV. Learn to conduct comprehensive fire safety inspections, ensuring compliance with regulations and identifying potential risks.

V. Foster a strong sense of responsibility for fire safety in individuals and organizations, emphasizing ethical conduct and professional standards.

Course Outcomes: (Summer Internship)

Students will be able to

CO-1: Understand and correlate the Fire prevention and protection processes with the technical knowledge gained.

CO-2: Apply the knowledge to develop, manage and implement engineering solutions within Fire engineering aspects.

CO-3: Learn and understand various skills required, along with professional ethics practiced by the industry.

CO-4: Communicate and present technical knowledge effectively.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	2	2	-	-	-	-	3	3	2	3
CO2	-	2	-	-	-	-	-	-	-	-	-		3	3	3
CO3	2	2	-	-		2	2	2	3	-	-	-	3	3	2
CO4	-	-	-	-	-	2	-	-	2	-	-	1	-	2	2
Avg.	2	2	-	-	-	2	2	2	32.5	-	-	2	3	2.5	2.75

1. Weak mapped 2. Moderate mapped 3. Strong mapped

SEMESTER VI

Course Code	Course name	L	T	P	C
	Start your Startup	3	0	0	3
Pre-requisites/Exposure	Basic knowledge about having an idea to start with				
Co-requisites	--				

Course Objectives

I. Foster an entrepreneurial mindset, including creativity, adaptability, and resilience, enabling students to identify and evaluate potential business opportunities!
II. Develop skills in conducting market research and competitor analysis.
III. Equip students with the tools to create comprehensive business plans and foster an understanding of the importance of effective team building and management.
IV. Provide insights into funding options and strategies for securing investment.
V. Understand the challenges of scaling operations and developing sustainable growth strategies.

Course Outcomes

CO-1: Foster an entrepreneurial mindset, including creativity, adaptability, and resilience, and enable students to identify, evaluate potential business opportunities.
CO-2: Demonstrate creativity by generating innovative business ideas.
CO-3: Identify and assess potential business opportunities for viability and market fit.
CO-4: Develop skills in conducting market research and competitor analysis.
CO-5: Conduct thorough market research to gather relevant data and insights.
CO-6: Use market research findings to make informed business decisions.
CO-7: Equip students with the tools to create comprehensive business plans and foster an understanding of the importance of effective team building and management.
CO-8: Create a well-structured and comprehensive business plan.

Catalog Description

This course helps to foster an entrepreneurial mindset, including creativity, adaptability, and resilience, enabling students to identify and evaluate potential business opportunities. This course equips students with the tools to create comprehensive business plans and foster an understanding of the importance of effective team building and management

Course Content

WEEK 1: **XX Lecture Hours**

Introduction to Startup world, Understanding the basics, Successful Entrepreneur's journey (can be done with alumni /seniors from Runway cohort)

WEEK 2: **XX Lecture Hours**

Definition and characteristics of entrepreneur, motivation for starting a new startup, Exploring entrepreneurial ecosystem, entrepreneurial mindset and skills

WEEK 3: **XX Lecture Hours**

SWOT Analysis for an Entrepreneur, challenges and overcoming challenges in Entrepreneurship

WEEK 4: **XX Lecture Hours**

Startup Idea Scouting Techniques and Exercises, Successful startups and validation process

WEEK 5: **XX Lecture Hours**

Your target audience and validation process Part 1, Your target audience and validation process Part 2 CO 1 CO 2 Course Curriculum

WEEK 6: **XX Lecture Hours**

Lean Startup Methodology and MVP Development, product development and Prototyping

WEEK 7: **XX Lecture Hours**

Introduction to Business Model Canvas Framework, identifying key elements of startup business model

WEEK 8: **XX Lecture Hours**

Value Proposition Canvas, How to create your VPC

WEEK 9: **XX Lecture Hours**

Legal considerations for startups, Intellectual Property Protection and Contracts

WEEK 10: **XX Lecture Hours**

Sales and marketing strategies for startups Digital marketing and customer acquisition

WEEK 11: **XX Lecture Hours**

Managing growth and avoiding common pitfalls, scalability and Growth strategies CO 3 CO 4 Course Curriculum

WEEK 12: **XX Lecture Hours**

Importance of storytelling, Storytelling

WEEK 13: **XX Lecture Hours**

Creating a compelling pitch deck, investor's perspectives on pitching to potential investors

WEEK 14: **XX Lecture Hours**

Social Impact and Sustainability in Entrepreneurship, entrepreneurship in emerging technologies and opportunities

WEEK 15: **XX Lecture Hours**

Review and recap, key concepts and lessons learnt, final leg Q/A , Evaluation, guidance and hand holding

Textbooks / Reference Books

Text Books:

1. Entrepreneurship: The Practice and Mindset
2. Start Your Own Business

Reference Books

1. The Infinite Game by Simon Sinek
2. The Lean Startup by Eric Ries

3. The $100 Startup by Chris Gillebeau
4. Start With Why by Simon Sinek
5. Zero to One" by Peter Thiel

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Quiz	Pitch Weightage	Total
Weightage (%)	60%	40%	100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
Avg.															

1 = Weakly mapped, 2 = Moderately mapped, 3 = Strongly mapped

Course Code	Course Name	L	T	P	C
	Exploratory - 4	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course objectives

Course outcomes

Catalog description

Course content

Unit 1 – Heading – 21 Lectures Hours

Unit 1 Detail content

Unit 2 – Heading – 24 Lectures Hours

Unit 1 Detail content

Textbooks / Reference Books

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	IA	MID SEM	End Sem	Total
Weightage (%)				100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
Avg.															

1 = Weakly mapped, 2 = Moderately mapped, 3 = Strongly mapped

Course Code	Course Name	L	T	P	C
HSFS7001	Environmental Engineering & Management	2	1	0	3
Pre-requisites/Exposure	• Basic knowledge of physics and chemistry • Basic knowledge of natural resources				
Co-requisites	--				

Course Objectives

I. To help the students understand the fundamentals and relevance of Environmental standards and laws for water, air, and land quality by Pollution Control board.

II. To enable students to understand water Quality Parameters and learn various water treatment processes.

III. To empower students with the required to translate a novel engineering idea to reality for sustainable development through providing the expertise of experimentation in the domain of water, air, soil, and noise pollution determination.

IV. To introduce various air pollutants models for trajectory tracking and dispersion to enable them to do wide variety of research/investigation/innovation in their chosen field of professional life.

V. To equip students with necessary engineering skills such as solving engineering problems in pollution control methodologies.

Course Outcomes

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

CO-1: Recall and list key environmental regulations and policies, demonstrating an understanding of their significance in shaping sustainable practices.

CO-2: Explain the fundamental principles of environmental systems and their interactions, illustrating comprehension of how various components influence ecological balance.

CO-3: Analyze real-world case studies to propose effective solutions for mitigating environmental challenges, showcasing the ability to apply engineering principles to practical situations.

CO-4: Evaluate the environmental impact assessment process for infrastructure projects, demonstrating the capacity to assess potential ecological repercussions and suggest improvements.

CO-5: Design of integrated environmental management plan that incorporates technological innovation and regulatory compliance, diSpecializationaying originality in developing comprehensive and sustainable solutions for sustainable development.

Catalog Description

Environmental engineering and management are important in many scientific and technological problems including natural resource conservation, Pollution control and different equipment's to control it, atmospheric and oceanic circulation, and renewable energy generation, energy production by chemical or green technology, optimum energy utilization in vehicles, buildings and industrial processes, and biological processes for sustainable development. The current course covers the fundamental background in the environmental resource conservation, with a special emphasis on water air and noise, as relevant to sustainable development in general and environmental engineering in particular. The course begins with a description of different fundamentals and relevance of Environmental standards and laws for water, air and land quality by Pollution Control board. The students will learn the fundamental laws of environmental conservation and then apply it to two distinct types of process commonly found in real life. The students will thus get an adequate exposure to water, air, soil and noise and the fundamental concepts that are required to translate a novel engineering idea to reality for sustainable development.

Course Content

UNIT 1 FUNDAMENTAL OF ENVIRONMENT **9 lecture hours**

Basic Concepts in Ecology, Environmental Science, Ecosystem, Population Ecology, Habitat, Major Ecosystems of the World, Human Impact on Environment. Environmental Degradation, Causes and, effects, Population Pressure, Concept of Development, Global Environmental Issues-Climate change, Global warming, Acid Rain, Ozone depletion, Natural Resources and its Management, Environmental Laws, and regulations.

UNIT 2 WATER QUALITY AND POLLUTION CONTROL 9 lecture hours

Physical, chemical, and biological characteristics of wastewater. Wastewater treatment processes. Primary treatment: Screening, grit removal, oil and grease removal, sedimentation-coagulation. Secondary treatment: Activated Sludge Process, The Oxygen Sag Curve, Rotating Biological Contactor. Tertiary treatment methods. Process design of wastewater treatment equipment, Typical Range of Composition of Domestic Sewage and Regulatory Standards, Advanced Treatment- Nitrogen and Phosphorous removal, Emerging Contaminants in Water.

UNIT 3 AIR &NOISE POLLUTION CONTROL 9 lecture hours

Introduction- Definition, Overview of Emissions, Type of Pollutants, Chemical Composition. Sources and Effects of Major Air Pollutants- CO, Sox, NOx, Hydrocarbons, Ozone, Photochemical Oxidants, Lead, Particulate Matter. Air Pollution and Metrology- Environmental Lapse Rate and Adiabatic Lapse Rate, Atmospheric Stability, Inversion, Type of Plumes., Gaussian Atmospheric Dispersion Model for Point Sources, Emission Controls., Control Devices for Particulate Pollutants- Gravity Settling Chambers, Centrifugal Separators, Wet Scrubber, Electrostatic precipitator, Control devices for Gaseous Pollutants- Adsorption, Absorption, Condensation and Combustion. Noise Levels and control mechanisms with current trends.

UNIT 4 ENVIRONEMENTAL IMPACT ASSESSMENT 9 lecture hours

Objectives and Purpose of EIA Studies, Indian Policies requiring EIA- Enactment of EIA as a Law, EIA Notifications, Siting Criteria. Components and Types of EIA, Roles in the EIA Process, Objectives and purpose of EIA studies., Indian policies requiring EIA- Enactment of EIA as a law, EIA notifications, Siting criteria, EIA cycle and procedure- Initial screening till Environmental Management plan. Components and Types of EIA, Roles in the EIA process, Environmental Audit- Need, Purpose, Criteria., Case studies.

UNIT 5 SOIL POLLUTION AND SOLID WASTE MANAGEMENT 9 lecture hours

Fundamentals of solid waste management, Storage, Collection and Transportation on of Municipal Solid Waste, Disposal of Municipal Solid Waste, Biomedical Waste management and

Health aspects and public Involvement in Solid Waste Management, Industrial waste management and E-waste waste management.

Textbooks:

3. Masters, g. M. & Ela, W. (2008). Introduction to environmental engineering and science, prentice hall englewood cliffs, nj.
4. Metcalf & eddy (1979). Wastewater engineering: treatmentm disposal, reuse, McGraw-Hill.
5. Punmia, B., and Jain, A. K. (1998). Waste water engineering, Firewall Media.
6. Tchobanoglous, G. & Burton, F. L. 1991. Wastewater Engineering. Management, 7, 1-4.

Reference Books:

1. Nevers N. (2011) Air Pollution Control Engineering, McGraw Hill, Singapore.
2. P. E. Cunniff (1987), Environmental Noise Pollution, McGraw Hill, New York, 1987.
3. Abbasi, S.A. (2010), Environmental Pollution and its Control, DPH, New Delhi.
4. Canter, L.W., (2010), Environmental Impact Assessment, Mc Graw Hill, New York.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO2
CO1	2	-	-	-	-	-	2	-	-	-	1	2	-	1
CO2	1	3	3	-	-	-	2	-	-	-	-	-	3	-
CO3	3	-	-	-	-	-	-	-	-	-	-	3	3	-
CO4	3	-	3	-	-	-	-	-	-	-	3	-	-	3
CO5	3	-	-	-	3	-	-	-	3	-	3	-	2	3
AVG	2.4	.6	1.2		.6		.8		.6		1.4	1	1.6	1.4

1. Weak mapped 2. Moderate mapped 3. Strong mapped

Course Code	Course Name	L	T	P	C
HSFS 3110	Environmental Engineering &Management Lab	0	0	2	1
Pre-requisites/Exposure	Basic Knowledge on Physics, Chemistry, and environment				
Co-requisites	--				

Course Objectives

I. Utilize theoretical principles from environmental engineering and management coursework to design and conduct hands-on experiments and field investigations
II. Develop proficiency in collecting environmental data, using specialized equipment and analytical techniques, and interpreting results to draw meaningful conclusions
III. Collaborate with peers to identify, analyze, and propose solutions to real-world environmental challenges, emphasizing sustainable practices and regulatory compliance
IV. Demonstrate a strong commitment to safety protocols, ethical conduct, and adherence to environmental regulations during laboratory work.
V. Effectively communicate experimental findings, observations, and recommendations through written reports, presentations, and discussions, fostering skills essential for environmental engineering practice and research.

Course Outcomes

At the end of the course students will be able to:

CO-1: Conduct experiments and determine the physical, chemical, and biological characteristics of air, water, and wastewater.

CO-2: Compare the experimental results with standards and deliberate based on the purpose of analysis.

CO-3: Determine type & degree of treatment, for air, water, and wastewater.

CO-4: Apply Relate the significance of experimental results in environmental engineering practices.

Catalog Description

Environmental engineering and management lab provides the application of science and engineering principles to protect and utilize natural resources, control environmental pollution, improve environmental quality to enable healthy ecosystems and comfortable habitation of humans. It requires multiple disciplinary knowledge including geology, hydrology, biology, chemistry, physics, medicine, engineering, management, economics, law, etc. Experiments are related to water supply, pollution control, recycling, waste (solid and liquid) disposal, radiation protection, industrial hygiene, environmental sustainability, and public health.

List of Experiments

Experiment 1: Estimation of Noise at different Location and its variation with respect to distance.

Experiment 2: Determination of Quality of particulate matter in Stack Emission

Experiment 3: Determination of SO2 and NOx in Stack Emission by application of stack air sampler.

Experiment 4: Study of digital meter (Hands on practice)

Experiment 5: Estimation of Indoor air quality specially ozone with application of Ozone analyzer.

Experiment 6: Estimation of Indoor air quality specially VOC with application of VOC analyzer.

Experiment 7: Estimation of Total, Organic and Inorganic carbon by application of TOC.

Experiment 8: Atomic Absorption Spectrophotometric Determination of Heavy metals (Pb)

Experiment 9: Determination of Particulate matter PM 2.5 & P.M 10 in ambient air

Experiment 10: Determination of SO2 in ambient air by application of impinger inbuilt air sampler

Experiment 11: Determination of NOx in ambient air by application of impinger inbuilt air sampler

Experiment 12: Filed visit and records of findings (visits notes) in industries with pollution control measures.

Textbooks:

1. Lab Manual, ISO 14001 Environmental Management, Regulatory Standards for Drinking Water and Sewage disposal.
2. Clair Sawyer and Perry McCarty and Gene Parkin (2005) "Chemistry for Environmental Engineering and Science", McGraw-Hill Series in Civil and Environmental Engineering.

Reference Books:

1. Guide manual: Water & wastewater analysis, Central Pollution Control Board, Govt. of India.
2. APHA standard methods for the examination of water and wastewater – 20th edition.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components Continuous evaluation	Presentation	Viva	File	Total
Weightage (%)	30	30	40	100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	2	-	-	-	1	3	-
CO2	-	-	-	-	-	-	-	-	2	-	-	-	1	3	-
CO3	-	-	-	-	-	-	-	-	2	-	-	-	1	3	-
CO 4	-	-	-	-	-	-	-	-	2	-	-	-	1	3	-
Average	-	-	-	-	-	-	-	-	2	-	-	-	1	3	-

1 = Weakly mapped, 2 = Moderately mapped, 3 = Strongly mapped

Course Code	Course Name	L	T	P	C
HSFS 3050	Construction Safety and Management	3	0	0	3
Pre-requisites/ Exposure	• Basics of civil engineering • Fundamental safety at the workplace • Basic knowledge legal laws related to safety				
Co-requisites	--				

Course Objective

The objectives of this course are:

I. To learn the legal and other requirements applicable to safety in construction.

II. To know the hazards and risks pertaining to the building or construction work and their preventive measures.

III. To familiarize students with the criticality of construction work and their impacts.

IV. To know the hazardous activities encountered during construction work and their general provision for minimizing their risk level.

V. To learn the technological tools and methodologies applicable to carrying out construction work activities.

Course Outcomes

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

CO-1: Learn the various construction projects, activity, and their safety challenges.

CO-2. Solve the HSE-related issues or challenges encountered at construction being an employee or consultant or any third party.

CO-3: Use their competency in assessing and analyzing site HSE conditions in accordance with global practices.

CO-4: Create a safe working environment at the construction site by including best innovative practices.

CO-5: Carry out incident investigation, developing new methodologies/procedures for improving project site conditions.

Catalog Description

Students will get exposure to the leading work-related safety hazards on construction sites which have a significant impact on human health, and overall construction work. Construction work includes hourly changed activities and encounters job-specific hazards which are the biggest problematic concern among the lines managers to tackle with. This course mainly focuses on work-related safety procedures and the planning/designing requirements in accordance with legal and other requirements. Construction-related legal provisions always support the safety professional to ensure safety at the worksite ultimately resulting in the minimization of accidents. Material handling, excavation, work at height, underground construction, blasting, and lifting operation including environmental concerns are the major areas to be covered in this course. The student will be capable enough to add best safety practices based on the specific activities which could elevate workplace safety culture throughout the organization.

Course Content

UNIT 1: LEGAL LAWS RELATED TO CONSTRUCTION SAFETY 12 lecture hours

Overview of construction safety, Buildings and Other Construction Workers (RE & CS) Act and Central Rules. Provisions regarding Licensing, safety, health, welfare, and social security aspects. Various chapters under BOCW, General & Special Provisions related to construction work activities, Inspection and Inspecting staff, Penalty, and their procedures.

UNIT 2: CONSTRUCTION PROJECTS AND THEIR CHALLENGES 10 lecture hours

Meaning and scope of safety in construction operations, Various types of construction projects, Safety in Excavations, Different types of soil, Trenching, Manual material handling Concrete work- Safety aspects during concrete work, Mechanical device used during concreting work..

UNIT 3: HAZARDOUS ACTIVITIES OF CONSTRUCTION 10 lecture hours

Work at various challenges faced during work at height, Scaffolding- Types, erection & dismantling of scaffolds, Formwork and their safety challenges, Underwater Works, Cofferdams, Underpinning & Shoring, Permit to Work System

UNIT 4: HARMFUL ENVIRONMENTS IN CONSTRUCTION OPERATION

9 lecture hours

Confined space & tunnelling, Batching plant operations, Hoisting & Rigging- Safety Lifting Equipment, Pre-Construction Preparation, Health Hazards while Handling Construction Materials and Chemicals, Safe Demolition, Human Factors involved, Environment management system in infrastructure work.

UNIT 5: UNDERWATER WORKS **4 lecture hours**

History of Dock Safety Statues in India- Background of Present Dock Safety Statues- Dock Workers (Safety, Health & Welfare) Act 1986 and the Rules and Regulations framed there under. Dock Safety Statutes. Role & Responsibility of Different Agencies for Safety/ authorities, Health safety & welfare of dock workers, Lifting Appliances and Gear, Competent Persons and Dock Worker responsibilities and limitations.

Text Books

1. Davies and Tomasin (1996), Construction Safety Handbook, London: Thomas Telford Publishing.
2. Jha, Patel and Singh (2022), Construction Safety Management, New Delhi: Pearson Education.
3. M. Rashad Islam (2022), Construction Safety: Health, Practices, and OSHA, New York, NY: McGraw-Hill.
4. T. Z Harmathy (2000), Fire Safety Science and engineering, London: ASTMINTL.

Reference Books

1. Goetsch, D. (2018). Construction Safety and the OSHA standards, Second Edition. Upper Saddle River, NJ: Pearson.
2. Heinrich, H. W. (1931). Industrial Accident Prevention: A Scientific Approach. New York, NY: McGraw-Hill.
3. R. K. Mishra (2013), Construction Safety, India: Aitbs Publishers.

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	3	2	-	-	-	-	2	1	-	2
CO2	3	3	-	-	-	-	1	-	-	-	-	2		-	3
CO3	-	-	2	-	-	-	-	-	-	-	-	2		-	-
CO4	-	-	2	-	-	-	-	-	-	-	-	1		-	-
CO5	-	-	-	-	2	-	-	-	-	-	-	1		-	-
Avg.	2.3	2.3	2	-	2	3	1.5	-	-	-	-	1.6	1	-	2.3

1= Weakly Mapped 2= Moderately Mapped 3= Strongly Mapped

Course Code	Course Name	L	T	P	C
HSFS 4002	Hazard Identification and computer aided Risk Analysis	2	1	0	3
Pre-requisites/ Exposure	▪ Principles of safety management ▪ Basic Knowledge of safety at work. ▪ Basic knowledge human physiology & the surrounding factors and its effects				
Co-requisites	--				

Course Objectives

The objectives of this course are:

I. To provide knowledge in Quantitative Risk Analysis Process Industries
II. To provide in-depth knowledge of risk Control and Management
III. To familiarize the student with various types of Hazard Identification techniques
IV. To understand qualitative risk assessment in construction industry.

Course Outcomes

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

CO-1: Understand advantage and disadvantage of various risk analysis techniques.

CO-2: Identify various Hazards related to the work practices and activity using various technique.

CO-3: Carryout Risk assessment methods to various Industries and work practices and activity.

CO-4: Compute the consequence modelling using various computational techniques.

Catalog Description

Hazard Identification, Risk Analysis and Management helps students to apply during system development to identify and mitigate hazards, and in so doing eliminate or reduce the risk of potential mishaps and accidents. With systems and technology also comes exposure to mishaps because systems can fail or work improperly resulting in damage, injury, and deaths. The possibility that a system fails and results in death, injury, damage, and the like is referred to as mishap risk will be identified from this subject.

Course Content

Unit I: Hazard Identification and Risk Analysis 16 lecture hours

Introduction - Hazard - Process - Hazard - Monitoring - Risk - Issues - Perception - Management Assessment-Analysis-Safety Audits-Management System Audits-Check Lists-Material Safety Data-What If Analysis-Event Tree-Fault Tree Analysis-Hazard and Operability Studies- Coarse Hazard Studies-Human Error Analysis-Safety Review System-Hazard Warning Methods-Hazard Warning Analysis- Plant Safety Audit.

Unit II: Software for Risk Analysis 16 lecture hours

Basic Concepts of Risk Analysis - Quantitative - Qualitative Methods - Hazard Models System-Hazard Assessment Systems - Principles of Applications of Software's- FETI - Hazard Operability Studies (HAZOP) - EFFECTS - Hazard Analysis (HAZAN) - PHAST - SAFETI - Failure Mode and Effect Analysis (FMEA).

Unit 3: Risk Control & Management 13 lecture hours

Impact estimation: Property, People, Man and Machine System, Job and Personal Risk Factors-Standards-Selection and Training-Body Size and Posture-Body Dimension (Static/Dynamic)-Adjustment Range- Penalties. -Guide Lines for Safe Design and Postures- Evaluation and Methods of Reducing Posture Strain.

Man-Machine Interface-Controls-Types of Control-Identification and Selection-Types of DiSpecializationays-Compatibility and Stereotypes of Important Operations-Fatigue and Vigilance- Measurement Characteristics and Strategies for Enhanced Performance Human Factor Engineering & Behavioral based safety.

Textbooks:

1. AIChE/CCPS, Guidelines for Hazard Evaluation Procedures second edition. Centre for Chemical Process Safety, American Institute of Chemical Engineers, New York, 1992.

2. AIChE/CCPS, Guidelines for Chemical Process Quantitative Risk Analysis second edition. Centre for Chemical Process Safety, American Institute of Chemical Engineers, New York, 2000.

Reference Books

1. Lees F.P. Loss Prevention in the Process Industries second edition. Butterworths, London, 1996.
2. Accident Prevention Manual for Business and Industry, Vol. I – National Safety Council, USA

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Table: Correlation of POs, PSOs v/s COs

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	2	-	1	1	1		-	-	2		1
CO2	3	2	2	1	1	-		1		1	-	-	1		1
CO3	-	1	1		1	-	-	-	-	-	-	-	1	-	-
CO 4	2	2	2	1	1	-	-	-	1	-	-	-	-	-	-
Average	2.3	2	2	1	2.3	-	1	1	1	1	-	-	2.3	2	2.3

1 = Weakly mapped, 2 = Moderately mapped, 3 = Strongly mapped

SEMESTER VII

Course Code	Course name	L	T	P	C
Signature-6	school of life courses	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Courses offered by School of Life are as follows:

- India and its place in the contemporary world
- Theory of everything
- Digital Transformation
- Finding your purpose in Life
- Contemporary world

Student to select from the available options.

Course Objectives

Course Outcomes

Catalog Description

Course Content

Unit 1 – Heading – **22 Lectures Hours**

Unit 1 Detail content

Unit 2 – Heading – **23 Lectures Hours**

Unit 1 Detail content

Textbooks / **Reference Books**

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	**IA**	**MID SEM**	**End Sem**	**Total**
Weightage (%)				**100**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
Average															

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course Code	Course Name	L	T	P	C
	Exploratory - 5	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

Course Outcomes

Catalog Description

Course Content

Unit 1 – Heading – **21 Lectures Hours**

Unit 1 Detail content

Unit 2 – Heading – **24 Lectures Hours**

Unit 1 Detail content

Textbooks / Reference Books

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	IA	MID SEM	End Sem	Total

Weightage (%)				100

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
Avg.															

1 = Weakly mapped, 2 = Moderately mapped, 3 = Strongly mapped\

Course Code	Course Name	L	T	P	C
HSFS 4018	Electrical System safety and its Design	3	0	0	3
Pre-requisites/Exposure	▪ Basic Knowledge of Electrical Circuits ▪ Basic Physics ▪ Basic First Aid				
Co-requisites	▪ Basics of Fire engineering				

Course Objectives

The objectives of this course are as follows:

I. To provide an overview of basic electrical engineering concepts

II. To provide in-depth view of electrical safety at workplace as per national/international standards, codes and/or rules

III. To brief the legislative requirements for electrical safety- national/international laws/codes of practices/ standards and/or regulations

Course Outcomes

Upon completion of the course the students will be able to

CO-1: Understand the hazards associated with electrical system.

CO-2: Analyse various hazards in electrical system operation

CO-3: Apply various control methods and implement various legal standards to control the hazards.

CO-4: Design safe electrical system and develop electrical safety management system.

Catalog Description

In the modern era of industrialization and globalization, humans not only is enjoying the benefits of development, but also experiencing huge loss of life due to exposure to different sets of hazards in day-to-day life. Among these hazards, electricity became one of the most common and severe ones. Hence, national/local governments formulating, enforcing, and updating legislations for ‘Being electricity Safe’ everywhere. However, without understanding the fundamental concepts, achieving the same would be difficult. Thus, this subject aimed to impart knowledge to and development of skills for students, by giving a strong base for industrial and building electrical safety.

Course Content

Unit I ELEMENTARY IDEAS OF ELECTRICAL EQUIPMENT 10 lecture hours

Transformers, DC Machines, Alternators, Induction Machines- Characteristics, application *Protection Relays*: Requirements of relay- types of protection, Classification: Distance Relay, Differential Relay, Static Relay- Definitions and types.

Unit II: CIRCUIT BREAKERS 12 lecture hours

Function switchgear, Arc Phenomenon- Initialization of an Arc, Arc interruption, Recovery voltage, and Restriking voltage classification and working, Working of MCB and ELCB Faults in Power System: Causes and types, Fuses: Definition, types of fuses, selection of fuses, advantages, and disadvantages. Grounding: Neutral grounding, Solid grounding, Resistance grounding, Arc suppression coil grounding, Equipment grounding for safety, Grounding sub-station, Grounding of line structure, Earthing

Unit III: EFFECT OF ELECTRIC FIELD AND MAGNETIC FIELD 8 lecture hours

Human Safety Aspects, Effect of Current and Voltage on Human being- distance from the source, Typical V-I characteristics of skin – Nervous System, Electrical Shocks and their prevention, Insulation: Classes of Insulation, FRLS insulation, Continuity test.

Unit IV: **INSTALLATION AND TESTING SAFETY MEASURES 8 lecture hours**

Safe sequences in installation – risk during installation, Safety during testing and commissioning- steps, Test on relays- Protection and interlock system on safety.

Unit V: HAZARDOUS ZONES: 7 lecture hours

Classification of hazardous zones. Intrinsically safe and explosion proof electrical apparatus, Selection of equipment in hazardous area

Electrical Fires: Hazards of static electricity, Safety procedures in electrical maintenance, Statutory requirements from Electrical Inspectorate. Introduction to Indian Electricity Act and Rules

Textbooks:

5. "**Electrical Safety, Fire Safety and Safety Management**"-S. Rao, Khanna Publishers, Delhi
6. "**Electrical Safety Handbook**"- John Cadick, TMH publishers, 6^{th} Edition
7. "**Basic Electrical Engineering**"- C.L.Wadhwa, New Age Publishers

Modes of Evaluation: Quiz/Assignment/ Class Test/ Tutorial

Examination Scheme:

Components	**Internal Assessment**	**MSE**	**ESE**
Weightage (%)	**30**	**20**	**50**

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	--	-	-	-	2	-	-	-	-	-	-	-	-	-
CO2	1	1	-	1	-	-	-	-	-	-	-	-	1	1	1
CO3	1	2	-	2	-	-	-	-	-	-	1	-	2	1	1
CO4	1	1	2	1	-	-	-	-	-	-	-	1	1	1	2
Avg.	1	1.3	2	1.3	-	2	-	-	-	-	1	1	1.5	1	1.3

1 = Weekly mapped, 2 = Moderately mapped, 3 = Strongly mapped

Course Code	Course Name	L	T	P	C
HSFS 4019	Chemical Engineering III	2	0	0	2
Pre-requisites/Exposure	Basic knowledge of physics and mathematics, Knowledge of Thermodynamics (1st law), Knowledge of Unit Operations, Mass, and Energy Balance				
Co-requisites	Not any				

Course Objectives

I. To familiarize the student with various aspects of a chemical process plant and enable him to do related calculations from conception to commissioning of plant.

II. To give student the knowledge of commonly used processes in chemical process plants and various codes implemented in the selection of material, equipment, etc.

III. To give student the knowledge and understanding of various sources of energy and their relative performance.

Course Outcomes

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

CO-1 : Describe/explain various considerations involved in designing a process plan from conception to commissioning.

CO-2 : Describe an integrated bioprocess and various unit operations involved in bioprocesses.

CO-3 : Classify various sources of energy and access their comparative economy.

CO-4 : Describe the process for extraction of raw materials and manufacture of basic chemicals.

CO-5 : Sketch P&ID for a chemical process using standard symbols

Catalog Description

This course equips a student with the knowledge of process technology. A student with the knowledge of process technology can be a key member of a team of people responsible for planning, analysing, and controlling the production of products from the acquisition of raw materials through the production and distribution of products to customers in a variety of process industries. These industries include, but are not limited to, chemical, food and beverage, power generation, pulp, and paper, refining and wastewater treatment. This program assists students in developing skills necessary for being an effective operator, such as working effectively in a team-based environment, strong oral and written communication, maintaining a safe work environment, controlling, monitoring, and troubleshooting equipment, analysing, evaluating, and communicating about data, and training others.

Course Content

Unit I: PLANT DESIGN AND DEVELOPMENT 8 lecture hours

Bench scale experiments, Pilot plant studies, Semi-commercial plant, Process flow chart, Material and energy balance, Process design, The P and I diagram, Detailed engineering including mechanical, structural, electrical, instrument and building designs, Equipment specifications, Piping and layout, Pressure vessel design codes, Plant location and Site selection, Capital cost estimates, Fixed and working capital, Cost escalation.

Unit II: BIOTECHNOLOGICAL PROCESSES 5 lecture hours

An overview of traditional and modern applications of biotechnological processes, Outline of an integrated bioprocess and the various (upstream and downstream) unit operations involved in bioprocesses, General requirements of fermentation processes, Types of fermenters, Design of fermenters, Auxiliary instrumentation of bioreactors, Main parameters to be monitored and controlled in fermentation processes, An overview of aerobic and anaerobic fermentation processes and their application in the biotechnology industry.

Unit III: **7 lecture hours**

Classification and sources of energy, Fossil, and processed fuels – solid, liquid, and gaseous, Effective utilization of solar energy, Energy from high velocity winds, Geothermal, Tidal and ocean thermal sources of energy, Fuel cells, MHD systems, Different types of furnaces and kilns used in industry, Refractories, Fuel economy, Thermal efficiency.

Unit IV: ENERGY SOURCES AND EFFICIENCY **6 lecture hours**

Processes for the manufacture of important basic chemicals like Sulphuric acid, soda ash, chlorine and caustic soda, Manufacture of ammonia, nitrogenous and phosphatic fertilisers, Extraction of copper, iron and aluminium, Manufacturing processes for pulp and paper, sugar, Oils and fats, Soaps and detergents, agrochemicals, Introduction to petrochemical industries.

Unit V: MATERIALS AND CORROSION **4 lecture hours**

Selection of engineering materials – carbon and low alloy steels, high alloy steels, cast iron, nickel and alloys, copper and alloys, aluminum and alloys, lead and alloys, glass, cement, bricks and tiles, plastics, and rubbers. Corrosion of metals – nature and mechanism of corrosion, theories of corrosion, factors that influence corrosion, corrosion in the atmosphere, corrosion under water, methods of prevention of corrosion. Choice of metals and alloys for chemical plant construction under ordinary temperature and pressure and under high temperature and pressure conditions.

Textbooks

1. McCabe, W. L., Smith, J. C., & Harriott, P. (1993). *Unit operations of chemical engineering (Vol. 5)*. New York: McGraw-Hill.
2. Peters, M. S., & Timmerhaus, K. D. (1991). *Plant design and economics for chemical engineers*. McGraw-Hill chemical engineering series

Reference Books

1. Sinnott, R. K. (2006) *Chemical Engineering Design*, Coulson & Richardson's Chemical Engineering, vol 6., fourth edition.
2. Seider, W. D., Seader, J. D., & Lewin, D. R. (2009). *Product & process design principles: synthesis, analysis, and evaluation*. John Wiley & Sons.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Programme Outcomes**
CO-1	Design a chemical process plant from scratch – conception to commissioning.	**PO1-5, 7, 9-11; PSO1, 2**
CO-2	Outline integrated bioprocess and various unit operations involved in bioprocesses.	**PO1-4, 12; PSO1**
CO-3	Classify various sources of energy and access their comparative economy.	**PO1, 2, 7; PSO3**
CO-4	Describe the process for extraction of raw materials and manufacture of basic chemicals.	**PO2, 4, 6; PSO1, 2**
CO-5	Apply engineering knowledge for Selection of engineering materials based on their chemical and physical properties.	**PO1, 3-8, 12; PSO2**

Table: Correlation of POs v/s COs

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	-	2	-	2	2	2	-	3	2	-
CO2	1	1	2	2	-	-	-	-	-	-	-	3	2	-	-
CO3	1	2	-	-	-	-	3	-	-	-	-	-	-	-	2
CO4	-	2	3	-	-	2	-	-	-	-	-	-	3	2	-
Avg.	2	-	3	2	1	3	2	2	-	-	-	2	-	3	-

1 = Weakly mapped, 2 = Moderately mapped, 3 = Strongly mapped

Course Code	Course Name	L	T	P	C
HSFS 4005	Risk assessment and planning	3	0	0	3
Pre-requisites/Exposure	• Basic Knowledge of basics sciences. • Knowledge of the basics of fire engineering • Principles of safety management • Knowledge of civil engineering basics				
Co-requisites	National Building code IS Codes, NFPA				

Course Objectives

The course will enable the students to:

I. To learn various type of building and their general requirements.

II. To understand the various aspects considered during evacuation in lined with codes of practices. Acknowledge planning and design consideration while constructing various categories of building with respect to fire & safety.

III. To Lean means of access, routes and exit used during any emergency evacuation.

IV. To In-depth learning of inspection, auditing process, fire investigation & fire risk assessment.

Course outcomes:

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

CO-1: Understand and explain the different types of buildings and their fire safety requirements applicable during an emergency.

CO-2: Ensure, interpret, and implement building fire safety requirements as advised or laid in legal and other requirements.

CO-3: Examine or compare workplace/ building fire safety conditions for adopting best practices.

CO-4: Carry out fire safety audit, and incident investigation being a fire safety auditor, assessor, advisor, or investigator and recommend suitable control measures.

CO-5: Develop a fire safety plan and assist in designing fire protections facilities in a building or workplace.

Catalog Description

Fire safety is an essential requirement for any building or industrial premises today. It has many challenges during construction with respect to complying with legal requirements and for the safe execution. Globally, fire risk is a major catastrophe and based on its level suitable techniques are available which is to be taught, and students should be aware about it minimizing losses due to fire. On building fire safety, the national building code has given guidelines, which covers various classification of building and their general requirements. This course is based on practical aspects of firefighting and the hurdles coming in during building evacuation at the time of fire emergency. Mainly the focus of NBC part IV is to cover various aspects of fire safety parameters, which can be helpful in planning and designing of building and evacuation routes/ exit. To ensure the fire safety requirements and complying legal requirements or recommendation stated in NBC, learning of audit and inspections are important. Students will learn about various types of building and apply their learning to cope with fire and other emergencies by suitable control measures.

Course Content

Unit I: BUILDING OCCUPANCY TYPES 12 lecture hours

Classification of buildings based on occupancy. Residential - Educational - Institutional - Assembly - business - Mercantile - Industrial - storage - hazardous. General Requirements.

Unit II: EMERGENCY EVACUATION PLANNING 10 lecture hours

Process of emergency evacuation - special features of personnel movement. Parameter characteristics of the movement of people-practical methods of designing evacuation passages and exists. Evacuations exist and routes - stages of evacuation.

Unit III: EVACUATION ROUTE PLANNING AND SAFETY 8 lecture hours

Planning of evacuation routes and exits - Seating arrangement - Passages and corridors - Stairs - Smoke proof stairs - External fire escape ladders.

Unit IV: EVACUATION ROUTE AND EXIT PLANNING **5 lecture hours**

Technical economical evacuation of fire safety - special fire protection features for modern buildings - Ensuring fire safety and capital investment - Evaluation of cost effectiveness - Case study.

Unit V: FIRE SAFETY MEASURES AND INVESTIGATIONS **10 lecture hours**

Training and education, Arson, Fire safety audits, Risk Assessment, Fire Insurance. Investigation of fire -evidence and court procedure - law of evidence - cross-examination - giving evidence.

Textbooks

1. BIS, NBC Part IV – Fire and Life Safety", Bureau of Indian Standards, New Delhi, 2016.
2. Royetman M Ya – Principles of fire safety standards for building construction
3. Jain V K – Fire Safety in Building
4. Butcher and Parnell; Designing of Fire Safety.
5. BS 5588: British Standard – Fire precautions in the design, construction and use of buildings
6 T. Z Harmathy - Fire Safety Science and Engineering

Reference Books

1. Fire Insurance Policies of Public Sector insurance companies
2. AIFT (TAC) Regulations
3. BIS, "IS 2189:2008 –Selection, Installation and Maintenance of Automatic Fire Detection and Alarm System – Code of practice" Bureau of Indian Standards, New Delhi, 2008.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written
Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Co-relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	-	1	-	2	2	1	3	-	2	-	-	2	3
CO2	2	1	-	-	2	2	-	2	2	2	3	3	2	3	2
CO3	2	-	1	-	2	-	2	2	2	-	1	2	2	2	2
CO4	1	2	2	2	2	2	-	2	2	3	2	2	1	2	1
CO5	2	2	3	3	-	1	2	2	-	2	2	1	1	2	2
Avg	1.8	1.8	2	2	2	1.8	2	1.8	2.3	2.3	2	2	1.5	2.2	2

1 = Weakly mapped 2 = Moderately mapped, 3 = Strongly mapped

Course Code	**SIIB 4101**	L	T	P	C
Version 1.0	Industrial Internship	0	0	2	0
Pre-requisites/Exposure					
Co-requisites					

Course Outcomes: (Summer Internship)

CO-1: To understand and correlate the industrial processes with the technical knowledge gained.

CO-2: To apply the knowledge to develop, manage and implement engineering solutions within the chemical, petrochemical, and oil and gas sector.

CO-3: To learn and understand various skills required, along with professional ethics practiced by the industry.

CO-4: To communicate and present technical knowledge effectively.

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	2	2	-	-	-	-	3	3	2	3
CO2	-	3	-	-	-	-	-	-	-	-	-		3	-	2
CO3	3	3	-	-		2	2	3	3	-	-	-	3	3	2
CO4	-	-	-	-	-	2	-	-	3	-	-	1	-	2	2
Avg.	3	3	-	-	-	2	2	3	3	-	-	3	3	2.33	2.75

1 = Weakly Mapped, 2 = Moderately Mapped, 3 = Strongly Mapped

Course Code	Course Name	L	T	P	C
PROJ 3112	Minor Project	0	0	8	4
Pre-requisites/Exposure	Fire Safety, Occupational Health and Safety and Environment related Subjects				
Co-requisites	Not any				

Course Objectives

I. To review research literature and identify the complex engineering problems.
II. To apply the technical knowledge to find solutions to engineering problems.
III. To analyse the research-based knowledge to provide valid conclusions.
IV. To commit to professional ethics and work effectively as an individual, and as team within the norms of engineering practices.

Course Outcomes

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

CO-1: Identify an industrial/engineering HSE problem by reviewing comprehensive literature.

CO-2: Analyze research-based knowledge to provide valid conclusions.

CO-3: Devise feasible solutions by working in a team abiding to legal, professional, and engineering practices.

CO-4: Develop detailed proposal/project documentation in coordination with team members.

Catalog Description

Major Project-II is a crucial part of their curriculum as it comprises with identifying/providing the students with the practical/ real life problem statement related to HSE allied areas and students work on determining solution for the same. Students will be divided into groups to do the project work as a team so that they work collectively to solve the identified problem. Students are also encouraged to develop a prototype (if any- in case of proposal of innovative ideas)

Correlation of COs with POs:

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2	PSO 3
CO1	3	3	-	-	-	2	2	-	-	-	-	3	3	2	3
CO2	-	3	-	-	-	-	-	-	-	-	-		3	-	2
CO3	3	3	-	-		2	2	3	3	-	-	-	3	3	2
CO4	-	-	-	-	-	2	-	-	3	-	-	1	-	2	2
Average	3	3	-	-	-	2	2	3	3	-	-	3	3	2.33	2.75

1 = Weakly mapped, 2= Moerately mapped, 3 = Strongly mapped

SEMESTER VIII

Course Code	Course Name	L	T	P	C
ECEG 4039	Process Instrumentation and Control Engineering	2	0	0	2
Pre-requisites/Exposure	a. Basic Knowledge of law of physics and mathematics. b. Knowledge of partial differential equations c. Knowledge of transfer functions				
Co-requisites	Chemical Process Safety				

Course Objectives

I. To understand various measuring and control instruments.
II. To learn the principle of various measurement instruments and their functioning.
III. To learn about various controllers – functioning, strength, and limitations.

Course Outcomes

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

CO-1: To understand the basic principles & importance of process control in industrial process plants.

CO-2: To draw and explain the use of block diagrams & the mathematical basis for the design of control systems.

CO-3: To explain functioning of various instruments for measurement of temperature, pressure, flow rate, and other flow parameters.

CO-4: To perform frequency response analysis, stability analysis.

CO5-: To apply good instrumentation for the efficient design of process control loops for process engineering plants.

Catalog Description

The purpose of this course is to introduce the key concepts in automatic control and instrumentation of process plants. Material and energy balances are extended to unsteady state (dynamic) systems and Laplace Transforms are introduced as a means of conveniently representing process control systems and solving ordinary differential equations. First order, second order, and integrating systems including dead time are treated with basic controller algorithms. Commonly used sensing, transmission and final control elements are described and depicted in piping and Instrumentation Diagrams (P&IDs). The course is delivered through a combination of lectures, tutorials and exposure to simulation programs currently used in industry. Once you have completed the course, you should be able to characterize and tune simple processes and appreciate the relevance of control systems to safety and profitability.

Course Content

Unit I MEASUREMENT BASICS 8 lecture hours

Elements of measurement – Fundamental standards, Quality of measurement, Meaning of measurement, Errors in measuring instruments, Precision and accuracy, Calibration principle, Static and dynamic characteristics of measuring instruments.

Measurement of temperature – Bimetallic and pressure thermometers, Thermocouples, Resistance thermometers, Pyrometry, Calibration.

Pressure and vacuum measurement – Manometers, Measuring element, Absolute pressure measurement, Static accuracy of pressure gauges.

Unit II FLOW, LEVEL, AND INSTRUMENTATION 8 lecture hours

Flow measurement - Orifice installation, Pitot tube, Area flow meters, Open channel meters. Level measurement – Direct method, Measurement of level in open and pressure vessels. Measurement of pH and humidity.

Recording Instruments, Indicating and signaling instruments, Signal transmission, and codes.

Unit III CONTROL SYSTEMS ANALYSIS 7 lecture hours

Open loop and close loop systems – Transfer function modeling – block diagram representation of mechanical, thermal, and liquid level systems.

Transient response analysis – Time response of first and second order system for impulse and step inputs – Effect of damping factors on transient response – Characteristics of proportional, integral, derivative, PI, PD and PID controllers.

Frequency response method of analysis – polar plot – Bode Plot.

Unit IV CONTROL SYSTEM STABILITY AND COMPONENTS 7 lecture hours

Introduction to stability – Definition via impulse response function – Routh-Hurwitz stability criterion – Nyquist stability criterion.

Control system components – error detectors – modulators and demodulators – Hydraulic controllers – Pneumatic controllers – PLC. Introduction to computer control in chemical process industry. Comparison between discrete data, digital and analogue control systems. Introduction to digital signal processing.

Textbooks

1. Ogata, K. (2010). Modern Control Engineering, Prentice Hall.

Reference Books

1. Johnson C. D. (2013), Process control instrumentation technology. Pearson Education Limited.
2. Douglas O de Sa (2001) Instrumentation fundamentals for process control. CRC Press.
3. Dunn (2005), Fundamentals of industrial instrumentation and process control. Tata McGraw-Hill Education
4. Kallen H. P. (Ed) (1961) Handbook of instrumentation and control. New York: McGraw-Hill Book Company

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Table: Correlation of POs v/s COs

POs/COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	2	-	-	-	3	-	-		2	-	-	-	-	2
CO2	1	2	3	-	2		-	-	3	-	-	-	2	3	2
CO3	2	3	2	3	3		-	-	2	-	-	-	3	-	-
CO4	-	2	-	-	-	2	3	-	-	2	-	-	-	-	2
CO5	3	3	-	-	-	2	2	3	2	2	3	1	2	2	3
Average	2	2.4	2.5	3	2.5	2.3	2.5	3	2.3	2	3	1	2.3	2.5	2.25

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course Code	Course Name	L	T	P	C
HSFS 4003	Safety in Rail and Road Transport	2	0	0	2
Pre-requisites/Exposure	• Brief Idea of Transportation Engineering and Rail Engineering. • Fundamental knowledge of Mathematics and Physics				
Co-requisites	--				

Course Objectives

I. To provide in-depth knowledge in safety in rail and road transport engineering industry.
II. To provide in-depth knowledge of various components of railway and road sections.
III. To familiarize the student with cause of train accidents, Road classification, Control of traffic, Geometric Design.

Course Outcomes

On completion of this course, the students will be able.

CO-1: To understand the functions and features of different components of permanent way.

CO-2: Explain the control of train movement by various systems.

CO-5: Describe the classification of Highways, Consideration for safe designs.

CO-4: To apply the learning in geometric design, Super elevation of a Railway section.

CO-5: Analyze the safer method of operation of railways and roads.

Catalog Description

This subject deals with all aspects of railway and road engineering in fundamental concepts with special focus on Indian Railways and Highways. It also presents the theories and field practices as well as the modern techniques in detail. It is very important for engineering students and new entrants into the field of railways to be aware of not only the fundamentals of railway engineering but also latest developments about railway tracks, locomotives and rolling stock, signaling, and interlocking, etc.

Course Content

Unit 1: RAILWAY ENGINEERING **06 lecture hours**

Permanent way- components. Rails- Functions, requirements, defects, rail joints and fastenings, check and guard rails, coning of wheels, creep of rails. Sleepers- functions, requirements, types, density. Ballast- functions, requirement types.

Unit 2: GEOMETRIC DESIGN **07 lecture hours**

Horizontal curves, Super- elevation, Negative super elevation in branches, Length of transition curves- Grade compensation on curves, Widening of Gauge on curves.

Unit 3: RAILWAY OPERATION CONTROL **06 lecture hours**

Points and crossings- Design features of a turn out –Types of Railway track- Points- Details of Station Yards and Marshalling Yards- Signaling and interlocking- Principles of track circuiting-Control of train movement by absolute block system- Automatic block system- Centralized traffic control Systems.

Unit 4: CLASSIFICATION OF HIGHWAYS **06 lecture hours**

Historical development of road construction- Typical cross section of roads - Definition of various cross- sectional elements- Requirements & factors controlling alignment of roads - Basic Geometric design.

Unit 5: TRAFFIC ENGINEERING **05 lecture hours**

Traffic characteristics- various traffic studies and their applications – Traffic Regulations and Controls- Traffic Control devices- Traffic signals- Classification of signals- carriage- way markings- Traffic islands- Highway intersections- Principles of highway lighting.

Textbooks

1. S.C. Rangwala, *Railway Engineering,* Charotar Book Distributors, 2012.
2. S. Chandra and M.M. Agarwal, Railway Engineering, Oxford University Press
3. S.K. Khanna and C.E.G. Justo, *Highway Engineering,* Nem Chand & Brothers
4. L.R. Kadiyali, *Traffic Engineering and Transport Planning*, Khanna Publishers, New Delhi, 2004.
5. Mike Slinn, Peter Guest and Paul Mathews, Traffic *Engineering Design: Principles and Practice*, Butterworth-Heinemann Elsevier.

Reference Books

1. Railway Engineering by B.L Gupta, Amit Gupta
2. Highway Engineering by L.R. Kadyali, N,B.Lal

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	2	2		2
CO4	2	3	2	2	-	1	-	-	-	-	-	-	1	1	2
Avg.	2.2	1.8	1.6	1.5		1	-	-	-	-	-		1.5	1	2

1 = Weakly mapped, 2 = Moderately mapped, 3 = Strongly mapped

Course Code	Course Name	L	T	P	C
HSFS 4022	Leadership in Safety	1	0	0	1
Pre-requisites/Exposure	Knowledge of behavioral based safety and presentation skills				
Co-requisites	--				

Course Objectives

I. To create the awareness among students regarding importance of safety in industries.

II. To introduce the definitions, concepts, methodologies used in management of occupational safety in industries.

III. To enhance the safety and risk management leadership skills

Course Outcomes

On completion of this course, the students will be able.

CO-1: To remembering and Understanding the role & necessary skills to be a safety leader.

CO-2: To identify and Evaluate concept of safety culture and leadership safety.

CO-3: To apply various tools & techniques to continually reinforce the desired workplace safety culture.

Catalog Description

This course is designed to provide students with a deeper understanding of the role of leadership in determining safety outcomes. Safety Leadership models and theories are introduced that centers on changing the organization's safety culture. Improving safety performance by increasing effective safety leadership skills and be ready to meet the difficult challenges of today's needs.

Course Content

Unit I: LEADERSHIP, MOTIVATION, AND ETHICS **7 lecture hours**

Leadership- Introduction Leadership theories models and styles, Inclusive leadership, Theories on motivation. Leadership vision and strategic thinking, Ethical decision making.

Unit II: BUILDING A SAFETY CULTURE **8 lecture hours**

Understanding and transforming the Safety Culture -Principles of Safety Culture, Reporting Culture, Safety Culture vs. Illusion of Safety, The Human Element, Building a culture of compliance, Safety leadership principles, Bradley Curve.

Textbooks

1. Leading with Safety Thomas Krause Wiley 2005.
2. Safety Culture: Theory, Method and Improvement by StianAntonsen CRC Press 2009

Reference Books

3. Accident Prevention Manual: Administration & Programs, 14th Edition, National Safety Council, 2015
4. Practical Leadership Skills for Safety Professionals and Project Engineers Gary L. Winn CRC Press 2016

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C O 1	-	-	-	3	-	-	-	-	-	-	-	-	-	3	3
C O 2	-	-	-	2	-	-	-	-	-	-	-	-	2	-	2

CO3	-	-	-	-	-	3	-	2	2	2	2	-	1	-	-
AVG	**-**	**-**	**-**	**2.5**	**-**	**3**	**-**	**2**	**2**	**2**	**2**		**1.5**	**3**	**2.5**

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course Code	Course Name	L	T	P	C
PROJ 4117	Major Project	0	0	16	8
Pre-requisites/Exposure	Fire Safety, Occupational Health and Safety and Environment related Subjects				
Co-requisites					

Course Objectives

I. To review research literature and identify the complex engineering problems.
II. To apply the technical knowledge to find solutions to engineering problems.
III. To analyse the research-based knowledge to provide valid conclusions.
IV. To commit to professional ethics and work effectively as an individual, and as team within the norms of engineering practices.

Course Outcomes:

On completion of this course, the students will be able.

CO-1: To identify an industrial/engineering HSE problem by reviewing comprehensive literature.

CO-2: To analyze research-based knowledge to provide valid conclusions.

CO-3: Devise feasible solutions by working in a team abiding to legal, professional, and engineering practices.

CO-4: Develop detailed proposal/project documentation in coordination with team members.

Catalog Description

Minor Project-II is a crucial part of their curriculum as it comprises with identifying/providing the students with the practical/ real life problem statement related to HSE allied areas and students work on determining solution for the same. Students will be divided into groups to do the project work as a team so that they work collectively to solve the identified problem. Students are also encouraged to develop a prototype (if any- in case of proposal of innovative ideas)

Correlation of COs with POs:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	2	2	-	-	-	-	3	3	2	3
CO2	-	3	-	-	-	-	-	-	-	-	-		3	-	2
CO3	3	3	-	-		2	2	3	3	-	-	-	3	3	2
AVG	-	-	-	-	-	2	-	-	3	-	-	1	-	2	2

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Specialization in Safety and Risk Analysis

Course code	Course Name	L	T	P	C
MEEG745	Sustainability Engineering	3	0	0	3
Pre-requisites/Exposure	• Basic knowledge of physics and chemistry (Basic science) • Basic knowledge of Environment				
Co-requisites	Not Any				

Course Objectives:

I. To help the students understand the fundamental key concepts on Sustainable Development (SD), such as intra- and inter-generational equity, economic, social and environmental, sustainability; strong and weak sustainability, natural capitalism, steady state and green economy.

II. To enable students to understand to identify and discuss in detail the key empirical issues on sustainable development, such as renewable energy transitions, urban agriculture, and green architecture.

III. To empower students with the expertise to distinguish between "green economy" and "sustainability", and various efforts at multiple levels of governance: from individual to governments.

IV. To expose students to a wide variety of research areas to apply and therefore appropriate theoretical knowledge on public policy and international relations to the issue area of sustainable development, in such aspects as international aid, global climate change negotiations, the importance of international regimes as opposed to voluntary private governance.

Course Outcomes :

On completion of this course the students will be able to

CO-1: Understand about the elements of sustainability.

CO-2: Know the conventions on sustainable development around the world.

CO-3: Learn dynamics of sustainability and factors responsible for it.

CO-4: Apply the design aspects of sustainability on socio-economic systems.

CO-5: Create the awareness for sustainable Development and its Role in Building of Environment

Catalog Description:

Sustainable Development is the key policy concept of the contemporary world, both in academic and policy circles. The world has entered the new geological era of Anthropocene, that is, we, as human beings, change the structure of Earth and its climate to an extent that it warrants a new geological era. This comes with the depletion of resources, growing climate instabilities, demographic changes of unprecedented scale and the social inequality. The world is currently discussing the Sustainable. Development Goals to take humanity to 2030 in place of the expired Millennium Development Goals. This course will give the students the key concepts to discuss sustainable development and its three pillars: the social, the environmental, and the economic.

Course Content

Unit I CONCEPT OF SUSTAINABLE DEVELOPMENT 09 lecture hours

Definition of sustainability - History and emergence of the concept of sustainable development– Our Common Future - Objectives of Sustainable Development - Millennium Development Goals - Environment and Development linkages – Globalization and environment - Population, Poverty and Pollution – Global, Regional and Local environmental issues – Resource Degradation – Greenhouse gases and climate Change – Desertification – Industrialization – Social insecurity.

Unit II SUSTAINABILITY AND THE TRIPLE BOTTOM LINE 09 lecture hours

Components of sustainability – Complexity of growth and equity - Social, economic and environmental dimensions of sustainable development – Environment – Biodiversity – Natural Resources – Ecosystem integrity – Clean air and water – Carrying capacity –Equity, Quality of Life, Prevention, Precaution , Preservation and Public participation.- Structural and functional linking of developmental dimensions – Sustainability in national and regional context.

Unit III SUSTAINABLE DEVELOPMENT AND RESPONSE 09 lecture hours

Role of developed countries in the development of developing countries – International summits – Stockholm to Johanesburg – Rio Principles – Agenda 21 - Conventions – Agreements – Tokyo Declaration-Doubling statement-Transboundary issues –Integrated approach for resource protection and management.

Unit IV SUSTAINABLE DEVELOPMENT OF SOCIO-ECONOMIC 09 lecture hours

Demographic dynamics of sustainability – Policies for socio-economic development – Strategies for implementing eco-development programmes – Sustainable development through trade – Economic growth – Action plan for implementing sustainable development – Urbanization and Sustainable Cities – Sustainable Energy and Agriculture – Sustainable Livelihoods – Ecotourism

Unit V FRAMEWORK FOR ACHIEVING SUSTAINABILITY 09 lecture hours

Sustainability indicators - Hurdles to Sustainability - Operational guidelines –Interconnected prerequisites for sustainable development – Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities, Business and Industry - Science and Technology for sustainable development –Performance indicators of sustainability and Assessment mechanism – Constraints and barriers for sustainable development.

Textbooks / Reference Books

1. Austin, James and Tomas Kohn. (1990). Strategic Management in Developing Countries.The Free Press.
2. Berger. (1994). "The Environment and the Economy." In Smelser and Swedberg (eds.)
3. The Handbook of Economic Sociology. Russel Sage Foundation. D'Arcy, David. Transcript of broadcast. (2002) "In Houston, a Treasure of Exiled Afghan Art," National Public Radio,
4. Elkington, John. (1997). Cannibals with Forks: The Triple Bottom Line for 21st Century Business Oxford: Capstone Publishing.
5. Guillen, Mauro and Sandra L. Suarez. (2002). "The Institutional Context of Multinational Activity." In Organization Theory and the Multinational Corporation. 2nd edition. New York: St. Martin's Press http://discover.npr.org/features/feature.jhtml?wfld=867875

6. Egan, Mary Lou and Marc Bendick, Jr. (2003). Workforce Diversity Initiatives of US MNCs in Europe. Thunderbird International Business Review, Forthcoming December 2003.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Components	IA	MID SEM	End Sem	Total
Weightage (%)	30	20	50	100

Correlation between the Program Outcomes (POs), Program Specific Outcomes (PSOs) and Course Outcomes (COs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	2	-	-	-	-	-	-	-	3	3
AVG	3	2.2	1	-	1	-	-	-	-	-	1.25	-	1.25	1.25

1=Weakly mapped 2= Moderately mapped 3=Strongly mapped

Course code	Course Name	L	T	P	C
HSFS 3008 (Version 3.2)	Process Safety and Security	3	0	0	3
Pre-requisites/Exposure	▪ Basic Knowledge of Physics, Chemistry and Mathematics ▪ Basics of thermodynamics and heat transfer				
Co-requisites	Basics of fire				

Course Objectives (CO):

I. To inculcate the skill to comprehend & apply principles/approaches of inherently safer design for reducing/eliminating hazards and risk pertaining to operating chemical systems.

II. To provide in-depth knowledge related to applications of process safety and security systems in the chemical industry.

III. To deliver in-depth awareness among the students related to safety designs and operations of chemical process plants.

IV. To familiarize the student with hazards arising from chemical reactions in hazardous process industries.

Course Outcomes

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

CO-1: Understand the typical sources of risk in a process plant by hazard identification and examination of case studies.

CO-2: Apply the knowledge of past accidents to make failure estimations of various equipment in chemical industries, storage facilities and petrochemical refineries.

CO-3: Analyse the risk and estimate the consequences of failure of various equipment which can lead to fires, explosions and toxic releases.

CO-4: Design safety systems for process industries to prevent major accidents from occurring.

Catalog Description

The course will provide an overview of Process Safety in the Chemical Industry, focusing on the nature of chemical plant accidents, their causes, and steps to eliminate them, with emphasis on inherently safe designs. Chemical plant accidents deal most often with ‘flammability and toxicity’ issues. The role of ‘Human Error’ in accidents will also be examined through actual case studies (including Bhopal, BP Texas City, Piper Alpha) to show the relevance in today's workplace. Student will be equipped with the tools to perform consequence assessment for

accidents involving fire, explosion or toxic substance release. The course requires active student participation via discussions of system designs, their weakness and improvements.

Course Content

Unit I INHERENT SAFETY **10 lecture hours**

Design principles – reliability and safety in designing – inherent safety – engineered safety - piping and instrumentation – safety during startup and shutdown – safety checks in the design of the equipment – reactor safety – safety in erection and commissioning of chemical plants - non-destructive testing methods – pressure and leak testing – emergency safety devices – scrubbers and flares – new concepts in safety design and operation- Pressure vessel testing standards - Inspection techniques for boilers and reaction vessels.

Unit II SAFETY IN OPERATION **9 lecture hours**

Properties of chemicals – Material Safety Data Sheets – methods available for property determination; Operational activities and hazards – standards operating procedures –pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping systems; effects of pressure, temperature, flow rate and humidity on operations; corrosion and control measures- condition monitoring, control valves – safety valves – pressure reducing valves, drains, bypass valves, inert gases. chemical Specializationashes, eye irritation, and automatic showers.

UNIT III SAFETY IN STORAGE AND HANDLING **10 lecture hours**

Types of storage-general considerations for storage layouts- atmospheric venting, pressure and temperature relief – relief valve sizing calculations - storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation – pipe line transport – safety in chemical laboratories. Safety provisions like level and flow indicators – alarms, trips – protection of stills, columns and towers from lightening – colour coding for pipe lines and cylinders.

UNIT IV CHEMICAL KINETICS **10 lecture hours**

Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self – heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening, Case studies. Stability and sensitivity tests, Classification of materials with explosive potential, Hazard prediction by thermodynamic calculations, Prevention and control of explosions and detonations – diluting a release, purging and inserting, venting, explosion relief, flame arrestors, explosion suppression, Classification of hazardous areas.

UNIT V CHEMICAL PLANT SECURITY **6 lecture hours**

Safety vs Security, Concept of security, Security Threats and vulnerability, Security risk standards, Security Vulnerability Assessment methods, Prevention of Security incidents in various infrastructure handling hazardous materials, Case studies. Cyber security in process plants.

Textbooks and Reference Books

1. Crowl and Louvar (2002), Chemical Process Safety: Fundamentals with applications, New Jersey: Prentice Hall
2. Quantitative Risk Assessment in Chemical Process Industries" American Institute of Chemical Industries, Centre for Chemical Process safety.
3. Fawcett, Howard H.; Wood, William S, "Safety and Accident Prevention in Chemical Operations" Wiley Inters, Second Edition, 1984
4. GREEN, A.E., "High-Risk Safety Technology", John Wiley and Sons, 1984.
5. Lees, F.P. "Loss Prevention in Process Industries" Butterworths and Company, 1996

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Components	Internal Assessment	Mid-Semester Examination (MSE)	ESE
Weightage (%)	50	20	30

Correlation between the Course Outcomes (COs) and Program Outcomes (POs) Table:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12	PSO13
CO1	2	-	-	-	-	-	3	2	3	-	-	3	3	-	-
CO2	2	3	2	-	3	-	-	-	-	-	2	2	-	3	-
CO3	2	-	-	-	3	2	-	-	-	3	-	-	-	-	3
CO4	2	-	-	2	3	-	-	-	-	3	-	-	2	3	-
AVG	2	3	2	2	3	2	3	2	3	3	2	2.5	2.5	3	3

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course Code	Course Name	L	T	P	C
HSFS 7004	Human Factors Engineering	3	0	0	3
Pre-requisites/ Exposure	• Basic Knowledge of Health, Environment and Safety. • Basic Knowledge Safety & its implications in Workplace. • Basic Knowledge of psychology and its factors pertaining to Management systems. • Basic knowledge human physiology & the surrounding factors and its effects.				
Co-requisites					

Course Objectives

I. To illustrate the importance and need of Human factors engineering in Safety Engineering

II. To understand the concepts of global scenario of Occupational Health & safety Management system.

III. To analyses the gaps between reference standards & pertinent conditions of Human factor Engineering.

Course Outcomes

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

CO-1: Understand the concepts, Human factors engineering (HFE)

CO-2: Understand the importance of Human factors Engineering in establishing a safe workplace.

CO-3: To Apply the concepts of HFE in workplace to enhance the working conditions and prevent occupational disease and injury.

CO-4: Evaluate workplace to determine the existence of occupational safety and health hazards.

Course Content

Unit I ERGONOMICS AND ANATOMY **9 lecture hours**

Introduction to ergonomics: The focus of ergonomics, ergonomics and its areas of application in the work system, a brief history of ergonomics, attempts to humanize work, modern ergonomics, future directions for ergonomics Anatomy, Posture and Body Mechanics: Basics of mechanics, anatomy of related to posture, posture stability and posture adaptation, low back pain, risk factors for musculoskeletal disorders in the workplace, behavioral aspects of posture, effectiveness and cost effectiveness.

Unit II HUMAN BEHAVIOR 9 lecture hours

Factors contributing to personality, Fitting the man to the job, Influence of difference on safety, Method of measuring characteristics, Accident Proneness. Motivation, Complexity of Motivation, Job satisfaction. Management theories of motivation, Job enrichment theory. Frustration and Conflicts, Reaction to frustration, Emotion and Frustration. Attitudes Determination of attitudes, Changing attitudes.

Unit III WORK DESIGN FOR STANDING AND SEATED WORKS 9 lecture hours

Designing for a population of users, percentile, sources of human variability, anthropometry and its uses in ergonomics, principals of applied anthropometry in ergonomics, application of anthropometry in design, design for everyone, anthropometry and personal space, effectiveness and cost effectiveness Fundamental aspects of standing and sitting, an ergonomics approach to work station design, design for standing workers, design for seated workers, work surface design, visual diSpecializationay units, guidelines for design of static work, effectiveness and cost effectiveness, research directions.

Unit IV Man - Machine System and Repetitive Works Task 9 lecture hours

Applications of human factors engineering, man as a sensor, man as information processor, man as controller – Man vs Machine. Ergonomics interventions in Repetitive works, handle design, key board design- measures for preventing in work related musculoskeletal disorders (WMSDs), reduction and controlling, training Anatomy and biomechanics of manual handling, prevention of manual handling injuries in the workplace, design of manual handling tasks, carrying, postural stability.

Unit V CONTROLS AND VIRTUAL ENVIRONMENTS 9 lecture hours

A general information-processing model of the users, cognitive system, problem solving, effectiveness. Principles for the design of visual diSpecializationays- auditory diSpecializationays- design of control combining diSpecializationays and controls- virtual (synthetic) environments. Case studies.

Text books and Reference Books

1. McCornick, E.J., Human Factors in Engineering and Design, Tata McGraw-Hill, 1982.
2. Accident Prevention Manual for Industrial Operations, NSC, Chicago, 1982
3. Human factors in engineering and design, MARK S. SANDERS
4. Introduction to Ergonomics, R.S. Bridger, Taylor and Francis
5. The Ergonomics manual, Dan Mc Leod, Philip Jacobs and Nancy Larson

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Examination Scheme:

Components	Internal Assessment	ESE
Weightage (%)	70	30

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	2	-	-	-	-	-	-	-	3	3
AVG	3	2.2	1	-	1	-	-	-	-	-	1.25	-	1.25	1.25

1=Weakly mapped 2= Moderately mapped 3=Strongly mapped

Course Code	Course Name	L	T	P	C
	Modeling and simulation	3	0	0	3
Pre-requisites/Exposure	Basic programming skills in a high-level language like MATLAB, Python, or R.				
Co-requisites	Basic mathematics				

Course Objectives

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

I. To provide students with an understanding of the principles and techniques of environmental modelling and simulation, including their applications in various domains.

II. Introduce students to modelling and simulation methodologies, including continuous, discrete, Monte-Carlo, agent-based, and game theory models.

III. To equip students with the skills to design and implement environmental models using software packages such as MATLAB.

IV. To enable students to critically evaluate and analyse environmental models, including their strengths, limitations, and assumptions, and to communicate their findings effectively.

Course Outcomes

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

CO1-Understand the fundamentals of modeling and simulation, including the modeling process, model classification and evaluation, and the basics of environmental system decision-making.

CO2-Understand the modeling transport phenomena, atmospheric and porous media transport and transformation of pollutants, and environmental risk management and health risk assessment.

CO3-Analyze and interpret ecological data using cluster analysis, ecological modeling, and stability of complex ecosystems, and apply this knowledge to real-world environmental problems.

CO4-Develop and apply lumped and distributed parameter models, solution methods using MATLAB, and simulation methodologies such as continuous, discrete, Monte Carlo, and agent-based models.

Catalog Description

This course introduces modeling and simulation and its applications in the environmental field. The course covers the development process of models, model classification, and evaluation, as well as an overview of environmental system design. The course also introduces students to software packages commonly used for modeling and simulation. The course covers both lumped and distributed parameter models and their solution methods using MATLAB. The simulation methodologies, including continuous, discrete, Monte-Carlo, and agent-based models, are also discussed. Students will learn about 1D and 2D models, bifurcations, sensitivity analysis, Lotka-Volterra models, and outbreak models.

Course Content

Unit 1: Introduction To Modeling And Simulation **(9 lecture hours)**

Overview of environmental modeling and simulation, Development process and applications, Benefits, and limitations of modeling and simulation, Types of models and modeling frameworks, Environmental system decision-making

Unit 2: Model Classification And Evaluation **(6 lecture hours)**

Model evaluation and selection criteria, Model classification based on structure and behavior, Validation and verification of models, Sensitivity analysis, and uncertainty assessment.

Unit 3: Software Packages **(6 lecture hours)**

Introduction to software packages used for environmental modeling and simulation, Comparison of software packages for specific applications, Basic skills, and functions of software packages, Strengths, and limitations of different software packages.

Unit 4: Modeling Methods and Techniques **(12 lecture hours)**

Lumped and distributed parameter models, Solution methods using MATLAB, Simulation methodologies, including continuous, discrete, Monte Carlo, and agent-based models, Game theory and system dynamics, Design of experiments and reactor modelling, Parameter estimation and RTO studies.

Unit 5: Advanced Modeling Techniques **(12 lecture hours)**

Nonlinear dynamics and bifurcations, 2D models and sensitivity analysis, Lotka-Volterra and outbreak models, Modeling transport phenomena, including atmospheric and porous media transport and transformation of pollutants, Environmental risk management, health risk assessment, and uncertainty analysis.

Text Books / References Books

1. Environmental Modeling: Fate and Transport of Pollutants in Water, Air, and Soil by Jerald L. Schnoor (2nd Edition)
2. Non-linear dynamics and Chaos by Steven Strogatz
3. Environmental Modeling: Using MATLAB® by Ekkehard Holzbecher
4. Introduction to Environmental Modelling: An Introduction to the Principles of Environmental Modelling by John Wainwright and Mark Mulligan
5. Fundamentals of Environmental and Urban Economics: Matthew E. Kahn and Siqi Zheng
6. Modeling and Simulation of Complex Systems: A Framework for Efficient Agent-Based Modeling and Simulation Using Swarm Intelligence by Muhammad Abdul Wahab
7. Modeling Complex Systems: An Introduction by Nino Boccara

Course Code	Course Name	L	T	P	C
Specialization Courses (MJ) **Risk Analysis**	Fluid Power Safety	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	Elements of Mechanical Engineering				
Co-requisites	Basic knowledge of Fluid Mechanics				

Course Objectives

- To recognize the standard symbols and to understand the functions of basic fluid power system and actuation elements.
- To realize the functions of fluid regulation and control elements and its typical uses in fluid power system and to acquire the practice on assembling the various types of pneumatic circuits.
- To familiar and exercise the safety procedure of various types of pneumatic and hydraulic fluid power systems and to provide a training to create the various types of hydraulic circuits.

Course Outcomes

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

CO-1: Fundamental core understanding of safety working with fluid power.

CO-2: Identify and analyse the functional requirements of a fluid power system for a given application.

CO-3: Visualize how a hydraulic/pneumatic circuit will work to accomplish the function.

CO-4: Safety procedure for appropriate hydraulic or pneumatic circuit or combination circuit like electro-hydraulics, electro- pneumatics for a given application.

CO5-Select and size the different components of the circuit.

Catalog Description

The uniqueness and variation of fluid power can result in potentially dangerous situations. This course covers the key safety aspects to be considered while handling fluid power systems. Fluid power safety is a comprehensive course designed to provide students with core understanding of safety practices related to hydraulic and pneumatic systems. Students will gain knowledge and skill necessary to prevent accidents and injuries.

Course Content

Unit I: INTRODUCTION TO FLUID POWER SYSTEMS 08 lecture hours

Fluid power system: components, advantages, and applications. Transmission of power at static and dynamic states. Pascal's law and its applications. Fluids for hydraulic system: types, properties, and selection. Additives, effect of temperature and pressure on hydraulic fluid. Seals, sealing materials, compatibility of seal with fluids. Types of pipes, hoses, and quick acting couplings. Pressure drops in hoses/pipes. Fluid conditioning through filters, strainers; sources of contamination and contamination control; heat exchangers.

Unit II: PUMPS AND ACTUATORS 10 lecture hours

Pumps: Classification of pumps, Pumping theory of positive diSpecializationacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable diSpecializationacement pumps, Pump performance characteristics, pump selection factors, problems on pumps.
Accumulators: Types, and applications of accumulators. Types of Intensifiers, Pressure switches /sensor, Temperature switches/sensor, Level sensor. Actuators: Classification cylinder and hydraulic motors, Hydraulic cylinders, single and double acting cylinder, mounting arrangements, cushioning, Theoretical torque, power, flow rate, and hydraulic motor performance; numerical problems. Symbolic representation of hydraulic actuators (cylinders and motors)

Unit III: HYDRAULIC CIRCUIT DESIGN COMPONENTS 10 lecture hours

Classification of control valves, Directional Control Valves-symbolic representation, constructional features of poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, and check valves. Pressure control valves - types, direct operated types, and pilot operated types. Flow Control Valves -compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated, pressure and temperature compensated

FCV, symbolic representation. Hydraulic Circuit Design**:** Control of single and Double -acting hydraulic cylinder, regenerative circuit, pump unloading circuit, counterbalance valve application, hydraulic cylinder sequencing circuits, hydraulic circuit for force multiplication; speed control of hydraulic cylinder- metering in, metering out and bleed off circuits. Pilot pressure operated circuits.

Unit IV: INTRODUCTION TO PNEUMATIC SYSTEMS **08 lecture hours**

Pneumatic power system, advantages, limitations, applications, Choice of working medium. Characteristics of compressed air and air compressors. Structure of pneumatic control System.

Pneumatic Actuators: Linear cylinder – types of cylinders, working, end position cushioning, seals, mounting arrangements, and applications. Rotary cylinders- types, construction and application, symbols.

Pneumatic Control Valves: DCV such as poppet, spool, suspended seat type slide valve, pressure control valves, flow control valves, types and construction, use of memory valve, Quick exhaust valve, time delay valve, shuttle valve, twin pressure valve, symbols.

Unit V: MISCELLANEOUS MACHINES AND SAFETY SYSTEMS 09 **lecture hours**

Demonstrate of constructional details of hydraulic press, hydraulic accumulator, and hydraulic intensifier. Hydraulic crane, hydraulic jack, hydraulic lift, hydraulic ram, fluid couplings and fluid torque converter and problems on above machines. Calibration of safety equipment. Emergency Stop buttons, their location and effect. Isolation procedures, electrical and mechanical. Overriding safety interlocks – when and when not to.

Textbook

1. Fluid Power with applications Anthony Esposito Pearson edition 2000
2. Oil Hydraulics Majumdar S.R Tala McGRawHllL 2002
3. Pneumatic systems - Principles and Maintenance Majumdar S.R Tata McGraw-Hill 2005

Reference Books

1. Introduction to Fluid power Thomson Prentice Hall 2004
2. Fundamentals of fluid power control John Watton Cambridge University press 2012

3. Industrial Hydraulics John Pippenger, Tyler Hicks McGraw Hill International Edition 1980
4. Hydraulics and pneumatics Andrew Par Jaico Publishing House 2005
5. 4 Hydraulic Control Systems Herbert E. Merritt John Wiley and Sons, Inc

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Internal	Mid term	End Term examination	Total
Weightage (%)	30%	20%	50%	100%

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															
Avg															

1=weakly mapped 2= Moderately mapped 3=Strongly mapped

Course Code	Course Name	L	T	P	C
Specialization (MJ) Risk Analysis	Probability and Reliability Engineering	**3**	**0**	**0**	**3**
Pre-requisites/Exposure	Advance Mathematics and familiarity with Microsoft Excel				
Co-requisites	Normal distribution, The concept of Correlation				

Course Objectives.

I. To provide knowledge about safety and risk assessment showing its industrial relevance.

Course Outcomes

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

CO-1: Recognize engineering problems requiring statistical methods.

CO-2: Determine probabilities from probability mass functions, probability density functions and cumulative distribution functions.

CO-3: Construct and interpret normal Probability Plots and Histograms.

CO-4: Design and conduct engineering experiments involving a single factor.

Catalog Description

This course will provide the students with the tools and techniques that can be used in collection, presentation, analysis, and use of data to make engineering decisions, solve problems and design products and processes. Statistical techniques can be a powerful aid in designing new systems, improving existing designs, and improving safety processes. Because many aspects of today's engineering practice involve working with data, obviously a good knowledge of statistics is important for every engineer. Engineering decisions are frequently based on measurements from only a subset of objects selected in a sample. Reasoning from a sample of objects to arrive at conclusions for a population of objects is referred to as statistical inference. How can we quantify the risks of engineering decisions based on limited samples? Probability models help quantify the risks involved in statistical inference - the risks involved in decisions made every day.

Course Content

Unit 1: THE ROLE OF STATISTICS ENGINEERING 08 lecture hours

Collecting Engineering Data, Data Representation, Graphing and Analysis (with and without EXCEL) , Statistics with EXCEL: sampling, Radom Number Generator, (RAND, ROUND) , Rank, percentile, mode, median, average, processes chart, Retrospective Study , Observational Study , Observing Engineering Processes over time ,Preliminary definitions (random variable, sample, population) ,

Unit 2: INTRODUCTION TO PROBABILITY 08 lecture hours

Sample space, discrete/continuous random variables, experiments with and without repetition, experiments with and without order , Outcome, Event, Tree Diagram, Venn Diagrams, de Morgan's Law • Interpretations and Axioms of Probability , Absolute/relative Frequency, Multiplication and Total Probability Rule, (HISTOGRAM) , Probability and Probability
Models.

Unit 3: INTRODUCTION TO RELIABILITY 08 lecture hours

Concepts, Terms, and Definitions, Failure distribution, Constant failure rate model, Time dependent failure mode, Simple systems, State dependent system, Physical reliability models, Design for Reliability.

Unit 4: HAZARD IDENTIFICATION AND RISK ASSESSMENT 10 **lecture hours**
Introduction - Hazard - Process - Hazard - Monitoring - Risk - Issues - Perception - Management Assessment-Analysis-Safety Audits-Management System Audits-Check Lists-Material Safety Data-What If Analysis-Event Tree-Fault Tree Analysis-Hazard and Operability Studies- Coarse

Hazard Studies-Human Error Analysis-Safety Review System-Hazard Warning Methods-Hazard Warning Analysis- Plant Safety Audit.

Unit 5: DESIGN AND ANALYSIS OF SINGLE FACTOR 11 lecture hours

Designing Engineering Experiments, Completely Randomized Single Factor Experiment, the Random Effects Model, Reliability testing, Risk Based Inspection and maintenance, Economic analysis based on availability.

Text Books

1. "Applied Statistics and Probability for Engineers "by Douglas C. Montgomery, George C. Runger, 5th Edition, John Wiley & Sons Inc., ISBN-13: 978-0-471-74589-1
2. "Schaum's Outline of Probability and Statistics," 2nd ed., M.R. Spiegel. J.J. Schiller and R.A. Srinivasan, 2nd Edition, McGraw-Hill Inc.
3. "Data Analysis using Microsoft Excel", M. Middleton, Brooks/Cole/Thomson Learning, Belmont CA, 2004
4. "Introduction to Statistical Quality Control", by Douglas C. Montgomery, John Wiley and Sons, 6th Edition, ISBN 978-0-470-16992-6
5. Crowl, D.A., and Louvar, J.F. (2011). Chemical Process Safety: Fundamentals with Applications, Third Edition, *Prentice Hall Publication Inc*., 723 pages.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Internal	Mid term	End Term examination	Total
Weightage (%)	30%	20%	50%	100%

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															
Avg															

1=weakly mapped 2= Moderately mapped 3=Strongly mapped

Course Code	Course Name	L	T	P	C
	Safety in Engineering Industry	3	0	0	3
Pre-requisites/Exposure	Basic knowledge of Manufacturing Processes				
Co-requisites	Occupational Safety and Health Management				

Course objectives:

Objectives of the subject are:

I. To provide in-depth knowledge in safety in engineering industry it's applications in various fields.

II. To provide in-depth knowledge of various processes involved in engineering industry and the associated hazards.

III. To expose the students to the basics in hazard identification and hazardous process management

IV. To familiarize the student with occupational hazards associated with various industrial processes.\

Course outcomes:

At the end of this course, students should be able to.

CO-1: Understand the engineering industry and its various processes.

CO-2: Identify the method of operation and hazards involved in operations.

CO-3: Implement the various methods of controlling the hazards.

CO-4: Examine the proper implementation of control measures.

Catalog description

Manufacturing Industry is the key role player of Indian Economy and oldest form of industry ever existed since the start of human civilization. However, as it one of the most hazardous materials like heavy metals and involves hazardous processes, many occupational injuries/illnesses were observed even in this modern era, with advent of engineering and technology. Thus, it would be imperative to deal with OHS & E aspects of Manufacturing Industry.

Course Content

Unit 1 INTRODUCTION TO ENGINEERING INDUSTRY 9 Lecture Hours

Introduction - definitions - classification of engineering industry - different processes in engineering industry. Safety in Metal working machines- Lathe, drilling, etc., Safety in woodworking machines. Concept of Gaurding-guiding principles, methods of guarding, Principle of Zero mechanical State (ZMS).

Unit 2 FOUNDRY AND FORGING OPERATIONS 7 Lecture Hours

Foundry operations - furnace - health hazard - safe methods of operation. Forging operations - heat radiation - maintenance of machines - final checking of tools, guards, lubrication, shop equipment and hand tools - safe work practice. Operations in hot and cold rolling mills.

Unit 3 SAFETY IN WELDING, HEAT TREATMENT HAZARDOUS 9 Lecture Hours

Safety in welding, cutting, finishing, cleaning, polishing, buffing. Safety in heat treatments - safety in handling and storage, disposal of effluents - health precautions, elimination and prevention of long-time exposure to hazardous fumes, source of fumes, ventilation and fume protection.

Unit 4 MATERIAL HANDLING SAFETY 10 Lecture Hours

Care and maintenance of common elements used in material handling equipment like rope chains slings, hooks, and clamps. general safety considerations in material handling - manual and mechanical handling. Handling assessments - handling techniques – lifting, carrying, pulling, pushing, palletizing, and stocking. Occupational diseases due to physical and chemical agents.

Unit 5 MATERIAL HANDLING EQUIPMENT AND SAFETY 10 lectures hours

Hoisting apparatus, types - cranes, types, design and construction, guards and limit devices, signals, operating rules, maintenance safety rules, inspection, and inspection checklist – conveyors, precautions, types, applications. Powered industrial trucks, requirements, operating principles, operators' selection and training and performance test, inspection and maintenance, electric trucks, gasoline operated trucks, LPG trucks – power elevators, types of drives, hoist way and machine room emergency procedure.

E. Textbooks and reference books

1. Accident Prevention Manual, 13th Edition, Engineering and Technology- NSC Chicago
2. ILO Encyclopedia of Occupational Health and Safety - Part XIII, Manufacturing Industries
3. Philip Hagan "Accident Prevention Manual for Business and Industry", N.S.C. Chicago, 13th edition, 2009.
4. "Occupational safety Manual" BHEL, Trichy, 1988.
5. John V. Grimaldi and Rollin H. Simonds, "Safety Management", Richard D Irwin, 1994.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	2	1	1	2	-	-	-	-	-	-	-	-	2	1	-
CO3	3	1	2	1	2	-	-	1		-	-	-	1	2	2
CO4	2	1	2	2	2	-	-	2	1	-	-	-	2	2	2
Avg	1.8	1	1.6	1.6	2	-	-	1.5	1	-	-	-	1.6	1.5	2

1=weakly mapped 2= Moderately mapped 3=Strongly mapped

Course Code	Course Name	L	T	P	C
HSFS (Version 3.2)	Fire Toxicology and Forensics	3	0	0	3
Pre-requisites/Exposure	Basics of Fire science, Occupational safety				
Co-requisites	Basics of Accident Investigation				

Course Objectives

Objectives of the subject are:

I. To provide in-depth knowledge in Fire toxicology and its application in various scenarios pertaining to safety issues.

II. To provide in-depth knowledge of various processes involved in Forensics investigations to prevent future accidents.

III. To expose the students to case studies involving Fire toxicology and forensics and to make them industry-ready experts.

IV. To familiarize the students with methods of assessment in toxicology and forensics and enable them to develop and do research to adopt new techniques.

Course Outcomes

At the end of this course, students should be able to.

CO-1: Understand the concept of ill effects of hazards and corresponding investigation methods.

CO-2: Identify the relevant methods in controlling the toxicological effects of fire and proper investigation methods.

CO-3: Implement the various methods of controlling the toxicological effects of fire and investigation of accidents.

CO-4: Examine the proper implementation of control measures.

Catalog Description

Fire toxicology is the study of the toxic effects of fire products on humans and animals. Forensic toxicology is the application of toxicology to legal matters, such as the investigation of fires. In the context of fire forensics, toxicologists can help to determine the cause of death in fire victims, identify the presence of accelerants, and reconstruct the fire scene. Fire toxicologists use a variety of methods to analyze fire products, including gas chromatography, mass spectrometry, and liquid chromatography. These methods can be used to identify the presence of toxic gases, particulate matter, and chemicals in fire debris. The results of fire toxicology analysis can be used to help investigators determine the cause of a fire, identify the victims, and reconstruct the fire scene. This information can be used to prevent future fires and to bring those responsible for arson to justice.

<u>Course Content</u>

Unit 1 FIRE TOXICOLOGY BASICS 10 Lecture Hours

Fire Fatality-Problems involving fire causes for fire fatality, Current fire scenario. The burning process, a typical compartment fire, Fire hazard Assessment, Time of evacuation- Time Needed and available. Fire hazard models and methods, Evacuation models Time-concentration of various gases, Fire growth curve, Yields of the major toxic products.

- Data requirements for modeling evacuation.

Unit 2 TOXICOLOGICAL BYPRODUCTS OF FIRE 10 Lecture hours

Toxicological study Hazards of fire-heat, Oxygen depletion, smoke. Health effects of fire, Toxicity and toxic hazard, Time-concentration of various gases, physiological and pathological effects of fire effluents, Small-Scale Toxicity Tests And Toxicity Indices, physiological effects of irritant smoke, tenability limits and hazard calculations for asphyxiant gases, Application of human animal exposure studies to human fire safety,. Laboratory methods for the fire evaluation of smoke potency, Use of Combustion-Product Toxicity Tests, Chemical Analysis vs. Biologic Assay, Test Methods That Use Death as an End Point, Test Methods That Use Nonlethal End Points. Case studies.

Unit 3 FORENSICS BASICS 9 Lecture Hours

Introduction to forensics engineering-Life cycle of technical systems, Treehouse of failure, Failure exploration routine, Investigations methods- Concept of hypothesis-generation- and testing-Finding and reporting-Delft method. Application in various fields- civil, structural-Aerospace- Biomechanics- case studies.

Unit 4 FIRE FORENSICS 10 Lecture Hours

Fire scene management- Fire scene investigation- Physical evidence aspects of fire investigation-Occupational health and safety issues associated with fire scene investigation- Arson and fraud indicators at fire scenes, setting theories and typology, Linking fire-setting strategies to motives, Sub-groups of fire-setters, Prevention and Intervention strategies for fire-setters, Investigative practice for incendiary fires, Report writing and the presentation of expert evidence.

Unit 5 LEGISLATION 5 lectures Hours

Introduction to NFPA 921-Components, Case study discussion, and application.

Textbooks and reference books/materials

1. NFPA 921 Guidelines for fire and explosion investigation, Published by NFPA, 2021
2. SFPE book of Fire protection engineering, Morgan, Springer.2015
3. Delft forensics engineering course, Delft University. Delft Open courseware
4. FIRE AND SMOKE: UNDERSTANDING THE HAZARDS, Committee on Fire Toxicology Board on Environmental Studies and Toxicology Commission on Life Sciences National Research Council,1986

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Internal	MSE	ESE

	Assessment		
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	2	1	1	2	-	-	-	-	-	-	-	-	2	1	-
CO3	3	1	2	1	2	-	-	1		-	-	-	1	2	2
CO4	2	1	2	2	2	-	-	2	1	-	-	-	2	2	2
Avg	1.8	1	1.6	1.6	2	-	-	1.5	1	-	-	-	1.6	1.5	2

1=weakly mapped 2= Moderately mapped 3=Strongly mapped

Specialization in Disaster Management

Course code (Version)	Course Name	L	T	P	C
MEEG745	Sustainability Engineering	3	0	0	3
Pre-requisites/Exposure	• Basic knowledge of physics and chemistry (Basic science) • Basic knowledge of Environment				
Co-requisites	Not Any				

Course Objectives:

I. To help the students understand the fundamental key concepts on Sustainable Development (SD), such as intra- and inter-generational equity, economic, social and environmental, sustainability; strong and weak sustainability, natural capitalism, steady state and green economy;

II. To enable students to understand to identify and discuss in detail the key empirical issues on sustainable development, such as renewable energy transitions, urban agriculture, and green architecture.

III. To empower students with the expertise to distinguish between "green economy" and "sustainability", and various efforts at multiple levels of governance: from individual to governments;

IV. To expose students to a wide variety of research areas to apply and therefore appropriate theoretical knowledge on public policy and international relations to the issue area of sustainable development, in such aspects as international aid, global climate change negotiations, the importance of international regimes as opposed to voluntary private governance;

Course Outcomes:

On completion of this course the students will be able to

CO-1: Understand about the elements of sustainability.

CO-2: Know the conventions on sustainable development around the world.

CO-3: Learn dynamics of sustainability and factors responsible for it.

CO-4: Apply the design aspects of sustainability on socio-economic systems.

CO-5: Create the awareness for sustainable Development and its Role in Building of Environment.

Catalog Description:

Sustainable Development is the key policy concept of the contemporary world, both in academic and policy circles. The world has entered the new geological era of Anthropocene, that is, we, as human beings, change the structure of Earth and its climate to an extent that it warrants a new geological era. This comes with the depletion of resources, growing climate instabilities, demographic changes of unprecedented scale and the social inequality. The world is currently discussing the Sustainable. Development Goals to take humanity to 2030 in place of the expired Millennium Development Goals. This course will give the students the key concepts to discuss sustainable development and its three pillars: the social, the environmental, and the economic.

Course Content

Unit I CONCEPT OF SUSTAINABLE DEVELOPMENT 09 lecture hours

Definition of sustainability - History and emergence of the concept of sustainable development– Our Common Future - Objectives of Sustainable Development - Millennium Development Goals - Environment and Development linkages – Globalization and environment - Population, Poverty and Pollution – Global, Regional and Local environmental issues – Resource Degradation – Greenhouse gases and climate Change – Desertification – Industrialization – Social insecurity.

Unit II SUSTAINABILITY AND THE TRIPLE BOTTOM LINE 09 lecture hours

Components of sustainability – Complexity of growth and equity - Social, economic and environmental dimensions of sustainable development – Environment – Biodiversity – Natural Resources – Ecosystem integrity – Clean air and water – Carrying capacity –Equity, Quality of Life, Prevention, Precaution , Preservation and Public participation.- Structural and functional linking of developmental dimensions – Sustainability in national and regional context.

Unit III SUSTAINABLE DEVELOPMENT AND RESPONSE 09 lecture hours

Role of developed countries in the development of developing countries – International summits – Stockholm to Johanesburg – Rio Principles – Agenda 21 - Conventions – Agreements – Tokyo Declaration-Doubling statement-Transboundary issues –Integrated approach for resource protection and management.

Unit IV SUSTAINABLE DEVELOPMENT OF SOCIO-ECONOMIC 09 lecture hours

Demographic dynamics of sustainability – Policies for socio-economic development – Strategies for implementing eco-development programmes – Sustainable development through trade – Economic growth – Action plan for implementing sustainable development – Urbanization and Sustainable Cities – Sustainable Energy and Agriculture – Sustainable Livelihoods – Ecotourism

Unit V FRAMEWORK FOR ACHIEVING SUSTAINABILITY 09 lecture hours

Sustainability indicators - Hurdles to Sustainability - Operational guidelines –Interconnected prerequisites for sustainable development – Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities, Business and Industry - Science and Technology for sustainable development –Performance indicators of sustainability and Assessment mechanism – Constraints and barriers for sustainable development.

Text Books / Reference Books

1. Austin, James and Tomas Kohn. (1990). Strategic Management in Developing Countries.The Free Press.
2. Berger. (1994). "The Environment and the Economy." In Smelser and Swedberg (eds.)
3. The Handbook of Economic Sociology. Russel Sage Foundation. D'Arcy, David. Transcript of broadcast. (2002) "In Houston, a Treasure of Exiled Afghan Art," National Public Radio,
4. Elkington, John. (1997). Cannibals with Forks: The Triple Bottom Line for 21st Century Business Oxford: Capstone Publishing.
5. Guillen, Mauro and Sandra L. Suarez. (2002). "The Institutional Context of Multinational Activity." In Organization Theory and the Multinational Corporation. 2nd edition. New York: St. Martin's Press http://discover.npr.org/features/feature.jhtml?wfld=867875

6. Egan, Mary Lou and Marc Bendick, Jr. (2003). Workforce Diversity Initiatives of US MNCs in Europe. Thunderbird International Business Review, Forthcoming December 2003.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Components	IA	MID SEM	End Sem	Total
Weightage (%)	30	20	50	100

Correlation between the Program Outcomes (POs), Program Specific Outcomes (PSOs) and Course Outcomes (COs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	3
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	-	3
CO3	3	2	-	-	2	-	-	-	-	-	-	-	3	3	3
CO4	3	2	3	-	-	-	-	-	-	-	3	-	-	3	3
CO5	3	2	-	-	3	-	-	-	-	-	3	-	-	-	3
Avg	3	2.2	1	-	1	-	-	-	-	-	1.25	-	1.25	1.25	3

1=Weakly mapped 2= Moderately mapped 3=Strongly mapped

Course code	Course Name	L	T	P	C
HSFS 3008	Process Safety and Security	3	0	0	3
Pre-requisites/Exposure	• Basic Knowledge of Physics, Chemistry and Mathematics • Basics of thermodynamics and heat transfer				
Co-requisites	Basics of fire				

Course Objectives:

I. To inculcate the skill to comprehend & apply principles/approaches of inherently safer design for reducing/eliminating hazards and risk pertaining to operating chemical systems.

II. To provide in-depth knowledge related to applications of process safety and security systems in the chemical industry.

III. To deliver in-depth awareness among the students related to safety designs and operations of chemical process plants.

IV. To familiarize the student with hazards arising from chemical reactions in hazardous process industries.

Course Outcomes

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

CO-1: Understand the typical sources of risk in a process plant by hazard identification and examination of case studies.

CO-2: Apply the knowledge of past accidents to make failure estimations of various equipment in chemical industries, storage facilities and petrochemical refineries.

CO-3: Analyse the risk and estimate the consequences of failure of various equipment which can lead to fires, explosions, and toxic releases.

CO-4: Design safety systems for process industries to prevent major accidents from occurring.

Catalog Description

The course will provide an overview of Process Safety in the Chemical Industry, focusing on the nature of chemical plant accidents, their causes, and steps to eliminate them, with emphasis on inherently safe designs. Chemical plant accidents deal most often with ‘flammability and toxicity’ issues. The role of ‘Human Error’ in accidents will also be examined through actual case studies (including Bhopal, BP Texas City, Piper Alpha) to show the relevance in today's workplace. Student will be equipped with the tools to perform consequence assessment for

accidents involving fire, explosion or toxic substance release. The course requires active student participation via discussions of system designs, their weakness and improvements.

Course Content

Unit I INHERENT SAFETY **10 lecture hours**

Design principles – reliability and safety in designing – inherent safety – engineered safety - piping and instrumentation – safety during startup and shutdown – safety checks in the design of the equipment – reactor safety – safety in erection and commissioning of chemical plants - non-destructive testing methods – pressure and leak testing – emergency safety devices – scrubbers and flares – new concepts in safety design and operation- Pressure vessel testing standards - Inspection techniques for boilers and reaction vessels.

Unit II SAFETY IN OPERATION **9 lecture hours**

Properties of chemicals – Material Safety Data Sheets – methods available for property determination; Operational activities and hazards – standards operating procedures –pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping systems; effects of pressure, temperature, flow rate and humidity on operations; corrosion and control measures-condition monitoring, control valves – safety valves – pressure reducing valves, drains, bypass valves, inert gases. chemical Specializationashes, eye irritation, and automatic showers.

UNIT III SAFETY IN STORAGE AND HANDLING **10 lecture hours**

Types of storage-general considerations for storage layouts- atmospheric venting, pressure and temperature relief – relief valve sizing calculations - storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation – pipe line transport – safety in chemical laboratories. Safety provisions like level and flow indicators – alarms, trips – protection of stills, columns and towers from lightening – colour coding for pipe lines and cylinders.

UNIT IV CHEMICAL KINETICS **10 lecture hours**

Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self – heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening, Case studies. Stability and sensitivity tests, Classification of materials with explosive potential, Hazard prediction by thermodynamic calculations, Prevention and control of explosions and detonations – diluting a release, purging and inerting, venting, explosion relief, flame arrestors, explosion suppression, Classification of hazardous areas.

UNIT V CHEMICAL PLANT SECURITY 6 lecture hours

Safety vs Security, Concept of security, Security Threats and vulnerability, Security risk standards, Security Vulnerability Assessment methods, Prevention of Security incidents in various infrastructure handling hazardous materials, Case studies. Cyber security in process plants.

Textbooks and Reference Books

6. Crowl and Louvar (2002), Chemical Process Safety: Fundamentals with applications, New Jersey: Prentice Hall
7. Quantitative Risk Assessment in Chemical Process Industries” American Institute of Chemical Industries, Centre for Chemical Process safety.
8. Fawcett, Howard H.; Wood, William S, “Safety and Accident Prevention in Chemical Operations” Wiley Inters, Second Edition, 1984
9. GREEN, A.E., “High-Risk Safety Technology”, John Wiley and Sons, 1984.
10. Lees, F.P. “Loss Prevention in Process Industries” Butterworths and Company, 1996

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Components	Internal Assessment	Mid-Semester Examination (MSE)	ESE
Weightage (%)	50	20	30

Correlation between the Course Outcomes (COs) and Program Outcomes (POs) Table:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	3	2	3	-	-	3	3	-	-
CO2	2	3	2	-	3	-	-	-	-	-	2	2	-	3	-
CO3	2	-	-	-	3	2	-	-	-	3	-	-	-	-	3
CO4	2	-	-	2	3	-	-	-	-	3	-	-	2	3	-

Avg	2	3	2	2	3	2	3	2	3	3	2	2.5	2.5	3	3

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course code	Course Name	L	T	P	C
Specializationz 1 **HSFS 4026**	Water supply, Refugee Health and Sanitation in Emergency	3	0	0	3
Pre-requisites/ Exposure	• Basic Knowledge of water supply Engineering • Basic knowledge of wastewater treatment • Basic knowledge of Global disaster and their causes				
Co-requisites					

Course Objectives

I. To develop a conceptual understanding on key issues related to environment and sanitation.
II. To orient and sensitize the students on the prevailing WASH practices.
III. To develop clarity on key concepts related to health and hygiene.
IV. To sensitize the students about the government mechanisms in addressing issues related to health and hygiene in the country.

Course Content

Unit – 1 WATER RESOURCE MANAGEMENT AND INFRASTRUCTURE

Water: Use, Sources, Systems in Rural and Urban Settings, Rainwater Harvesting, Liquid Waste Management, Institutional Framework for Monitoring Quality and Strategizing Techniques for Effective Water Management.

Unit – 2 PUBLIC HEALTH AND WELL-BEING

Health: Concept and Meaning, Determinants of Health and Well-being, Public Health, and Community Health, Right to Health, Communicable and Water Borne Diseases, Non-communicable Diseases and Lifestyle Illnesses, Emerging Concerns related to Public Health.

Unit – 3 HEALTHCARE ADMINISTRATION AND PROMOTION

Organization and Administration of Health Care from Centre to the Village Level, Health Education: Meaning, Components, and Importance, Communication Strategies for Health Promotion, Health Policies and Programmes in India.

Unit – 4 SANITATION, ENVIRONMENT, AND HEALTH

Sanitation: Meaning, Concept, and Applications, Institutional Sanitation, Waste Management: Types and its Management. Environment and Ecology: Meaning, Concepts, Principles, and Components, Environmental Pollution and Health Hazards, Water, Sanitation and Hygiene (WASH): Concept, Meaning, Principles, and Practices.

Unit – 5 GOVERNMENTAL POLICIES AND PROGRAMS FOR SANITATION AND WATER SUPPLY

Governmental Policies and Programmes - Central Rural Sanitation Programme (CRSP) 1986, Total Sanitation Campaign (TSC) Programme 1999, Nirmal Bharat Abhiyan 2012; Swachh Bharat Mission 2014, and Role of Local Bodies. b. Accelerated Rural Water Supply Programme (ARWSP), the Sector Reforms Project, Swajal Dhara, and the National Rural Drinking Water Programme (NRDWP).

References:

1. Adelaide M. L. (2008). Environmental Sanitation and Gender among the Urban Poor. Germany: VDM Verlag Dr. Mueller E.K.
2. Bansil, P. C. (2004). Water Management in India. New Delhi: Concept Publishing Companay.
3. Biron, Paul J. (1990). A World Bank – UNICEF Glossary: Terminology of Water Supply and Environmental Sanitation. Washington, DC : The World Bank.
4. Kumar, M. D. (2009). Water Management in India: What Works, What Doesn’t. New Delhi: Gyan Publishing House.
5. Cronin, A. A. (2019). Gender Issues in Water and Sanitation Programmes: Lessons from India. New Delhi: Sage Publication.

6. Sharma, M. Branscum, P. & Atri, A. (2014). Introduction to Community and Public Health. USA: John Wiley & Sons.
7. Park, W. H. (2019). Public Health and Hygiene: In Contributions by Eminent Authorities. Germany: Forgotten Books.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	2	-	2	-	-	-	-	-	
CO2	-	1	2	-	-	2	2	-	2	2	-	-	-	-	
CO3	-	-	-	-	-	2	1	-	3	2	-	-		-	2
CO4	-	-	2	-	-	-	-	-	-	-	2	-		-	3
CO5	-	-	-	-	2	-	-	-	2	2	-	-	-	-	
Avg															

1=Weakly mapped 2= Moderately mapped 3=Strongly mapped

Course code	Course Name	L	T	P	C
Specializationz 3 HSFS 4027P	Shelter and Settlement in Disaster (Disaster Response Management)	3	0	0	3
Pre-requisites/Exposure	Basic knowledge of disaster management and environmental resource management (Basic science)				
Co-requisites	--				

Course Objective:

I. To develop a conceptual understanding on key issues related to climate change.
II. To understand the organizational set up and the role of built environment professions in Disaster Risk Reduction (DRR).
III. To orient and sensitize the students on pre-disaster planning.
IV. To understand the mechanism of relief recovery and transition during disaster.

UNIT 1 DISASTER RISK AND RECOVERY

Introduction: Understanding Risk and Vulnerability; Disaster risk: Hazards X Exposure Vulnerability, Disaster Recovery and Build back better: Risk perception and disaster risk preparedness, Build back better – people's perspectives, Architecture at risk.

UNIT 2 CULTURAL HERITAGE AND VULNERABILITY MAPPING IN DISASTER RISK REDUCTION

Vulnerability mapping and culture at risk, culture, climate change adaptation and disaster risk reduction, disaster vulnerability, cultural heritage: reassembled, rock shelters at risk.

UNIT 3 PROFESSIONS AND COMMUNITY ENGAGEMENT IN DISASTER RISK MANAGEMENT

The built environment professions in disaster risk reduction and response, Gadri discussions: social dimension of risk, health and DRM, Community participation in disaster risk governance:

voices from Mumbai and Ghana, Community participation in disaster risk governance: Insights from Mumbai framework.

UNIT 4 DISASTER PREPAREDNESS, SOCIAL NETWORKS, AND CLIMATE CHANGE IN CITIES

Disaster preparedness from cognitive and heuristic perspectives, information for disaster preparedness, the role of social networks in disaster preparedness, diffusion of disaster preparedness technology: what pioneers contribute? Cities and climate change: Adaptation and mitigation.

UNIT 5 TEMPORARY SHELTER AND POST-DISASTER HOUSING STRATEGIES WORLDWIDE

Temporary shelter construction in India, temporary shelter construction in Kenya, build back better in Nepal recovery, lesson from Peru, progressive housing in El Salvador, Tsunami reconstruction in Tamil Nadu, self-help housing in turkey.

Course code	Course Name	L	T	P	C
Specializationz 3	Emergency Response and Disaster Management Plan	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Outcome:

The course on Emergency Response deals with essential components of response and stakeholder's coordination in disaster response. Students should learn how the respond to different disasters as well's Do's and Don'ts of different hazards.

Unit – I EMERGENCY RESPONSE AND PREPAREDNESS 7 Lectures hours

Introduction to Emergency Response, Essential Components of Emergency Response, Emergency Preparedness Plan.

Unit – II EMERGENCY TERMINOLOGY, PSYCHOLOGICAL RESPONSE, AND MEDICAL AID 8 Lectures hours

Terminology: Search, Rescue, Evacuation and Relief Psychological Response: Stress, Trauma, Rumor, and Pain Medical Aid in Emergencies

Unit – III DISASTER RESPONSE PROCEDURES AND RESOURCE MANAGEMENT 10 Lectures hours

Standard Operation Procedure (SOP) for disaster response, Information Management System; Warning Dissemination; Evacuation; Search and Rescue operations; Relief operations, Emergency Operation Center (EOC); Resource Management & Networking – India Disaster Resource Network, Role of Disaster Response Forces and Community Based Organizations (CBO) in emergency response mechanism.

Unit – IV **10 Lectures hours**

National Level Disaster Management Plan- Disaster Management Authority at National, State and District levels, Policies in Disasters- its significance, approaches, essential components, formulations and coordination, National Disaster Management Act 2005; National Policy on Disaster Management 2009.

Unit – V NATIONAL DISASTER MANAGEMENT POLICIES AND PLANS

10 Lectures hours

Village Disaster Management Plan (VDMP) - Design of VDMP- HRVC analysis, VDMP-Response Plan, Mitigation and Preparedness Plan, VDMP-Financial Mechanism- Constitution of Community Contingency Fund (CCF), Community Disaster Resilience Fund, Development Schemes and Disaster Mitigation.

Course code	Course Name	L	T	P	C
Specializationz 4	Natural and Manmade Disaster	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objective:

I. To impart knowledge about the various natural hazards, associated damage and lessons learnt.
II. To impart knowledge on various man-made, biological disasters and various mitigation strategies related to them.

Course Content

Unit - I – Natural Disasters

Natural Disasters- Types and Classification of natural disasters and their effects, Hydrological Disasters - Flood, Drought, cloud burst, Geological Disasters- Earthquakes, Tsunamis, Landslides, Volcanic eruptions, Mudflow, Wind related- Cyclone, Storm, Storm surge, Tidal waves, Heat, and cold Waves.

Unit – II – Geological Disaster

Earthquakes, causes and classification, estimation of size of earthquake, magnitude and intensity, seismic waves, site effect, attenuation effect, isoseismal maps, palaeo seismology, recurrence intervals, fault slip-rates and fault behavior models.

Unit – III – Hydrological disaster

Landslides, causative factors, landslide monitoring and prediction, landslide hazard zonation. Floods, causes of floods, flood damages, flood analysis and flood plain zoning, drought, and its impact.

Unit - IV – Man-Made Disasters

Man – made Disasters-Types and Classification of Man-made disasters and their effects, CBRN – Chemical disasters, biological disasters, radiological disasters, nuclear disasters, Fire – building fire, coal fire, forest fire, Oil fire, Accidents - road accidents, rail accidents, air accidents, sea accidents; Pollution - air pollution, water pollution.

Unit – V – Bioterrorism

Bioterror agents: Bacterial and Viral, Infectious diseases – Infectious agents, mortality due to major bacterial outbreaks, pathogens, and multiple drug resistance, means of detecting and mitigating bacterial pathogens.

Suggested Books:

1. Grey M. and Spaeth K., The Bioterrorism Sourcebook, McGraw Hill, 2006.
2. Luther E.L., George Korch, Biological Weapons Defence: Infectious Diseases and Counter bioterrorism, Humana Press, 2004.
3. Bryant E., Natural Hazards, Cambridge University Press, 2005.
4. Reiter, L., Earthquake Hazard Analysis: Issues and Insights, Columbia University Press, 200

Course code	Course Name	L	T	P	C
	Serach & Rescue Operations	3	0	0	3
Pre-requisites/ Exposure	• Basic knowledge of science • Basic knowledge of emergency				
Co-requisites	--				

Course Objectives

I. To explain the relationship between Incident Management and Response Protocols
II. Developing Practical Search and Navigation Skills
III. To provide basic information about ability to perform basic first aid interventions, such as bandaging, wound cleaning, and immobilization, in emergency situations.

Course Outcomes

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

CO-1: Explain the importance of situational awareness and risk assessment in search and rescue scenarios.

CO-2: Interpret maps, GPS coordinates, and other navigational tools commonly used in search and rescue operations.

CO-3: Demonstrate the use of specialized equipment, such as ropes, harnesses, and lifting devices, in a hands-on search and rescue exercise.

CO-4: Assess the potential risks and benefits of using advanced technologies, such as drones and thermal imaging, in search and rescue missions.

CO-5: Design a comprehensive search and rescue plan for a complex and diverse disaster scenario, integrating various disciplines and resources.

Catalog Description

Search and Rescue Operations" is a comprehensive subject that focuses on the principles, techniques, and strategies involved in effectively responding to emergencies and disasters to locate, assist, and rescue individuals in distress. This subject covers a wide range of topics, from understanding incident management and emergency protocols to developing practical skills for navigating challenging terrains and providing medical assistance in high-stress situations.

Course Content

Unit I: Introduction to Search and Rescue Operations

Understanding the principles and objectives of search and rescue operations, Overview of search and rescue organizations and their roles, Introduction to search and rescue equipment and tools, Ethical considerations and legal aspects of search and rescue missions

Unit II: Search and Rescue Planning

Assessing different types of search environments (urban, wilderness, maritime, etc.), Formulating effective search strategies and tactics, understanding search patterns and their applications, Risk assessment and management during search and rescue missions, Utilizing technology and GIS in search planning

Unit III: Search and Rescue Techniques

Conducting search operations on foot, by vehicle, and using specialized equipment, Navigational techniques for search teams, Tracking and following clues during a search, Handling evidence and clues found during the search, Communicating effectively within a search team and with incident command.

Unit IV: Rescue Operations and Victim Handling

Techniques for assessing and stabilizing victims in various situations, Implementing safe and efficient rescue methods, Handling injured and non-injured victims during the rescue process, Rescue considerations for different environments (e.g., confined spaces, high angle, Swiftwater), Providing initial medical aid and preparing victims for evacuation

Unit V: Search and Rescue Coordination and Incident Management

Incident command system and its application in search and rescue missions, Coordination between search teams, first responders, and other agencies, managing resources effectively during search and rescue operations, communicating with the media and public during critical incidents, post-incident evaluation and lessons learned for continuous improvement, Course Duration: This course is designed to be completed over 12 weeks, with each unit lasting two weeks. The course will consist of a combination of lectures, practical exercises, case studies, and group projects to reinforce learning outcomes.

Text & Reference books:

- Lost Person Behavior: A Search and Rescue Guide on Where to Look - For Land, Air and Water" by Robert J. Koester
- Search and Rescue Operations in the Alps by the Austrian Mountain Rescue Service
- Essentials of Search and Rescue by Ben A. Hirst
- Search and Rescue: How to Bring Your Family and Friends Back Home by Tim Young and Ross Simpson
- Search and Rescue: A Guide for First Responders" by Robert C. Krause and Michael S. Hildebrand

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Internal Assessment	ESE
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	2	-	2	-	-	-	-		-
CO2	-	1	2	-	-	2	2	-	2	2	-	-	-		-
CO3	-	-	-	-	-	2	1	-	3	2	-		-	2	-
CO4	-	-	2	-	-	-	-	-	-	-	2		-	3	-
CO5	-	-	-	-	2	-	-	-	2	2	-	-	-		-

Avg		**1**	**2**		**2**	**2**	**1.7**		**2.5**	**2**	**2**			**2.5**	

1=Weakly mapped 2= Moderately mapped 3=Strongly mapped

Course code	Course Name	L	T	P	C
Specializationz 5	Explosive Safety	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Unit – I: Introduction **8 Lectures Hours**

Loud Bang and Disruption, Blast Wave in an Explosion, Prediction from Dimensional, Considerations, Typical Examples of Explosions and Classification.

Unit – II: Theory of Blast Waves **9 Lectures Hours**

Characteristics of Blast Waves, Decay of a Blast Wave, Sach's Scaling, Overpressure, and Impulse in the near and Far Field, Missiles, Fragments and Shrapnel, Craters, Shock Huguenot and Rayleigh Line, Properties behind Constant Velocity Shock.

Unit – III: Energy Release in an Explosion **10 Lectures Hours**

Energy Release in a Chemical Reaction, Standard Heats of Formation, Stoichiometry, Equivalence Ratio and Heat Release in Fuel-rich and Oxidizer-rich Compounds, Energy release calculations, Higher and Lower Calorific Values, Internal Energy of Formation.

Unit – IV: Interaction of Blast with Objects and Structures **9 Lectures Hours**

Reflection and Transmission of Blast Waves, Impedance, Amplification of Reflected Blast waves, Spall, Damage to Organs, Mushroom Cloud, Damage from Blast waves, Iso-damage Curve

Unit – V: Detonations **9 Lectures Hours**

Introduction to Detonations, Structure of Detonation, Realizable States in a Detonation, One Dimensional Model of a Detonation, Case Histories of explosions Involving Detonation or Quasi-Detonation.

Suggested Books:

1. Ramamurthi, K. Explosions and Explosion Safety, McGraw Hill, New Delhi, 2011.
2. Kinney G. F. and Graham K. J., Explosive Shocks in Air, Springer, Berlin, 1985.
3. Stull, D.R., Fundamentals of Fire and Explosion, AIChE Monograph Series, Vol. 73, No. 10, 1977.
4. Cooper P. W. and Kurowski S.R., Introduction to the Technology of Explosives, Wiley-VCH, New York, 1966.

Specialization in Environment

Course code (Version)	Course Name	L	T	P	C
MEEG745	**Sustainability Engineering**	3	0	0	3
Pre-requisites/Exposure	• Basic knowledge of physics and chemistry (Basic science) • Basic knowledge of Environment				
Co-requisites	Not Any				

Course Objectives:

I. To help the students understand the fundamental key concepts on Sustainable Development (SD), such as intra- and inter-generational equity, economic, social and environmental, sustainability, strong and weak sustainability, natural capitalism, steady state and green economy.

II. To enable students to understand to identify and discuss in detail the key empirical issues on sustainable development, such as renewable energy transitions, urban agriculture, and green architecture.

III. To empower students with the expertise to distinguish between "green economy" and "sustainability", and various efforts at multiple levels of governance: from individual to governments.

IV. To expose students to a wide variety of research areas to apply and therefore appropriate theoretical knowledge on public policy and international relations to the issue area of sustainable development, in such aspects as international aid, global climate change negotiations, the importance of international regimes as opposed to voluntary private governance;

Course Outcomes :

On completion of this course the students will be able to

CO-1: Understand about the elements of sustainability.

CO-2: Know the conventions on sustainable development around the world.

CO-3: Learn dynamics of sustainability and factors responsible for it.

CO-4: Apply the design aspects of sustainability on socio-economic systems.

CO-5: Create the awareness for sustainable Development and its Role in Building of Environment

Catalog Description:

Sustainable Development is the key policy concept of the contemporary world, both in academic and policy circles. The world has entered the new geological era of Anthropocene, that is, we, as human beings, change the structure of Earth and its climate to an extent that it warrants a new geological era. This comes with the depletion of resources, growing climate instabilities, demographic changes of unprecedented scale and the social inequality. The world is currently discussing the Sustainable. Development Goals to take humanity to 2030 in place of the expired Millennium Development Goals. This course will give the students the key concepts to discuss sustainable development and its three pillars: the social, the environmental, and the economic.

Course Content:

Unit I CONCEPT OF SUSTAINABLE DEVELOPMENT 09 lecture hours

Definition of sustainability - History and emergence of the concept of sustainable development– Our Common Future - Objectives of Sustainable Development - Millennium Development Goals - Environment and Development linkages – Globalization and environment - Population, Poverty and Pollution – Global, Regional and Local environmental issues – Resource Degradation – Greenhouse gases and climate Change – Desertification – Industrialization – Social insecurity.

Unit II SUSTAINABILITY AND THE TRIPLE BOTTOM LINE 09 lecture hours

Components of sustainability – Complexity of growth and equity - Social, economic and environmental dimensions of sustainable development – Environment – Biodiversity – Natural Resources – Ecosystem integrity – Clean air and water – Carrying capacity –Equity, Quality of Life, Prevention, Precaution , Preservation and Public participation.- Structural and functional linking of developmental dimensions – Sustainability in national and regional context.

Unit III SUSTAINABLE DEVELOPMENT AND RESPONSE 09 lecture hours

Role of developed countries in the development of developing countries – International summits – Stockholm to Johanesburg – Rio Principles – Agenda 21 - Conventions – Agreements – Tokyo Declaration-Doubling statement-Transboundary issues –Integrated approach for resource protection and management.

Unit IV SUSTAINABLE DEVELOPMENT OF SOCIO-ECONOMIC 09 lecture hours

Demographic dynamics of sustainability – Policies for socio-economic development – Strategies for implementing eco-development programmes – Sustainable development through trade – Economic growth – Action plan for implementing sustainable development – Urbanization and Sustainable Cities – Sustainable Energy and Agriculture – Sustainable Livelihoods – Ecotourism

Unit V FRAMEWORK FOR ACHIEVING SUSTAINABILITY 09 lecture hours

Sustainability indicators - Hurdles to Sustainability - Operational guidelines –Interconnected prerequisites for sustainable development – Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities, Business and Industry - Science and Technology for sustainable development –Performance indicators of sustainability and Assessment mechanism – Constraints and barriers for sustainable development.

Text Books / Reference Books

7. Austin, James and Tomas Kohn. (1990). Strategic Management in Developing Countries.The Free Press.
8. Berger. (1994). "The Environment and the Economy." In Smelser and Swedberg (eds.)
9. The Handbook of Economic Sociology. Russel Sage Foundation. D'Arcy, David. Transcript of broadcast. (2002) "In Houston, a Treasure of Exiled Afghan Art," National Public Radio,
10. Elkington, John. (1997). Cannibals with Forks: The Triple Bottom Line for 21st Century Business Oxford: Capstone Publishing.
11. Guillen, Mauro and Sandra L. Suarez. (2002). "The Institutional Context of Multinational Activity." In Organization Theory and the Multinational Corporation. 2nd edition. New York: St. Martin's Press http://discover.npr.org/features/feature.jhtml?wfld=867875

12. Egan, Mary Lou and Marc Bendick, Jr. (2003). Workforce Diversity Initiatives of US MNCs in Europe. Thunderbird International Business Review, Forthcoming December 2003.
13.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Components	IA	MID SEM	End Sem	Total
Weightage (%)	30	20	50	100

Coorelation between the Program Outcomes (POs), Program Specific Outcomes (PSOs) and Course Outcomes (COs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	3
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	-	3
CO3	3	2	-	-	2	-	-	-	-	-	-	-	3	3	3
CO4	3	2	3	-	-	-	-	-	-	-	3	-	-	3	3
CO5	3	2	-	-	3	-	-	-	-	-	3	-	-	-	3
Avg	3	2.2	1	-	1	-	-	-	-	-	1.25	-	1.25	1.25	3

1=Weakly mapped 2= Moderately mapped 3=Strongly mapped

Course code (Version)	Course Name	L	T	P	C
HSFS 3008 (Version 3.2)	Process Safety and Security	3	0	0	3
Pre-requisites/Exposure	▪ Basic Knowledge of Physics, Chemistry and Mathematics ▪ Basics of thermodynamics and heat transfer				
Co-requisites	Basics of fire				

Course Objectives:

I. To inculcate the skill to comprehend & apply principles/approaches of inherently safer design for reducing/eliminating hazards and risk pertaining to operating chemical systems.

II. To provide in-depth knowledge related to applications of process safety and security systems in the chemical industry.

III. To deliver in-depth awareness among the students related to safety designs and operations of chemical process plants.

IV. To familiarize the student with hazards arising from chemical reactions in hazardous process industries.

Course Outcomes:

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

CO-1: Understand the typical sources of risk in a process plant by hazard identification and examination of case studies.

CO-2: Apply the knowledge of past accidents to make failure estimations of various equipment in chemical industries, storage facilities and petrochemical refineries.

CO-3: Analyse the risk and estimate the consequences of failure of various equipment which can lead to fires, explosions and toxic releases.

CO-4: Design safety systems for process industries to prevent major accidents from occurring.

Catalog Description:

The course will provide an overview of Process Safety in the Chemical Industry, focusing on the nature of chemical plant accidents, their causes, and steps to eliminate them, with emphasis on inherently safe designs. Chemical plant accidents deal most often with 'flammability and toxicity' issues. The role of 'Human Error' in accidents will also be examined through actual case studies (including Bhopal, BP Texas City, Piper Alpha) to show the relevance in today's workplace. Student will be equipped with the tools to perform consequence assessment for

accidents involving fire, explosion or toxic substance release. The course requires active student participation via discussions of system designs, their weakness and improvements.

Course Content:

Unit I INHERENT SAFETY **10 lecture hours**

Design principles – reliability and safety in designing – inherent safety – engineered safety - piping and instrumentation – safety during startup and shutdown – safety checks in the design of the equipment – reactor safety – safety in erection and commissioning of chemical plants - non-destructive testing methods – pressure and leak testing – emergency safety devices – scrubbers and flares – new concepts in safety design and operation- Pressure vessel testing standards - Inspection techniques for boilers and reaction vessels.

Unit II SAFETY IN OPERATION **9 lecture hours**

Properties of chemicals – Material Safety Data Sheets – methods available for property determination; Operational activities and hazards – standards operating procedures –pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping systems; effects of pressure, temperature, flow rate and humidity on operations; corrosion and control measures-condition monitoring, control valves – safety valves – pressure reducing valves, drains, bypass valves, inert gases. chemical Specializationashes, eye irritation, and automatic showers.

UNIT III SAFETY IN STORAGE AND HANDLING **10 lecture hours**

Types of storage-general considerations for storage layouts- atmospheric venting, pressure and temperature relief – relief valve sizing calculations - storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation – pipeline transport – safety in chemical laboratories. Safety provisions like level and flow indicators – alarms, trips – protection of stills, columns and towers from lightening – colour coding for pipelines and cylinders.

UNIT IV CHEMICAL KINETICS **10 lecture hours**

Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self – heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening, Case studies. Stability and sensitivity tests, Classification of materials with explosive potential, Hazard prediction by thermodynamic calculations, Prevention and control of explosions and detonations – diluting a release, purging and inerting, venting, explosion relief, flame arrestors, explosion suppression, Classification of hazardous areas.

UNIT V CHEMICAL PLANT SECURITY **6 lecture hours**

Safety vs Security, Concept of security, Security Threats and vulnerability, Security risk standards, Security Vulnerability Assessment methods, Prevention of Security incidents in various infrastructure handling hazardous materials, Case studies. Cyber security in process plants.

Textbooks and Reference Books

11. Crowl and Louvar (2002), Chemical Process Safety: Fundamentals with applications, New Jersey: Prentice Hall
12. Quantitative Risk Assessment in Chemical Process Industries" American Institute of Chemical Industries, Centre for Chemical Process safety.
13. Fawcett, Howard H.; Wood, William S, "Safety and Accident Prevention in Chemical Operations" Wiley Inters, Second Edition, 1984
14. GREEN, A.E., "High-Risk Safety Technology", John Wiley and Sons, 1984.
15. Lees, F.P. "Loss Prevention in Process Industries" Butterworths and Company, 1996

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Components	Internal Assessment	Mid-Semester Examination (MSE)	ESE
Weightage (%)	50	20	30

Correlation between the Course Outcomes (COs) and Program Outcomes (POs) Table:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	3	2	3	-	-	3	3	-	-
CO2	2	3	2	-	3	-	-	-	-	-	2	2	-	3	-
CO3	2	-	-	-	3	2	-	-	-	3	-	-	-	-	3

CO4	2	-	-	2	3	-	-	-	-	3	-	-	2	3	-
Avg	2	3	2	2	3	2	3	2	3	3	2	2.5	2.5	3	3

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course Code	Course Name	L	T	P	C
HSFS 8009	Environment Surveillance and One Health	3	0	0	3
Pre-requisites/Exposure	• Fundamentals of environmental pollution • Exposure to hazard identification, disaster, risk assessment and control.				
Co-requisites					

Course Objectives:

This course provides primary gains or reinforcement of the following competencies:

I. Describe to specific communities or general populations the direct and indirect human and ecological effects of major environmental agents.
II. Describe genetic, physiological, and psychosocial factors that affect susceptibility to adverse health outcomes following environmental exposure(s)
III. Specify approaches for assessing, preventing, and controlling environmental hazards that pose risks to human health and the environment.
IV. Develop testable hypotheses and models to evaluate biological and chemical environmental exposures.

Course Outcomes

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

CO-1: To understand specific communities or general populations the direct and indirect human and ecological effects of major environmental agents.

CO-2: TO describe genetic, physiological, and psychosocial factors that affect susceptibility to adverse health outcomes following environmental exposure(s).

CO-3: Apply approaches for assessing, preventing, and controlling environmental hazards that pose risks to human health and the environment.

CO-4: Develop testable hypotheses and models to evaluate biological and chemical environmental exposures.

Catalog Description

Worldwide, increasing, and significant public health challenges result from complex and inextricable interactions between human, animal, and the environment, necessitating a systems approach, One Health, to addressing the challenges. This intermediate level course introduces concepts, theories, and applications of environmental health sciences in the context of one's health. With an emphasis on environmentally mediated and zoonotic diseases, the course will cover how key biological and chemical agents affect human health in both developed and developing nations, and how One Health approach is utilized to address these health issues.

Course Content

Unit 1 INTRODUCTION TO ONE HEALTH **6 Lectures Hours**

Introduction to the One Health One Medicine Concept and National & International health/public health agencies, Global Health vs One Health, Integrated human and animal disease surveillance systems, Global environmental change & health, Global burden of disease: concepts and applications, Environmental burden of disease, Environmental toxicology in one health, h, Recent success of One Health in control of emerging infectious diseases and the application of One Health in the control of endemic zoonosis in resource-poor communities.

Unit 2: EMERGING INFECTIOUS DISEASES **10 Lectures Hours**

Emerging infectious diseases, Process of disease emergence and assessment of the risk factors,

Mechanisms of pathogen cross over across species boundaries and emerging infectious disease transmission, and its relevance in the 21st century, Importance of disease detection, Identification and monitoring in public health and the gaps in current health systems approaches and importance of Genome Sequencing. Introduction to disease vectors and basics of Medical Entomology, The factors influencing an emerging disease (whether is controlled or becomes endemic/epidemic as illustrated by different emerging diseases -STDs, HIV/AIDS, avian influenza, SARS, Ebola)- Antimicrobial resistance a global threat and Importance of antibiotic stewardship program, Introduction of Food Safety and Food Borne Diseases.

Unit 3: CLIMATE CHANGE AND ENVIRONMENTAL TOXICOLOGY

5 Lectures Hours

Risk assessment in one health, One Health: theories and study designs, Systems approaches in one health & environmental health, Indoor and outdoor pollution – a global perspective, Air pollution & infectious diseases, water, food, sanitation and one health, Development and one Health - Agriculture, antibiotics, and zoonotic diseases, Urbanization & health, climate change and one health, Transmission and control of vector-borne diseases, Global environmental change and one health.

Unit 4: ONE HEALTH APPLICATION IN MANAGEMENT OF ZOONOTIC DISEASES 9 Lectures Hours

What are zoonotic diseases & its role in our changing world, Understanding of bacterial, viral, and parasitic zoonotic diseases; critical evaluation of its control measures, awareness of local, national, and global factors and Influences, Biogeography of zoonosis, The integration of human, animal and ecosystem health in the control and prevention of these diseases, Community engagement for zoonotic disease control in humans and animals through One Health. Basics of Epidemiological Studies, Rapid Response system, Disaster Management and Outbreak Investigation Plans, Basic statistical methods and their application and the measurement of disease frequency, Principles of survey design and the concepts of sampling, Mixed method research, Environmental epidemiology, and ecology in one health.

Unit 5: HEALTH POLICY & COMMUNITY ENGAGEMENT FOR ONE HEALTH 4 Lectures Hours

Introduction to health policy, Political and institutional challenges in implementing One Health and the importance of a unified policy to address the shared health threats of humans and animals. Risk Communication and Pandemic Preparedness, How ICMR and other Public Health Institutes tackled and managed pandemic situation in the country, Role of community in disease control & ways for community engagement, Uses of different types of media for communication and impact of the media on public attitudes to disease.

Books and references

1. Mackenzie JS, Jeggo M, Daszak P, Richt JA, editors. One Health: The Human-Animal-Environmental Interfaces in Emerging Infectious Diseases: The Concept and Examples of a One Health Approach (Current Topics in Microbiology and Immunology). Springer; 2013.
2. One Health the Theory and Practice of Integrated Health Approaches 2020 Edition by Jakob Zinsstag, Esther Schelling, CABI Publishing.
3. One Health from AIDS to Zika by Richard Riegelman and Brenda Kirkwood
4. One Health: People, Animals, and the Environment (ASM Books) by Ronald M. Atlas and Stanley Maloy.
5. Bhattacharya D, Kshatri JS, Choudhary HR, Parai D, Shandilya J, Mansingh A (2021) One Health approach for elimination of human anthrax in a tribal district of Odisha: Study protocol. PLoS ONE 16(5): e0251041. https://doi.org/10.1371/journal.pone.0251041.
6. Kock R, Haider N, Mboera LE, Zumla A. A One-Health lens for anthrax. The Lancet. Planetary Health. 2019 Jul;3(7): e285.
7. Mansingh A, Choudhary HR, Shandilya J, Bhattacharya D, Kshatri JS, Parai D, Pattanaik M, Padhi AK, Jain HK, Mohanty P, Kanungo S. A qualitative exploratory study using One Health approach for developing an intervention package for elimination of human anthrax in an endemic district of Odisha, India. The Indian journal of medical research. 2021 Mar;153(3):394.
8. Mazet JA, Clifford DL, Coppolillo PB, Deolalikar AB, Erickson JD, Kazwala RR. A "one health" approach to address emerging zoonoses: the HALI project in Tanzania. PLoS medicine. 2009 Dec 15;6(12): e1000190.

Textbooks

1. Environmental Health: from Global to Local (2nd edition). Howard Frumkin, John Wiley & Sons, Inc., 2010 (*EH*).

2. One Health: People, Animals, and the Environment. Ronald M. Atlas & Stanley Maloy, ASP Press, 2014 (*OH1).*

3. One Health: The Theory and Practice of Integrated Health Approaches. Jakob Zinsstag et al., CAB International, 2015 (*OH2)* For technical support related to course materials and links, please contact me. *Reading list* (RL)

1. Corvalán C, Hales S, McMichael AJ, Millennium Ecosystem Assessment (Program), World Health Organization. Ecosystems and human well-being: health synthesis. Geneva, Switzerland: World Health Organization; 2005. (*Read page 11-26*).

2. Eisenberg JN, Desai MA, Levy K, Bates SJ, Liang S, Naumoff K, et al. Environmental determinants of infectious disease: a framework for tracking causal links and guiding public health research. Environ Health Perspect. 2007;115(8):1216-23. doi: 10.1289/ehp.9806. PubMed PMID: 17687450; PubMed Central PMCID: PMC1940110.

3. Prüss-Üstün A, Corvalán C, World Health Organization. Preventing disease through healthy environments: towards an estimate of the environmental burden of disease. Geneva, Switzerland: World Health Organization; 2006. (Chapter 4: Methods)

(http://www.who.int/quantifying_ehimpacts/publications/preventingdisease.pdf)

4. Carlton EJ, Liang S, McDowell JZ, Li HZ, Luo W, Remais JV. Regional disparities in the burden of disease attributable to unsafe water and poor sanitation in China. B World Health Organ. 2012; **90**(8): 578-87.

5. Smith KR, Corvalan CF, Kjellstrom T. How much global ill health is attributable to environmental factors? Epidemiology. 1999; **10**(5): 573-84.

6. Feingold BJ, Vegosen L, Davis M, Leibler J, Peterson A, Silbergeld EK: A niche for infectious disease in environmental health: rethinking the toxicological paradigm. *Environ Health Perspect* 2010, 118(8):1165-1172.

7. Lin HH, Ezzati M, Murray M: Tobacco smoke, indoor air pollution and tuberculosis: a systematic review and meta-analysis. *PLoS Med* 2007, 4(1):e20.

8. Wu, X., Nethery, R., Sabath, M.B., Braun, D., Dominici, F. Exposure to air pollution and COVID-19 mortality in the University States. 2020.

(https://github.com/wxwx1993/PM_COVID/blob/master/Manuscript/PM%20and%20COVID)

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Components	Internal Assessment	Mid-Semester Examination (MSE)	ESE

Weightage (%)	30	20	50

Correlation between the Course Outcomes (COs) and Program Outcomes (POs) Table :

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4
CO2	2											2			
CO3	2	1			1							2	1		
CO4	3	1		1	2			1			2	3	1		1
Avg	2	2		1	1			1			1	2	2		1

1=Weakly mapped 2= Moderately mapped 3=Strongly mapped

Course Code	Course Name	L	T	P	C
	Environmental Toxicology and Risk Assessment	3	0	0	3
Pre-requisites/Exposure	Environmental Sciences				
Co-requisites					

Course Objectives:

Objectives of the subject are:

I. Introduce the basic concepts, approaches and principles of toxicology.
II. Understand the dose-response relationship and the main parameters derived from it.
III. Explain the mechanisms of action of environmental toxicants in causing a toxic response in living organisms.
IV. Provide fundamental knowledge on the environment's fate and transport of toxicants and how these processes affect their toxicity.

Course Outcomes:

At the end of this course, student should be able to:

CO-1: Discuss toxicological impacts of environmental contaminants on biota emphasizing health effects on humans.

CO-2: Demonstrate competencies in specific techniques/tools used for assessing toxic effects of environmental contaminants, preparation of laboratory reports based on critical analysis of toxicological data in a scientific manner,

CO-3: Assess, evaluate, and predict the human health risks and ecological health risks posed by environmental contaminants and hazardous situations for managing the environment and

CO-4: Investigate contaminant exposure and risk assessment.

Catalog Description

This course introduces the principles of environmental toxicology and risk assessment. Study of the basic principles of toxicology, including routes of exposure, dose response, and target organ effects from exposure to environmental toxicants will be covered. The course presents the quantitative methods used to assess the human health risks associated with exposure to toxicants, focusing on the four major components of risk assessment - hazard identification, dose-response assessment, exposure assessment, and risk characterization.

Course Content:

Unit I: FOUNDATIONS OF ENVIRONMENTAL TOXICOLOGY: CONCEPTS AND UPTAKE MECHANISMS **05 lecture hours**

Introduction to Environmental Toxicology: concepts and definitions. Routes and kinetics of toxicant uptake. Toxicokinetic vs toxicodynamic. Bioaccumulation and bioavailability.

Unit II: METABOLISM OF XENOBIOTICS AND MOLECULAR MECHANISMS OF TOXICITY ASSESSMENT **08 lecture hours**

Metabolism of xenobiotics: phase 1 and phase 2 reactions; detoxification and bioactivation. Molecular mechanisms of toxic effects. Evaluation of acute and chronic toxicity (bioassays and biomarkers).

Unit III: Chronic Effects and Endocrine Disruption in Environmental Toxicology **06 lecture hours**

Chronic effects: mutagenesis, carcinogenesis and teratogenesis, endocrine disruption.

Unit IV: Environmental Toxicology: Contaminants, Hazards, and Health Risks **08 lecture hours**

Environmental toxicology of selected groups of environmental contaminants: heavy metals, pesticides and herbicides, polychlorinated biphenyls, dioxins and furans, cyanobacteria and associated toxins, engineered nanomaterials and micro plastics. Radiation and health risks. Occupational toxicology. Toxicity of animal venom.

Unit V: Risk Assessment Essentials: Identification, Exposure, Dose-Response, and Characterization **08 lecture hours**

Major elements of Risk assessment: hazard identification, exposure assessment, dose response assessment and risk characterization.

Unit VI: Ecological Risk Assessment and Management **10 lecture hours**

Techniques and tools in ecological health risk assessment: probabilistic risk assessment methods, assessment factor methods, assessment of relative risks. Radiation risk assessment. Prospective and retrospective risk assessments. Formulation of environmental quality standards based on risk assessments. Risk management and risk communication.

Textbooks:

1. Landis, W.G., R.M. Sofield & M.H. Yu (2018). Introduction to Environmental Toxicology: Molecular Substructures to Ecological Landscapes: 5th Edition. Taylor Francis/CRC Press.

2. Klaassen, C. D., L.J. Cassarett & J. Doull (2018). Toxicology – The Basic Science of Poisons. 9th Edition. McGrew Hill.

3. Newman, M.C. (2019) Fundamentals of Ecotoxicology. 5th Edition. CRC Press, New York.

4. Wright, D. A. & P. Welbourne (2002). Environmental Toxicology. Cambridge University Press

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	2	1	1	2	-	-	-	-	-	-	-	-	2	1	-
CO3	3	1	2	1	2	-	-	1		-	-	-	1	2	2
CO4	2	1	2	2	2	-	-	2	1	-	-	-	2	2	2

Avg.	1.8	1	1.6	1.6	2	-	-	1.5	1	-	-	-	1.6	1.5	2

1=Weakly mapped 2= Moderately mapped 3=Strongly mapped

Course Code	Course Name	L	T	P	C
	Environmental Monitoring & Assessment	3	0	0	3
Pre-requisites/ Exposure	• Basic knowledge of science. • Basic knowledge of analysis & laboratory practice.				
Co-requisites	--				

Course Objectives

V. To explain the relationship between the environment and water, sanitation and hygiene related analysis

VI. To present standards and key practices of laboratory

VII. To provide basic information about control measures for improving hands on practice

Course Outcomes

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

CO-1: Understand the general principles of environmental monitoring.

CO-2: Identify the good practice and requirements of laboratory.

CO-3: Identify the environmental risks, the standard quality assessment methods.

CO-4: Describe how environmental emergencies can be managed, including the treatment, storage, and handling of environmental resources.

CO-5: Explain the regulatory and economic issues related to environmental services.

Catalog Description

This course provides an in-depth understanding of sampling techniques and tools used in various environmental media. Students will gain hands-on experience in collecting samples from different sources such as water, air, solid waste, noise, illumination, and soil. Emphasis will be placed on proper sampling methodologies, equipment selection, quality assurance, and data interpretation. By the end of the course, students will be proficient in sampling techniques and possess the necessary skills to conduct environmental assessments.

Course Content

Unit 1: Basics in Environmental Monitoring & Assessment — 9 Lecture Hours

Exploring methods for qualitative and quantitative analysis of samples, Understanding the concepts of accuracy and precision in measurements and their importance in obtaining reliable data, examining sources of errors in measurements and distinguishing between repeatability and reproducibility, applying rules for determining significant figures in measured values and calculated results, exploring different ways to express concentration and understanding their equivalences, differentiating between primary and secondary standards and learning the proper use of each.

Unit 2: Water Sampling Tools & Techniques — 9 Lecture Hours

Introduction to water sampling and its importance, water sampling objectives and considerations. Techniques for collecting surface water samples techniques for collecting groundwater samples. Sampling tools and equipment for water analysis quality assurance and quality control in water sampling.

Unit 3: Air Sampling Tools & Techniques — 9 Lecture Hours

Overview of air pollution sampling, types of air pollutants and their sources, sampling techniques for gaseous pollutants, sampling techniques for particulate matter, collection and analysis of air samples, air sampling instruments and equipment, quality assurance in air pollution sampling.

Unit 4: Sampling & Analysis of Solid Waste — 9 Lecture Hours

Introduction to solid waste management, sampling strategies for solid waste characterization,

techniques for sampling different types of solid waste, sample preservation and storage, analytical methods for solid waste analysis, equipment and tools for solid waste sampling, quality control considerations in solid waste sampling Excreta Disposal.

Unit 5: Legal Compliance in environmental monitoring — 9 Lecture Hours

Understanding the guidelines and precautions associated with the use of standards, familiarizing with common laboratory glassware and techniques for accurate volume measurements, promoting cleanliness and good laboratory practices to ensure accurate and reliable results.

Textbooks:

1. Harvey, P.A., Baghri, S. and Reed, R.A. (2002) Emergency Sanitation: Assessment and programme design, WEDC, Loughborough University, UK.
2. Adams, John Managing Water Supply and Sanitation in Emergencies. Oxfam: Oxford.
3. Assar, M. Guide to sanitation in Natural disasters.
4. House, Sarah and Reed, Bob Emergency Water Sources: Guidelines for selection and treatment. WEDC, Loughborough University: Loughborough.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	2	-	2	-	-	-	-		-
CO2	-	1	2	-	-	2	2	-	2	2	-	-	-		-
CO3	-	-	-	-	-	2	1	-	3	2	-		-	2	-
CO4	-	-	2	-	-	-	-	-	-	-	2		-	3	-
Avg.	-	-	-	-	2	-	-	-	2	2	-	-	-		-

1=Weakly mapped 2= Moderately mapped 3=Strongly mapped

Course Code	Course Name	L	T	P	C
HSFS 8009	**Environmental Impact Assessment**	3	0	0	3
Pre-requisites/Exposure	• Fundamentals of environmental pollution • Exposure to hazard identification, disaster, risk assessment and control.				
Co-requisites	-				

Course Objectives:

I. To provide overview about Environmental Impact Assessment (EIA) study.
II. To make students aware about the environmental factor's importance in the decision-making process.
III. To teach students in detail about the Environmental Impact Assessment (EIA) and its importance in construction projects along with some real-life projects discussion.
IV. To provide comprehensive knowledge about legal aspects of environmental field.

Course Outcomes:

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

CO-1: Understand the EIA study and its importance.

CO-2: Understand environmental legislations applicable countrywide and internationally.

CO-3: Apply the knowledge for assessment of EIA study.

CO-4: Analyse the EIA study, its management and control strategies.

Catalog Description

Environmental Impact Assessment (EIA) is a process of evaluating the likely environmental impacts of a proposed project or development, considering inter-related socio-economic, cultural, and human-health impacts, both beneficial and adverse. Environmental legislation explains in detail the legalities behind all environmental concerns and mandates. This course will encompass students with thorough knowledge of EIA, its importance in real life construction projects and the significance of legal aspects in the environmental field.

Course Content

Unit 1 Introduction to EIA 08 Lecture Hours

Concepts of Environmental Impact Assessment: Environment; Environmental Impacts; Environmental Impact Analysis; Environmental Impact Assessment and Environmental Impact Statement; EIA- As an Integral Part of the Planning Process.

Unit 2 Detailed approach towards EIA 10 Lecture Hours

Project Description; Description of The Environment; Anticipated Environmental Impacts and Mitigation Measures: Analysis of Alternatives; Environmental Monitoring Programme; Additional studies; Project Benefits; Environmental Cost-Benefit Analysis; EMP; Summary; Public participation in the environmental decision-making process.

Unit 3 Prediction and Methods of Assessment **10 Lecture Hours**

Prediction and Methods of Assessment of Impacts on Various Aspects of Environment; Application of various models for the Prediction of impact on Air Environment, Water Environment, Noise Environment and Land. Case studies: EIA for the chemical industry, EIA for a construction project, EIA for mining project.

Unit 4 Environmental legislations applicable in India 7 Lecture Hours

Environment protection Act, 1986, National green tribunal Act, 2010, Water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act, 1981, Indian Forest Act,1927, Forest conservation Act, 1980.

Unit 5 Environmental Legislations applicable internationally 10 Lecture Hours

U.N. Conference on Human Environment, 1972 – Stockholm Principles, Establishment of Environmental Institutions like UNEP, World Charter for Nature, 1982; Ozone Protection – Montreal Protocol for the Protection of Ozone Layer, 1987 as amended; U.N. Conference on Environment and Development, 1992 – Rio Principles; U.N. Convention on Biological Diversity, 1992; Cartagena Protocol on Biosafety, 2000; U.N. Convention on Climate Change1992, Kyoto Protocol, 1997; Forest Principles; Agenda 21; Human Right to Healthy Environment; Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, 1998 (Aarhus Convention); Johannesburg Conference, 2002; Rio+20-United Nations Conference on Sustainable Development, Paris Agreement, 2015

Textbooks

1. Rau Whooten (1980) Environmental Impact Analysis Handbook; McGraw Hill publications 2.
2. Larry Canter (1995) Environmental Impact Assessment – ; McGraw Hill publications
3. Philippe Sands and Jacqueline Peel (2018) Principles of International Environmental Law
4. P. Leelakrishnan (2019) Environmental Law in India (5th ed.)
5. Stuart Bell & Donald Mc Gillivray (2008) Environmental Law (7th ed.,)

Reference Books

1. Jain R K (1980) Environmental Impact Analysis – A Decision-Making Tool by, Van Nostrand Reinhold Company; 2nd edition.
2. Petts Judith (1999) Handbook of Environment Impact Assessment by McGraw Hill publications.
3. Sahu Geetanjoy (2014) Environmental Jurisprudence and the Supreme Court: Litigation, Interpretation.
4. Shyam Diwan and Armin Rosencranz (2001) Implementation, Environmental Law and Policy in India– Cases, Materials and Statutes.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Components	Internal Assessment	Mid-Semester Examination (MSE)	ESE
Weightage (%)	30	20	50

Correlation between the Course Outcomes (COs) and Program Outcomes (POs) Table:

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4
CO2	2											2			
CO3	2	1			1							2	1		
CO4	3	1		1	2			1			2	3	1		1
Avg.	2	2		1	1			1			1	2	2		1

1=Weakly mapped 2= Moderately mapped 3=Strongly mapped

Course Code	Course Name	L	T	P	C
	Wastewater Engineering	3	0	0	3
Pre-requisites/Exposure	Basic environmental engineering, Fluid mechanics				
Co-requisites	Basic Chemistry,				

Course Objectives:

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

I. To provide students with an understanding of the principles of wastewater system design.
II. To introduce students to classical and advanced wastewater treatment approaches.
III. To introduce students to different disposal, reuse, and recycles approaches for the products of wastewater treatment plants.

Course outcomes:

The students completing the course will have.

CO-1: To estimate sewage generation and design sewer systems, including sewage pumping stations.

CO-2: To understanding of the characteristics and composition of sewage and the self-purification of streams.

CO-3: To perform the basic design of the unit operations and processes that are used in sewage treatment.

CO-4: To understand the standard methods for disposal of sewage.

CO-5: To gain knowledge on sludge treatment and disposal.

Catalog Description

This course introduces the characteristics of sewage, various conveyance systems, and disposal systems. The course covers the various tests conducted to characterize the sewage, estimate sewage flow, basic principles used in designing wastewater system, selection of treatment, and sustainable disposal of waste after treatment. The course also introduces students to different stages of treatment, their design, merits, and demerits of these techniques, and related advancements. The course covers the entire system design, from sewage collection to disposal in an open environment.

Course Content

Unit I: PLANNING AND DESIGN OF SEWERAGE SYSTEM 9 lecture hours

Characteristics and composition of sewage, population equivalent, Sanitary sewage flow estimation, Sewer materials, Hydraulics of flow in sanitary sewers, Sewer design, Storm drainage-Storm runoff estimation, sewer appurtenances, corrosion in sewers, prevention, and control, sewage pumping, drainage in buildings, plumbing systems for drainage, Rain Watering.

Unit II: Primary Treatment of Sewage 9 lecture hours

Unit Operations and Processes, Selection of treatment processes, Onsite sanitation, Septic tank-grey water harvesting, Primary treatment, Principles, functions and design of sewage treatment units, screens, grit chamber, primary sedimentation tanks, Construction, Operation, and Maintenance aspects.

Unit III: Secondary Treatment of Sewage 9 lecture hours

Selection of Treatment Methods, Principles, Functions, Activated Sludge Process, and Extended aeration systems, Trickling filters, Sequencing Batch Reactor (SBR), Membrane Bioreactor, UASB, Waste Stabilization Ponds, Other treatment methods, Reclamation and Reuse of sewage, Recent Advances in Sewage Treatment – Construction, Operation and Maintenance aspects.

Unit IV: Disposal of Sewage 9 lecture hours

Standards for Disposal, Methods, and Dilution. Mass balance principle, Self-purification of the river, Oxygen sag curve, deoxygenation, and reaeration, Streeter–Phelps model, Land disposal, Sewage farming, sodium hazards, Soil dispersion system.

Unit V Sludge Treatment and Disposal 9 lecture hours

Sludge characterization, Thickening, Design of gravity thickener, Sludge digestion, Standard rate and High-rate digester design, Biogas recovery, Sludge Conditioning and Dewatering, Sludge drying beds, ultimate residue disposal, recent advances.

Textbooks:

1. Garg, S.K., Environmental Engineering Vol. II, Khanna Publishers, New Delhi, 2015.

2. Duggal K.N., Elements of Environmental Engineering S.Chand and Co. Ltd., New Delhi, 2014.

3. Punmia, B.C., Jain, A.K., and Jain. A.K.., Environmental Engineering, Vol.II, Laxmi Publications, 2010.

References:

1. Manual on Sewerage and Sewage Treatment Systems Part A, B and C, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.

2. Metcalf and Eddy- Wastewater Engineering-Treatment and Reuse, Tata Mc.Graw-Hill Company, New Delhi, 2010.

3. Syed R. Qasim Wastewater Treatment Plants, CRC Press, Washington D.C.,2010

4. Gray N.F, Water Technology, Elsevier India Pvt. Ltd., New Delhi, 2006.

Course Code	Course Name	L	T	P	C
	Modeling and simulation	3	0	0	3
Pre-requisites/Exposure	Basic programming skills in a high-level language like MATLAB, Python, or R.				
Co-requisites	Basic mathematics				

Course Objectives

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

I. To provide students with an understanding of the principles and techniques of environmental modelling and simulation, including their applications in various domains.

II. Introduce students to modelling and simulation methodologies, including continuous, discrete, Monte-Carlo, agent-based, and game theory models.

III. To equip students with the skills to design and implement environmental models using software packages such as MATLAB.

IV. To enable students to critically evaluate and analyse environmental models, including their strengths, limitations, and assumptions, and to communicate their findings effectively.

Course Outcomes

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

CO-1: Understand the fundamentals of modeling and simulation, including the modeling process, model classification and evaluation, and the basics of environmental system decision-making.

CO-2: Understand the modeling transport phenomena, atmospheric and porous media transport and transformation of pollutants, and environmental risk management and health risk assessment.

CO-3: Analyze and interpret ecological data using cluster analysis, ecological modeling, and stability of complex ecosystems, and apply this knowledge to real-world environmental problems.

CO-4: Develop and apply lumped and distributed parameter models, solution methods using MATLAB, and simulation methodologies such as continuous, discrete, Monte Carlo, and agent-based models.

Catalog Description

This course introduces modeling and simulation and its applications in the environmental field. The course covers the development process of models, model classification, and evaluation, as well as an overview of environmental system design. The course also introduces students to software packages commonly used for modeling and simulation. The course covers both lumped and distributed parameter models and their solution methods using MATLAB. The simulation methodologies, including continuous, discrete, Monte-Carlo, and agent-based models, are also discussed. Students will learn about 1D and 2D models, bifurcations, sensitivity analysis, Lotka-Volterra models, and outbreak models.

Course Content

Unit 1: INTRODUCTION TO MODELING AND SIMULATION 9 lecture hours

Overview of environmental modeling and simulation, Development process and applications, Benefits, and limitations of modeling and simulation, Types of models and modeling frameworks, Environmental system decision-making.

Unit 2: MODEL CLASSIFICATION AND EVALUATION 6 lecture hours

Model evaluation and selection criteria, Model classification based on structure and behavior, Validation and verification of models, Sensitivity analysis, and uncertainty assessment.

Unit 3: SOFTWARE PACKAGES 6 lecture hours

Introduction to software packages used for environmental modeling and simulation, Comparison of software packages for specific applications, Basic skills, and functions of software packages, Strengths, and limitations of different software packages.

Unit 4: MODELING METHODS AND TECHNIQUES 12 lecture hours

Lumped and distributed parameter models, Solution methods using MATLAB, Simulation methodologies, including continuous, discrete, Monte Carlo, and agent-based models, Game theory and system dynamics, Design of experiments and reactor modelling, Parameter estimation and RTO studies.

Unit 5: ADVANCED MODELING TECHNIQUES 12 lecture hours

Nonlinear dynamics and bifurcations, 2D models and sensitivity analysis, Lotka-Volterra and outbreak models, Modeling transport phenomena, including atmospheric and porous media transport and transformation of pollutants, Environmental risk management, health risk assessment, and uncertainty analysis.

Text Books / References Books

1. Environmental Modeling: Fate and Transport of Pollutants in Water, Air, and Soil by Jerald L. Schnoor (2nd Edition).
2. Non-linear dynamics and Chaos by Steven Strogatz.
3. Environmental Modeling: Using MATLAB® by Ekkehard Holzbecher.
4. Introduction to Environmental Modelling: An Introduction to the Principles of Environmental Modelling by John Wainwright and Mark Mulligan.
5. Fundamentals of Environmental and Urban Economics: Matthew E. Kahn and Siqi Zheng.
6. Modeling and Simulation of Complex Systems: A Framework for Efficient Agent-Based Modeling and Simulation Using Swarm Intelligence by Muhammad Abdul Wahab.
7. Modeling Complex Systems: An Introduction by Nino Boccara.

Modes of Evaluation: Class Tests/Assignment/Tutorial Assessment/Written Examination Examination Scheme:

Components	Internal	Mid term	End Term examination	Total
Weightage (%)	30%	20%	50%	100%

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSO) and Course Outcomes (COs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	3	-	-	2	1	-	-	2	2	-

CO2	2	-	1	1	-	3	2	-	-	-	-	3	1	2	-
CO3	2	-	-	-	3	-	3	-	-	1	-	1	2	2	-
CO4	-	3	2	3	-	-	-	-	2	1	-	2	3	-	3
Avg.	2	2	-	-	-	3	-	-	-	-	-	-		2	2

1=weakly mapped 2= moderately mapped 3= strongly mapped

Minor Tracks

Course Code	Course Name	L	T	P	C
HSFS	**Behavior Based Safety**	3	0	0	3
Pre-requisites/Exposure	• Basics of Safety engineering • Basic occupational safety				
Co-requisites					

Course Objectives

The objectives of this course are.

I. To illustrate the importance and need of safety engineering in changing the hazardous workplace recognize the different types of hazards and risks that can occur in the workplace, as well as how to identify and avoid them.

II. To understand the concepts of global scenario of BBS and promote safety behaviours in the workplace that could create safe working environment.

III. To create a workplace environment where safety is valued, and everyone is committed to working safely.

IV. To analyse the gaps between reference standards & pertinent conditions of safety and to work towards reducing accidents in the workplace.

Course Outcomes

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

CO-1: Understand the concepts and the steps involved in a behavior-based safety program and organizational and procedural requirements for effective safety management.

CO-2: Apply the human factors engineering design concepts and principles to enhance workplace safety.

CO-3: To perform accident investigation and apply systematic procedure to identify the root cause of the incidents.

CO-4: Evaluate the workplace to determine the safety performance and implement right BBS concepts to enhance the safety culture.

Catalog Description

BBS, it is important for the students to have knowledge about basic safety in the company. Health, safety, and environment issues are very critical in industrial operations in the current scenario. It helps the students how hazards lead to an immediate or sudden accident like an injury, fire, explosion or toxic release. How the safety issues and safety management come in the picture of Top and bottom Management It provides basic knowledge of HSE efforts of many organizations that are driven by statutory requirements and they do whatever minimum is required to avoid litigation and fines.

Course Content

Unit 1 Basics of Safety Management **7 lecture hours**

Defining safety, Safety management systems, PDCA approach, Accidents, Concept of near miss, Causes of accidents- Unsafe acts vs conditions. Hazard vs risks, Safety Pyramids, Cost of accident, Safety policy, Safety organization. Hierarchy of control. Duties of safety officer.

Unit 2 Behavior-Based Safety **7 lecture hours**

Behavioral-based safety – overview –, BBS vs Traditional Safety, psychology of behavior management – focus on behavior to manage the risk – leadership- behavior safety Programme for employees- measure safety Programme – ABC model – BBS - case studies.

Unit 3 Accident Investigation **8 lecture hours**

Types and Severity of Accidents, Accident Classification, Accident- Objectives & Methodology of conducting accident investigation. Accident Reports, Legal Compliances of Accident reporting, Root cause analysis techniques, Incident Recall Techniques.

Unit 4 Safe System of Work **7 lecture hours**

Safe System of Work. Work permit system- objectives, hot work and cold work permits. Typical industrial models and methodology. Entry into confined spaces. 5 S & Housekeeping. Plant safety inspection types, and inspection procedure. Job Safety Analysis and safety sampling techniques. Safety surveys, Safety audits. Safety Inventory Technique.

Unit 5 Safety Education and Training 8 **lecture hours**

Importance of training-identification of training needs-training methods – programmes, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training

– creating awareness, awards, celebrations, safety posters, safety diSpecializationays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

Unit 6 Monitoring and Measuring Safety 8 lecture hours

Monitoring and Reporting, Leading and lagging indicators, IS 3786, Frequency rate, severity rate, incidence rate, Cost of accidents-Computation of Costs- Utility of Cost data, Safety t Score.

Textbooks and reference books

1) Juni Daalmans, "Human Behaviour in Hazardous Situations", Butterworth Heinemann, 2012.
2) Charles D. Reese, "Occupational Health and Safety Management: A Practical Approach", CRC Press, 3rd Edition,2018.
3) Roughton J E, J J Mercurio, " Developing An Effective Safety Culture", Butterworth Heinemann, 2012.
4) Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, New York, 1980.
5) John Ridley, "Safety at Work", Butterworth and Co., London, 1983.
6) Blake R.B., "Industrial Safety" Prentice Hall, Inc., New Jersey, 2000.

Modes of Evaluation: Quiz/Assignment/ Class Test/ Tutorial Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Table: Correlation of POs v/s Cos

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	1	1	2	-	1	-	-	3	-	2	-	2
CO2	-	2	1	2	-	3	-	-	-	-	3	-	2		2
CO3	-	2		2	-	3	-	-	-	-	3	-	2		2
CO4	-	2	-	-	-	2	-	-	-	-	2	-	2	1	2
Avg.	2	2	2	2	2	3	-	-	-	-	2	-	2		3

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course Code	Course Name	L	T	P	C
HSFS 3008	**Process Safety and Security**	3	0	0	3
Pre-requisites/Exposure	▪ Basic Knowledge of Physics, Chemistry and Mathematics ▪ Knowledge of manufacturing processes ▪ Principles of safety management				
Co-requisites	Not Any				

Course Objectives

I. To inculcate the skill to comprehend and apply principles approaches of inherently safer design for reducing hazards and risk pertaining to operating chemical systems.
II. To provide in-depth knowledge related to applications of process safety and security systems of various field of chemical process industry.
III. To deliver in-depth awareness among the students related to safety designs and operations of chemical process plant.
IV. To inculcate the mastery of safety in the storage and handling of chemicals and gases.

Course Outcome

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

CO-1: Understand the typical sources of risk in a process plant by hazard identification and examination of case studies.

CO-2: Apply the knowledge of past accidents to make failure estimations of various equipment in chemical industries, storage facilities and petrochemical refineries.

CO-3: Analyse the risk and estimate the consequences of failure of various equipment which can lead to fires, explosions, and toxic releases.

CO-4: Design safety systems for process industries to prevent major accidents from occurring.

Catalog Description

The course will provide an overview of Process Safety in the Chemical Industry, focusing on the nature of chemical plant accidents, their causes, and steps to eliminate them, with emphasis on inherently safe designs. Chemical Plant accidents deal most often with 'flammability and toxicity' issues. The role of 'Human Error' in accidents will also be examined through actual case studies (including Bhopal, BP Texas City, and Piper Alpha) to show the relevance in today's workplace. Student will be equipped with the tools to perform consequence assessment for accidents involving fire, explosion or toxic substance release. The course requires active student participation via discussions of system designs, their weakness and improvements.

Course Content

Unit I: Design Safety of Chemical Process Plants **10 lectures hours**

Design principles – reliability and safety in designing – inherent safety – engineered safety - piping and instrumentation – safety during start up and shutdown – safety checks in the design of the equipment – reactor safety – safety in erection and commissioning of chemical plants - non-destructive testing methods – pressure and leak testing – emergency safety devices – scrubbers and flares – new concepts in safety design and operation- Pressure vessel testing standards - Gas cylinder rules, SMPV rules – Inspection techniques for boilers and reaction vessels.

Unit II: Operation Safety of Chemical Process Plants **9 lectures hours**

Properties of chemicals – Material Safety Data Sheets – methods available for property determination. Operational activities and hazards – standards operating procedures – safe operation of pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping systems – effects of pressure, temperature, flow rate and humidity on operations – corrosion and control measures- condition monitoring- control valves – safety valves – pressure reducing valves, drains, bypass valves, inert gases. Chemical Specializationashes, eye irrigation and automatic showers.

Unit III: Storage and Handling of Chemicals and Gases **10 lecture hours**

Types of storage-general considerations for storage layouts- atmospheric venting, pressure and temperature relief – relief valve sizing calculations - storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation – pipeline transport – safety in chemical laboratories. Safety provisions like level and flow indicators – alarms, trips – protection of stills, columns and towers from lightening – colour coding for pipelines and cylinders.

Unit IV: Chemical Reaction Hazards **10 lectures hours**

Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self – heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening, Case studies. Stability and sensitivity tests, Classification of materials with explosive potential, Hazard prediction by thermodynamic calculations, Prevention and control of explosions and detonations – diluting a release, purging and inerting, venting, explosion relief, flame arrestors, explosion suppression, Classification of hazardous areas.

Unit V: Chemical Plant Security **6 lectures hours**

Safety vs Security, Concept of security, Security Risk-Threats and vulnerability, Security risk standards, Security Vulnerability Assessment methods, Prevention of Security incidents in various infrastructure handling hazardous materials, Case studies. Cyber security in process plants.

Text Books

1. Crowl and Louvar (2002), Chemical Process Safety: Fundamentals with applications, New Jersey: Prentice Hall.
2. Quantitative Risk Assessment in Chemical Process Industries" American Institute of Chemical Industries, Centre for Chemical Process safety.
3. Fawcett, Howard H.; Wood, William S, "Safety and Accident Prevention in Chemical Operations" Wiley Inters, Second Edition, 1984
4. GREEN, A.E., "High-Risk Safety Technology", John Wiley and Sons, 1984.

Reference Books

1. Arendt and Lorenzo (2000), Evaluating Process Safety in the Chemical Industry, New York: CCPS
2. Lees F. P. (2005) Lees Handbook of Loss Prevention in Chemical Process Industries: hazard identification, assessment and control, Butterworths.
3. King et al. (1998) King's safety in the process industries, London: Wuerz Publishing Ltd.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Components	Internal Assessment	Mid-Semester Examination	ESE

Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	3	2	3	-	-	3	3	-	-
CO2	2	3	2	-	3	-	-	-	-	-	2	2	-	3	-
CO3	2	-	-	-	3	2	-	-	-	3	-	-	-	-	3
CO4	2	-	-	2	3	-	-	-	-	3	-	-	2	3	-
Avg.	2	3	2	2	3	2	3	2	3	3	2	2.5	2.5	3	3

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

Course Code	Course Name	L	T	P	C
HSFS 2016	**Fire Protection System Design**	3	0	0	3
Pre-requisites/Exposure	• Basics of Fire Engineering • Fluid Mechanics • Hydraulic Machines				
Co-requisites	Basics of Fire engineering				

Course Objectives:

1. To provide an in-depth in site of Fire Water Pumping Systems & different types of Fire Vehicles used in fire service.
2. To enumerate the accessories used in Fire Service: -Functions/Uses/Applications, Types, Maintenance & Safe Handling Procedures
3. To provide a brief overview of Fire ground operations

Course Outcomes:

At the end of this course student should be able to:

CO-1: Explain operation uses/functions, Applications & limitations of different types of fire pumps and fire vehicles used in fire service.

CO-2: Calculate pump discharge pressure and maximum flow capacity for a fire stream.

CO-3: Identify & elaborate about different types of hoses, nozzles, tools & ladders used in fire service.

CO-4: Demonstrate usage of different kinds of breathing apparatus and PPEs along with their functions and applications.

CO-5: Formulate a rough plan of action to deal with any given fire emergency.

Catalog Description

To serve in fire service field, one must understand not only the dynamics of fire but also the science and engineering of various firefighting appliances, dealing with fire related emergencies to bring the situation under control for example, the type of pump to be used, its operational attributes to deliver certain quantity of water at a specific pressure, oriented and aimed to extinguish the fire. Fire engineer's role is to design/select/use appropriate firefighting equipment effectively and efficiently to bring situation under control. To do so, basic knowledge of the equipment, engineering (calculation of capacity, and how to use them, is required. Hence, this subject aims to inculcate knowledge and skills necessary for understanding, designing, and utilizing various firefighting equipment such as fire pumps, vehicles, firefighter's tools, breathing aids and utilization of these in real-time firefighting operations to decide right course of action.

Course Content

Module I: **9 lectures hours**

Fire fighting vehicles and appliances: - Pumps, primers and cooling system - use, Layout of fire fighting Vehicles and appliances: - Crash tenders, rescue tenders, hydraulic platforms, turntable ladders, hose laying tenders, control vans, Rescue boats (SCUBA).

Module II: **9 lectures hours**

Fire Service Equipment: Use and maintenance, hydrants, and standpipes. Hose reels hose fittings -coupling, Branches, Branch holders, Radial branches, Monitors, Nozzles, Collecting heads, suction, hose fittings, adopters, and ramps.

Module III: **10 lectures hours**

Ropes and Lines: Types-wire and rope lines used in fire service. Use and testing of lines, knots, Bends and hitches, General Rope work.
Ladders: features of Extension ladders, wheels escape, hook ladder, turntable, Snorkel, safety devices, uses and maintenance. Small gear and miscellaneous equipment's-
General-purpose tools and equipment, Lamps, and lighting sets.

Module IV **10 lectures hours**

Breathing apparatus and associated equipment, resuscitation apparatus, foam making equipment, hydraulic rescue equipment. Types and operational use of modern oxygen breathing apparatus, modern compressed air -breathing apparatus. Identification of cylinders used with their apparatus.

Module V **No. of Lectures: 7**

Fire ground operations - preplanning, action on arrival and control, methods of rescue, methods of entry. Personnel safety. Control procedure and use of other safety equipment. Ventilation and salvage operations. Investigations of fire - causes.

Textbooks:

1. "**Fundamentals of Firefighter skills-by IAFC**"- J&B learning, 2013 edition
2. "Fire **Service Pump Operator-by IAFC**"- J&B learning, 2013 edition
3. "**Fire Service Hydraulics & Pump Operation**"- Paul Spurgeon, Fire Engineering Series, Penwell Publications

Modes of Evaluation: Quiz/Assignment/ Class Test/ Tutorial

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Table: Correlation of POs v/s COs

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	2	1	-	1	-	-	-	-	2	2	-	2
CO2	1	2	-	2	2	-	2	-	-	-	-	3	2	-	1
CO3	1	1	-	1	2	-	-	-	-	-	-	2	2	-	2
CO4	1	2	-	2	1	-	-	-	-	-	-	2	2	1	2
CO5	2	2	3	1	2	-	-	-	-	-	-	2	2	1	1
Avg.	1.4	1.8	3	1.6	1.6	-	1.5	-	-	-	-	2.2	2	1	1.6

1=Weakly mapped 2= Moderately mapped 3=Strongly mapped

Course Code	Course Name	L	T	P	C
HSFS 3027	**Structural Fire Protection Design**	3	0	0	3
Pre-requisites/Exposure	• Basic Knowledge of basics sciences. • Knowledge of the basics of fire engineering • Principles of safety management • Knowledge of civil engineering basics				
Co-requisites	National Building code, IS Codes, NFPA				

Course Objectives

The course will enable the students to:

VI. Learn about building fires and their effects on structural integrity.
VII. Know the various material used and their characteristics.
VIII. Study various test methods and their applicability
IX. Enrich knowledge among students to become fire safety professionals assisting in the planning and design of buildings or occupancy.
X. Produce competent professionals useful in assessing the damage loss of reinstatement of the building.

Course Outcomes:

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

CO-1: To explain the building's materialistic properties and their effect on exposure to fire.

CO-2: Solve the structural fire safety issues and challenges in occupancies by applying their skills and potential.

CO-3: Include the innovative practices in the organization by analysing or assessing the need for material used and consequences.

CO-4: Use their competence in evaluating fire safety conditions of the workplace based on the various characteristics.

CO-5: Design and develop a new methodology, process/ procedure, and framework for structural fire protection to be implemented at the workplace.

Catalogue Description

Fire safety is an essential requirement for any building or industrial premises today. It has many challenges during construction with respect to complying with legal requirements and safe execution. Globally, fire risk is a catastrophe, based on its level suitable techniques are being recommended which require to be taught, and people should be aware of minimizing losses due to fire. While thinking about the minimization of losses due to fire, the material used in building plays important by which fire spread rate or fire intensity influence. This course broadly covered the effects of temperature on building material and their other properties. The effects of fire on building material with respect to time are the most important phenomenon, which is to be known to students. Further, they will apply its application at workplace being an engineering team at workplace or consultant. Students will be using a quantitative approach to identify and analyze building materials e.g., steel, concrete, wood, plastics, glasses & bricks to their fire resistance rating. Students will be able to work as fire consultants, fire safety engineers/ officers, advisors etc.

Course Content

Unit I: MATERIALS AND FIRE RESISTANCE IN CONSTRUCTION12 lecture hours

Effect of temperature on the properties of materials: concrete, steel, masonry and wood. Combustibility of building materials and structures - Fire resistance of structural members - Fire resistance of buildings.

Unit II: FIRE RESISTANCE TESTING AND CALCULATIONS 10 lecture hours

Experimental determination of fire resistance, approximate method for calculating the fire resistance of structures. Fire resistance limits of structures, coefficient of fire resistance, fire duration.

Unit III: FIRE-RESISTANT DESIGN FOR BUILDING ELEMENTS AND STRUCTURES 8 lecture hours

Design of fire-resistant walls - ceilings-screens -local barriers- Roof separations and partitioned fire areas - Fire stopped areas in connecting constructions. Fire protection of building structures: Wooden structures, Steel structures, Reinforced concrete structures, Plastic structures.

Unit IV: FIRE AREA CALCULATIONS AND OPENINGS PROTECTION

8 lecture hours

Building fire areas -calculation of fire areas, subdivision of fire areas, Industrial, Residential and Public buildings, Fire transmission between buildings, and propagation of fire. Protection of openings: Openings for conveyors - opening for doors – low combustible doors – Non-combustible doors - Spark proof doors - suspension of doors - Air-tight sealing of doors - Windows.

Unit V: REHABILITATING FIRE-DAMAGED STRUCTURES: ASSESSMENT AND REPAIR **7 lecture hours**

Reparability of fire damaged structures: Assessment of fire severity - assessment of damage-concrete, steel, masonry, timber - feasibility of repair -Repair techniques: Columns, beams, floors, etc. - a case study on building reinstatement.

Textbooks

5. Fire Safety Engineering: Design of Structures by John A. Purkiss and Long-Yuan Li
6. Fire Safety Engineering: Design of Structures by Martin Gillie and Brian Meacham
7. Structural Fire Engineering by Jean-Marc Franssen and Paulo Vila Real
8. Performance-Based Fire Engineering of Structures by Yong Wang and C. G. Bailey
9. Fire Safety Engineering: Design of Structures by John Wiley & Sons
10. Fire Resistance Design Manual by Gypsum Association
11. Structural Fire Engineering: Solutions to Fire Safety Problems by Anthony K. Abu and Jörg Lange
12. Structural Fire Engineering: Analysis and Design by Yong Bai and Quan-Sheng Zhao
13. Jain V K – Fire Safety in Building
14. Dr. Thank Singh Sharma- Fundamental of fire safety in building.
15. Butcher and Parnell; Designing of Fire Safety.

Reference Books

1) BIS, NBC Part IV – Fire and Life Safety", Bureau of Indian Standards, New Delhi, 2016.
2) Jain V K – Fire Safety in Building
3) Dr. Thank Singh Sharma- Fundamental of fire safety in building.
4) Butcher and Parnell; Designing of Fire Safety.
5) BS 5588: British Standard – Fire precautions in the design, construction, and use of
6) buildings
7) T. Z Harmathy- Fire Safety Science and engineering
8) Fire Insurance Policies of Public Sector insurance companies.
9) AIFT (TAC) Regulations.
10) BIS, "IS 2189:2008 –Selection, Installation and Maintenance of Automatic Fire Detection and Alarm System – Code of practice" Bureau of Indian Standards, New Delhi, 2008.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	1	-	-	-	-	-	2	2	2	2	-	1
CO2	2	3	2	3	1	1	2	-	-	1	3	2	2	3	2
CO3	3	2	3	2	2	2	2	1	2	3	3	3	3	3	3
CO4	2	3	2	1	2	2	2	2	2	1	2	-	2	1	2
CO5	2	1	2	2	2	2	1	-	1	3	3	2	2	2	2
Avg.	2.2	2.25	2.25	1.8	1.75	1.75	1.75	1.5	1.66	2	2.6	2.25	2.2	2.25	2

1. Weak mapped   2. Moderate mapped   3. Strong mapped

Course Code	Course Name	L	T	P	C
HSFS 3050	**Construction Safety and Management**	2	0	0	2
Pre-requisites/ Exposure	• Basics of civil engineering • Basic of safety engineering • Knowledge of human factor engineering				
Co-requisites					

Course Objective

The objectives of this course are to:

I. Highlight the construction safety challenges and their suitable control measures.
II. Study onsite safety procedures and precautions for minimizing incidents.
III. Know the legal compliances related to safety in construction.
IV. Familiarization with technological advancement in construction safety.
V. Develop competency among students for the design and development of tools, techniques, and procedures towards minimizing incidents.

Course Outcomes

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

CO-1: Learn and understand the construction projects activity, challenges and their HSE aspects.

CO-2: Solve or interpret health safety & environmental issues or problems arising at construction.

CO-3: Use their competency in assessing, analyzing, or comparing site HSE condition with global practices in this field complying with legal and other requirements.

CO-4: Assess site HSE condition (being an employee or third party) and appraise, support, or defend in improving safe construction practices.

CO-5: Carry out incident investigation and can develop new methodologies, and procedures for improving projects condition.

Catalog Description

Students will get an exposure on the leading safety hazards on construction sites including falls, being caught between objects, electrocutions, and being struck by objects and how these hazards have caused injuries and deaths on construction sites throughout the world. Construction work is basically a hazardous land-based job. Some construction site jobs include: building houses, roads, tree forts, and workplaces repair and maintaining infrastructures.

Students will study the work includes many hazardous task and conditions such as working with height, excavation, noise, dust, power tools and equipment. The most common fatalities are caused by the fatal four: falls, being struck by an object, electrocutions, and being caught in between two objects. Construction work has been increasing in developing and undeveloped countries over the past few years. With an increase in this type of work occupational fatalities have increased. Occupational fatalities are individuals who die while on the job or performing work related tasks. Within the field of construction, it is important to have safe construction sites. Failures in hazard identification are often due to limited or improper training and supervision of workers. Areas where there is limited training include tasks in design for safety, safety inspection, and monitoring safety. Failure in any of these areas can result in an increased risk in exposing workers to harm in the construction environment.

Course Content

Unit I: CONSTRUCTION SAFETY AND WORKERS' RIGHTS OVERVIEW

8 lecture hours

Overview of construction safety, Buildings, and other Construction Workers (RE & CS) Act and Central Rules. Provisions regarding Licensing, safety, health, welfare, and social security aspects. Various chapters under BOCW, General & Special Provisions related to construction work activities, Inspection and Inspecting staff, Penalty, and their procedures.

Unit II: CONSTRUCTION SAFETY FUNDAMENTALS AND PRACTICES

6 lecture hours

Meaning and Scope of Safety in Construction Operations, Various types of construction projects, Safety in Excavations, Different types of soil, Trenching, Manual material handling Concreting work- Safety aspects during concrete work, Mechanical device used during concreting work.

Unit III WORKING AT HEIGHT, SCAFFOLDING, AND SPECIALIZED CONSTRUCTION TECHNIQUES 6 lecture hours

Work at height-various challenges faced during work at height, Scaffolding- Types, erection & dismantling of scaffolds, Formwork and their safety challenges, Underwater Works, Cofferdams, Underpinning & Shoring, Permit to Work System

Unit IV: HEIGHT WORK, SCAFFOLDING, AND SPECIALIZED CONSTRUCTION SAFETY 6 lecture hours

Confined space & tunneling, batching plant operations, Hoisting & Rigging- Safety Lifting Equipment, Pre-Construction Preparation, Health Hazards while Handling Construction Materials and Chemicals, Safe Demolition, Human Factors involved, Environment management system in infrastructure work.

Unit V: DOCK SAFETY REGULATIONS AND RESPONSIBILITIES 4 lecture hours

History of Dock Safety Statues in India- Background of Present Dock Safety Statues- Dock Workers (Safety, Health & Welfare) Act 1986 and the Rules and Regulations framed there under. Dock Safety Statutes. Role & Responsibility of Different Agencies for Safety/ authorities, Health safety & welfare of dock workers, Lifting Appliances and Gear, Competent Persons and Dock Worker responsibilities and limitations.

<u>Textbooks and References</u>

1) K.N. Vaid (Ed.), *Construction Safety Management*, National Institute of Construction
2) Management and Research, Bombay.
3) V.J. Davies & K. Tomasin, *Construction Safety Handbook,* Thomas Telford Publishing, London.
4) James B. Fullman, *Construction Safety, Security & Loss Prevention,* John Wiley & Sons
5) Linger L, *Modern Methods of Material Handling*
6) R.T. Ratay, *Handbook of Temporary Structures in Construction,* Mc Graw-Hill
7) National Building Code of India 2005, SP-7, Bureau of Indian Standards, New Delhi.
8) Contract Labour Act and Central Rules
9) Building & Other Construction Workers (RE &CS) Act, 1996 and Central Rules.

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	3	2	-	-	-	-	2	1	-	2
CO2	3	3	-	-	-	-	1	-	-	-	-	2		-	3
CO3	-	-	2	-	-	-	-	-	-	-	-	2		-	-
CO4	-	-	2	-	-	-	-	-	-	-	-	1		-	-
CO5	-	-	-	-	2	-	-	-	-	-	-	1		-	-
Avg.	2.3	2.3	2	-	2	3	1.5	-	-	-	-	1.6	1	-	2.3

1= Weakly Mapped 2= Moderately Mapped 3= Strongly Mapped

Course Code	Course Name	L	T	P	C
HSFS 4005	**Fire Risk Assessment and Planning**	3	0	0	3
Pre-requisites/Exposure	a) Basic Knowledge of basics sciences. b) Knowledge of the basics of fire engineering c) Principles of safety management d) Knowledge of civil engineering basics				
Co-requisites	National Building code IS Codes, NFPA				

Course Objectives

The course will enable the students to:

1. Learn various type of building and their general requirements.
2. Understand the various aspects considered during evacuation in lined with codes of practices.
3. Acknowledge planning and design consideration while constructing various categories of building with respect to fire & safety.
4. Lean means of access, routes and exit used during any emergency evacuation.
5. In-depth learning of inspection, auditing process, fire investigation & fire risk assessment.

Course Outcomes:

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

CO-1: Understand and explain the different types of buildings and their fire safety requirements applicable during an emergency.

CO-2: Ensure, interpret, and implement building fire safety requirements as advised or laid in legal and other requirements.

CO-3: Examine or compare workplace/ building fire safety conditions for adopting best practices.

CO-4: Carry out fire safety audit, and incident investigation being a fire safety auditor, assessor, advisor, or investigator and recommend suitable control measures.

CO-5: Develop a fire safety plan and assist in designing fire protections facilities in a building or workplace.

Catalog Description

Fire safety is an essential requirement for any building or industrial premises today. It has many challenges during construction with respect to complying with legal requirements and for the safe execution. Globally, fire risk is a major catastrophe and based on its level suitable techniques are available which is to be taught, and students should be aware about it minimizing losses due to fire. On building fire safety, the national building code has given guidelines, which covers various classification of building and their general requirements. This course is based on practical aspects of firefighting and the hurdles coming in during building evacuation at the time of fire emergency. Mainly the focus of NBC part IV is to cover various aspects of fire safety parameters, which can be helpful in planning and designing of building and evacuation routes/ exit. To ensure the fire safety requirements and complying legal requirements or recommendation stated in NBC, learning of audit and inspections are important. Students will learn about various types of building and apply their learning to cope with fire and other emergencies by suitable control measures.

Course Content

Unit I: BUILDING OCCUPANCY CLASSIFICATION AND GENERAL REQUIREMENTS **12 lecture hours**

Classification of buildings based on occupancy. Residential - Educational - Institutional - Assembly - business - Mercantile - Industrial - storage - hazardous. General Requirements.

Unit II: EMERGENCY EVACUATION PLANNING AND DESIGN **10 lecture hours**

Process of emergency evacuation - special features of personnel movement. Parameter characteristics of the movement of people-practical methods of designing evacuation passages and exists. Evacuations exist and routes - stages of evacuation.

Unit III: EVACUATION ROUTE AND EXIT PLANNING IN BUILDING DESIGN **8 lecture hours**

Planning of evacuation routes and exits - Seating arrangement - Passages and corridors - Stairs - Smoke proof stairs - External fire escape ladders.

Unit IV: COST-EFFECTIVE FIRE SAFETY MEASURES IN MODERN BUILDINGS

5 lecture hours

Technical economical evacuation of fire safety - special fire protection features for modern buildings - Ensuring fire safety and capital investment - Evaluation of cost effectiveness - Case study.

Unit V: FIRE INVESTIGATION, EVIDENCE, AND LEGAL PROCEDURES

10 lecture hours

Training and education, Arson, Fire safety audits, Risk Assessment, Fire Insurance. Investigation of fire -evidence and court procedure - law of evidence - cross-examination - giving evidence.

Textbooks

1) BIS, NBC Part IV – Fire and Life Safety", Bureau of Indian Standards, New Delhi, 2016.
2) Royetman M Ya – Principles of fire safety standards for building construction
3) Jain V K – Fire Safety in Building
4) Butcher and Parnell; Designing of Fire Safety.
5) BS 5588: British Standard – Fire precautions in the design, construction, and use of buildings
6) T. Z Harmathy- Fire Safety Science and Engineering

Reference Books

1. Fire Insurance Policies of Public Sector insurance companies
2. AIFT (TAC) Regulations
3. BIS, "IS 2189:2008 –Selection, Installation and Maintenance of Automatic Fire Detection and Alarm System – Code of practice" Bureau of Indian Standards, New Delhi, 2008.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written

Examination Scheme:

Components	Internal Assessment	MSE	ESE
Weightage (%)	30	20	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	1	-	2	2	1	3	-	2	-	-	2	3
CO2	2	1	-	-	2	2	-	2	2	2	3	3	2	3	2
CO3	2	-	1	-	2	-	2	2	2	-	1	2	2	2	2
CO4	1	2	2	2	2	2	-	2	2	3	2	2	1	2	1
CO5	2	2	3	3	-	1	2	2	-	2	2	1	1	2	2
Avg.	1.8	1.8	2	2	2	1.8	2	1.8	2.3	2.3	2	2	1.5	2.2	2

1 = Weakly mapped 2 = Moderately mapped, 3 = Strongly mapped

Version Control

Details		Name	Date
Created by	Cluster Head/ Programme head		
Checked by	IQAC		
Approved by	Dean		
CCC/ DCC meeting date			
Board of Studies Approval Date			
AC subcommittee approval date			
Academic Council approval Date			

Version: **Approval Date:**