COURSE CURRICULUM

B.Tech. - Fire & Environment, Health, Safety Engineering.

(Fire & EHS)

Academic Year: 2026-2027

Updated on: August, 2026

GSFC University

School of Technology, P. O. Fertilizer Nagar,

Vadodara - 391750, Gujarat, India

B.Tech.
in
Fire & Environment, Health, Safety (Fire & EHS) Engineering

Course Curriculum

GSFC University, Vigyan Bhavan, P. O. Fertilizer Nagar,

Vadodara - 391750, Gujarat, India

Detailed Course Curriculum

Semester I

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
											Theory Marks				Practical Marks	**Total Marks**
			L	P	T	***Total***	L	P	T	**Total**	MS	CEC	ES	***Total***		
1	AECC111	Fundamentals of English	2	-	-	***2***	2	-	-	**2**	20	40	40	***100***	--	**100**
2	BTCY205	Engineering Chemistry	3	2	-	***5***	3	1	-	**4**	20	40	40	***100***	50	**150**
3	BTEC101	Basics of Electrical & Electronics	3	2	-	***5***	3	1	-	**4**	20	40	40	***100***	50	**150**
4	BTFS108	Fundamentals in Fire & Environment, Health, Safety	2	-	-	***2***	2	-	-	**2**	20	40	40	***100***	--	**100**
5	BTMA103	Mathematics – I	3	-	1	***4***	3	-	1	**4**	20	40	40	***100***	--	**100**
6	BTME106	Workshop	-	2	-	***2***	-	1	-	**1**	--	--	--	**--**	50	**50**
7	VACC101	FOUNDATION COURSE	-	-	-	**-**	-	-	-	**4**	--	--	--	**--**	100	**100**
		Total				***20***				**21**						**750**

Note: L = Lecture, **P =** Practice, **T=** Tutorial, **MS -** Mid Semester, **CEC -** Continuous Evaluation Component**, ES -** End Semester

COURSE CODE:	COURSE NAME:	SEMESTER:
AECC111	**Fundamentals of English**	I

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	0	0	**2**	2	0	0	**2**

Course Pre-requisites	Basic knowledge of English language at Higher Secondary (10+2) level.
Course Category	Ability Enhancement Compulsory Course (AECC)
Course focus	Skills Development
Rationale	Fundamentals of English develops the language proficiency and communication skills required for academic success, professional growth, and lifelong learning. The course strengthens grammar, vocabulary, reading, writing, speaking, and listening skills while improving confidence in interpersonal and workplace communication. It also introduces students to effective digital communication and professional etiquette required in engineering and multidisciplinary environments.
Course Revision/ Approval Date:	14/05/2026
Course Objectives	The course aims to: 1. Develop proficiency in English grammar, vocabulary, and language usage. 2. Strengthen listening, speaking, reading, and writing skills for academic and professional communication. 3. Enhance creative, technical, and workplace writing abilities. 4. Improve interpersonal communication, presentation, and public speaking skills. 5. Build confidence in professional and digital communication practices.

Course Content (Theory)	Weightage	Contact hours
Unit I: Fundamentals of English Language: Parts of speech; Word formation; Prefixes and suffixes; Synonyms; Antonyms; Homophones; Commonly used abbreviations; Vocabulary development; Basic grammar for communication.	20%	6
Unit II: Sentence Construction and Grammar: Types of sentences; Sentence structure; Phrases and clauses; Tenses; Determiners; Quantifiers; Punctuation; Modals; Subject–verb agreement; Common grammatical errors.	20%	6
Unit III: Academic and Professional Writing: Paragraph writing; Essay writing; Report writing; Notice writing; Memo writing; E-mail writing; Creative writing; Coherence and cohesion; Technical writing basics.	20%	6

Unit IV: Oral Communication Skills: Greetings and introductions; Professional etiquette; Public speaking; Group discussion; Debate; Just A Minute (JAM); Interview skills; Presentation skills; Listening strategies; Role play.	20%	6
Unit V: Language Accuracy and Digital Communication: Grammar correction; Vocabulary enhancement; Editing and proofreading; Common communication errors; Professional correspondence; Digital communication etiquette; AI-assisted writing tools; Workplace communication ethics.	20%	6

Instructional Method and Pedagogy:
Classroom Lecture, Case Studies, Quizzes, Presentations, Role Play, Expert Lecture (Consultant)

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: **CO1:** Apply English grammar, vocabulary, and language conventions accurately in academic and professional contexts.	Cognitive	Apply
CO2: Demonstrate effective listening, speaking, reading, and writing skills for academic and workplace communication.		Apply
CO3: Prepare professional documents and communicate ideas effectively through written communication.		Create
CO4: Communicate confidently through presentations, interviews, group discussions, and interpersonal interactions.		Apply
CO5: Apply digital communication practices and professional etiquette for effective workplace communication.		Apply

Learning Resources	
1.	**Reference Books** 1. Wren & Martin, High School English Grammar and Composition, S. Chand. 2. Raymond Murphy, English Grammar in Use, Cambridge University Press. 3. Meenakshi Raman & Sangeeta Sharma, Technical Communication: Principles and Practice, Oxford University Press. 4. Sanjay Kumar & Pushp Lata, Communication Skills, Oxford University Press. 5. Edgar Thorpe & Showick Thorpe, Objective English, Pearson Education.
2.	**Journals & Periodicals** 1. English Today 2. Journal of English for Academic Purposes 3. Business Communication Quarterly 4. ELT Journal
3.	**Codes, Standards & Online Resources** 1. British Council – https://learnenglish.britishcouncil.org

	2. Cambridge English – https://www.cambridgeenglish.org 3. Purdue Online Writing Lab (OWL) – https://owl.purdue.edu 4. NPTEL – Soft Skills and Communication – https://nptel.ac.in 5. Grammarly Writing Handbook – https://www.grammarly.com/blog

COURSE CODE:	**COURSE NAME:**			**SEMESTER:**			
BTCY205	**Engineering Chemistry**			I			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	**5**	3	1	0	**4**
Course Pre-requisites	Higher Secondary School Certificate (10+2) with Chemistry.						
Course Category	Basic Science						
Course focus	Skill Development						
Rationale	Engineering Chemistry provides the scientific foundation required to understand the chemical principles governing engineering materials, industrial processes, environmental sustainability, and energy systems. The course enables students to apply chemical concepts to water treatment, corrosion control, fuels and combustion, lubricants, and instrumental analytical techniques. It also develops laboratory skills, safety awareness, and analytical thinking required for engineering practice.						
Course Revision/ Approval Date:	**5th March 2024**						
Course Objectives	The course aims to: 1. Explain the chemical principles governing water treatment, corrosion, fuels, lubricants, and analytical techniques relevant to engineering applications. 2. Apply chemical concepts to solve engineering problems related to industrial water, corrosion prevention, fuel evaluation, and lubrication. 3. Analyze engineering materials and industrial processes using modern analytical techniques. 4. Perform standard laboratory experiments and interpret analytical data using appropriate chemical methods. 5. Develop awareness of environmental sustainability, industrial safety, and green chemistry practices.						

Course Content (Theory)	Weightage	Contact hours
Unit I: Water Technology: Chemistry of water; Water impurities; Hardness; Units of hardness; EDTA method; Boiler troubles (scale, sludge, caustic embrittlement, priming and foaming); Water softening (lime-soda, zeolite, ion exchange); Reverse osmosis; Desalination; Drinking water standards; Numerical problems.	20%	9
Unit II: Corrosion, Control and Prevention: Chemical and electrochemical corrosion; Pilling–Bedworth rule; Galvanic, pitting, crevice and waterline corrosion; Factors affecting corrosion; Corrosion monitoring; Corrosion prevention; Corrosion inhibitors; Metallic and non-metallic coatings; Galvanizing; Tinning; Electroplating; Anodizing; Powder coating.	20%	9
Unit III: Fuels & Combustion: Classification of fuels; Calorific value; Bomb calorimeter; Proximate and ultimate analysis of coal; Dulong's formula; Combustion calculations; Octane number; Cetane number; Knocking; Alternative fuels; Hydrogen fuel; Biofuels; Engineering applications.	20%	9
Unit IV: Lubricants & Engineering Materials: Mechanism of lubrication; Types of lubricants; Viscosity; Viscosity index; Flash and fire points; Cloud and pour points; Carbon residue; Acid number; Saponification number; Greases; Synthetic lubricants; Selection of lubricants for engineering applications.	20%	9
Unit V: Instrumental Techniques & Green Chemistry: Beer–Lambert law; UV-Visible spectroscopy; IR spectroscopy; Gas Chromatography; Introduction to HPLC; Nanomaterials; Principles of Green Chemistry; Sustainable chemical processes; Industrial analytical applications.	20%	9

List Of Practical	Weightage	Contact hours
1. Estimation of total hardness of water by EDTA method	12.5 %	4
2. Determination of pH, acidity and alkalinity of water samples	12.5 %	4
3. Determination of chloride content in water	12.5 %	4
4. Corrosion rate measurement of iron in different media	12.5 %	4
5. Determination of viscosity of lubricating oil	12.5 %	4
6. Determination of flash point and fire point	12.5 %	4
7. Determination of cloud point and pour point	12.5 %	3
8. UV-Visible spectrophotometric analysis / Industrial chemistry experiment	12.5 %	3

Instructional Method and Pedagogy: PPT, Tutorial, Video Presentation		
Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: **CO1:** Apply water chemistry principles to evaluate water quality and treatment methods for engineering applications. **CO2:** Analyze corrosion mechanisms and recommend suitable prevention and control techniques for engineering materials. **CO3:** Evaluate fuels and lubricants based on their properties and industrial performance. **CO4:** Perform chemical laboratory experiments and interpret analytical results using standard laboratory techniques. **CO5:** Explain modern analytical techniques and sustainable chemical practices applicable to engineering and industrial systems.	Cognitive	Apply Analyze Evaluate Apply Understand

Learning Resources	
1.	**Reference Books** 1. P. C. Jain & Monica Jain, Engineering Chemistry, Dhanpat Rai Publications. 2. S. S. Dara & S. S. Umare, Engineering Chemistry, S. Chand Publishing. 3. R. Gopalan, Engineering Chemistry, Wiley India. 4. Shashi Chawla, Engineering Chemistry, Dhanpat Rai Publications. 5. B. K. Sharma, Engineering Chemistry, Krishna Prakashan.
2.	**Journals & Periodicals** 1. Journal of Chemical Education 2. Industrial & Engineering Chemistry Research 3. Journal of Materials Chemistry 4. ACS Sustainable Chemistry & Engineering
3.	**Codes, Standards & Online Resources** 1. American Chemical Society (ACS) – https://www.acs.org 2. Royal Society of Chemistry (RSC) – https://www.rsc.org 3. Bureau of Indian Standards (BIS) – https://www.bis.gov.in 4. NPTEL – Engineering Chemistry – https://nptel.ac.in 5. National Green Tribunal & CPCB Resources – https://cpcb.nic.in

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	**20 marks**

Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

COURSE CODE:	**COURSE NAME:**			**SEMESTER:**			
BTEC101	**Basics of Electrical & Electronics**			I			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	**5**	3	1	0	**4**

Course Pre-requisites	NIL
Course Category	Engineering Science
Course focus	Skill development
Rationale	Basics of Electrical & Electronics provides fundamental knowledge of electrical circuits, electrical machines, electronic devices, measurement techniques, and industrial electrical systems. The course develops the ability to analyze electrical circuits, understand the operation of electrical machines, interpret electronic components and datasheets, perform electrical measurements, and apply safe electrical practices required for engineering applications.
Course Revision/ Approval Date:	5th March 2024

Course Objectives	The course aims to: 1. Explain the fundamental principles of electrical circuits and electromagnetic systems. 2. Apply AC and DC circuit analysis techniques using electrical laws and circuit theorems. 3. Understand the construction, operation, and applications of electrical machines. 4. Interpret the characteristics and industrial applications of basic electronic devices and circuits. 5. Develop practical skills in electrical measurements, testing, and safe operation of electrical equipment.

Course Content (Theory)	Weightage	Contact hours
Unit I: Fundamentals of Electrical Engineering: Electric current, voltage, power and energy; Ohm's Law; Kirchhoff's Laws; Series and parallel circuits; Electrical sources; Electromagnetic induction; Faraday's and Lenz's Laws; Transformer principle; Electrical safety fundamentals.	20%	9
Unit II: AC Circuits and Electrical Components: Single-phase and three-phase AC supply; RMS, average and peak values; Power factor; Resistors, capacitors and inductors; Electrical wiring accessories; Basic circuit protection devices (Fuse, MCB, RCCB); Electrical symbols and circuit diagrams.	20%	9
Unit III: Electrical Machines: Construction and working principles of transformers; DC motors; Single-phase and three-phase induction motors; Stepper motors; Servo motors; Motor characteristics; Motor selection and sizing; Industrial applications of electrical machines.	20%	9
Unit IV: Fundamentals of Electronics: Semiconductor materials; PN junction diode; Zener diode; LED; Bipolar Junction Transistor (BJT); Operational Amplifier (Op-Amp); Logic gates; Analog and digital signals; Electronic component datasheets; Introduction to industrial instrumentation and data acquisition systems.	20%	9
Unit V: Electrical Measurements and Instrumentation: Measurement of voltage, current, resistance and continuity; Digital Multimeter (DMM); Clamp meter; Digital Storage Oscilloscope (DSO); Measurement errors; Electrical power measurement; Energy meters; Introduction to sensors and transducers; Electrical troubleshooting and maintenance.	20%	9

Practical	Weightage	Contact Hours
1. Identification of electrical and electronic symbols, safety practices, PPE, and electrical safety rules	12.5%	4

2. Familiarization with Digital Multimeter (DMM), measurement of voltage, current, resistance, and continuity	12.5%	4
3. Verification of Ohm's Law and Kirchhoff's Laws	12.5%	4
4. Measurement of single-phase AC voltage, current, power, and power factor	12.5%	4
5. Study of transformer construction and verification of turns ratio	12.5%	4
6. Load test on single-phase induction motor and DC shunt motor	12.5%	4
7. Familiarization with Digital Storage Oscilloscope (DSO) and observation of analog and digital signals	12.5%	3
8. Study of electrical and electronic components, datasheets, and industrial instrumentation basics	12.5%	3

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: **CO1:** Apply fundamental electrical laws to analyze DC and AC electrical circuits. **CO2:** Analyze AC circuit parameters and electrical components used in engineering systems. **CO3:** Explain the construction, operation, and selection of electrical machines for industrial applications. **CO4:** Interpret the characteristics and applications of electronic devices and basic instrumentation systems. **CO5:** Perform electrical measurements and testing using standard measuring instruments while following safe electrical practices.	Cognitive	Apply Analyze Understand Analyze Apply

Learning Resources

1.	**Reference Books** 1. V.K. Mehta & Rohit Mehta, Principles of Electrical Engineering, S. Chand. 2. D.P. Kothari & I.J. Nagrath, Basic Electrical Engineering, McGraw-Hill. 3. Robert L. Boylestad & Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson. 4. S.K. Bhattacharya, Basic Electrical and Electronics Engineering, Pearson. 5. B.L. Theraja & A.K. Theraja, A Textbook of Electrical Technology, S. Chand.
2.	**Journals & Periodicals** 1. IEEE Transactions on Education 2. IEEE Transactions on Industrial Electronics

	3. International Journal of Electrical Engineering Education 4. Electronics For You (EFY)
3.	**Codes, Standards & Online Resources** 1. Bureau of Indian Standards (BIS) – https://www.bis.gov.in 2. IEEE Standards Association – https://standards.ieee.org 3. National Electrical Code (NFPA 70) – https://www.nfpa.org 4. NPTEL – Basic Electrical Engineering – https://nptel.ac.in 5. All About Circuits – https://www.allaboutcircuits.com

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

COURSE CODE:	**COURSE NAME:**	**SEMESTER:**
BTFS108	**Fundamentals of Fire, Safety, Health and Environment**	I

Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	0	0	**2**	2	0	0	**2**

Course Pre-requisites	NIL
Course Category	Engineering Science Course
Course focus	Foundation and Orientation towards Fire, Safety, Health & Environment

Rationale	Fundamentals of Fire, Safety, Health and Environment introduces first-year engineering students to the basic concepts of fire prevention, occupational safety, health, environmental protection, and sustainability. The course creates awareness of workplace hazards, accident prevention, industrial disasters, environmental challenges, and legal frameworks while promoting a strong safety culture and responsible engineering practices. It serves as the foundation for advanced Fire and Environmental Health & Safety courses in the programme.
Course Objectives	The course aims to: 1. Explain the basic concepts of fire, safety, health, environment, and sustainability. 2. Identify common workplace hazards, industrial accidents, and disaster scenarios. 3. Describe the principles of occupational safety, environmental protection, and risk prevention. 4. Explain the role of legislation, regulatory agencies, and professional ethics in Fire & EHS. 5. Develop awareness of sustainable practices and the responsibilities of engineers towards society and the environment.

Course Content (Theory)	Weightage	Contact hours
Unit I: Introduction to Fire, Safety and Environmental Hazards: Fundamentals of Fire, Safety, Health and Environment (FSHE); Importance of Fire & EHS in engineering; Types of workplace hazards; Fire hazards; Electrical hazards; Mechanical hazards; Chemical hazards; Biological hazards; Natural and man-made disasters; Overview of major industrial accidents; Safety culture and safety awareness.	20%	6
Unit II: Fundamentals of Occupational Safety and Health: Occupational safety; Occupational health; Accident, incident and near miss; Unsafe acts and unsafe conditions; Accident causation theories; Human factors; Hazard identification; Basic risk concepts; Hierarchy of controls; Personal Protective Equipment (PPE); Safety signs and symbols.	20%	6
Unit III: Fire Safety and Emergency Preparedness: Fundamentals of fire science; Fire triangle and fire tetrahedron; Classes of fire; Portable fire extinguishers; Basic fire protection systems; Emergency preparedness; Evacuation procedures; Assembly points; First aid awareness; Introduction to disaster management and emergency response.	20%	6

Unit IV: Safety Legislation and Professional Responsibility: Introduction to safety legislation; Occupational Safety, Health and Working Conditions Code, 2020; Environment (Protection) Act, 1986; Factories Act (historical perspective); Role of DGFASLI, NDMA, CPCB, SPCB and Fire Services; Safety ethics; Professional responsibilities of engineers.	20%	6
Unit V: Environmental Protection and Sustainability: Air, water and soil pollution; Waste management; Climate change; Sustainable Development Goals (SDGs); Resource conservation; Energy conservation; Water conservation; Circular economy; Green engineering; Environmental stewardship; Introduction to ESG concepts.	20%	6

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1: Explain the fundamental concepts of fire, safety, health, and environmental management.	Cognitive	Understand
CO2: Identify workplace hazards, accident causes, and basic risk prevention measures.		Apply
CO3: Explain the principles of fire safety, emergency preparedness, and disaster response.		Understand
CO4: Describe the role of safety legislation, regulatory authorities, and professional ethics in Fire & EHS.		Understand
CO5: Explain the importance of environmental protection, sustainability, and responsible engineering practices.		Understand

Learning Resources

1.	**Reference Books** 1. C. J. Cheunisinoff & J. Graffia, Environmental Health and Safety Management, Jaico Publishing House. 2. Tarafdar, Industrial Safety Management, Khanna Publishers. 3. R. Rajagopalan, Environmental Studies, Oxford University Press. 4. B. S. Dhillon, Safety and Human Error in Engineering Systems, CRC Press. 5. Hughes & Ferrett, Introduction to Health and Safety at Work, Routledge.
2.	**Journals & Periodicals** 1. Safety Science

	2. Process Safety and Environmental Protection 3. Journal of Safety Research 4. International Journal of Environmental Research and Public Health
3.	**Codes, Standards & Online Resources** 1. Occupational Safety and Health Administration (OSHA) – https://www.osha.gov 2. National Fire Protection Association (NFPA) – https://www.nfpa.org 3. Ministry of Environment, Forest and Climate Change (MoEFCC) – https://moef.gov.in 4. National Disaster Management Authority (NDMA) – https://ndma.gov.in

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	**COURSE NAME:**			**SEMESTER:**			
BTMA103	**Mathematics-I**			I			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	1	**4**	3	1	0	**4**

Course Pre-requisites	Differentiation and Integration (Basic calculus), Trigonometry
Course Category	Basic Science
Course focus	Skill Development
Rationale	Mathematics-I provides the fundamental mathematical concepts required for engineering analysis and problem-solving. The course develops analytical thinking through limits, continuity, differentiation, sequences and series, multivariable calculus, optimization, and linear algebra. It enables students to formulate mathematical models, solve engineering problems, and build a strong foundation for advanced engineering subjects.

Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain the concepts of limits, continuity, differentiability, and their applications in engineering problems. 2. Analyze sequences, series, and power series for mathematical modelling and approximation. 3. Apply multivariable calculus concepts to solve engineering and scientific problems. 4. Evaluate optimization problems using partial derivatives and related techniques. 5. Apply matrix algebra, eigenvalues, and eigenvectors in solving engineering applications.

Course Content (Theory)	Weightage	Contact hours
Unit I: Differential Calculus: Limits; Continuity; Differentiability of single-variable functions; Indeterminate forms; L'Hospital's Rule; Successive differentiation; Engineering applications.	20%	9
Unit II: Sequences and Series: Sequences; Infinite series; Tests for convergence (Comparison, Ratio, Root, Integral, Alternating); Power series; Taylor and Maclaurin series; Engineering approximations.	20%	9
Unit III: Multivariable Calculus: Functions of two variables; Limits; Continuity; Partial derivatives; Total derivatives; Chain rule; Taylor's theorem for two variables; Engineering applications.	20%	9
Unit IV: Applications of Partial Derivatives: Maxima and minima; Constrained optimization; Lagrange multipliers; Errors and approximations; Implicit functions; Tangent plane and normal to a surface; Engineering applications.	20%	9
Unit V: Linear Algebra: Elementary transformations; Rank of a matrix; Inverse of a matrix; Solution of linear equations; Special matrices; Eigenvalues and eigenvectors; Cayley–Hamilton theorem; Applications of matrices in engineering.	20%	9

Tutorial Activity	Weightage	Contact Hours
1. Problem solving on limits, continuity and differentiation	20%	3
2. Numerical problems on sequences, convergence tests and series	20%	3
3. Tutorial on multivariable calculus and total derivatives	20%	3
4. Optimization problems using partial derivatives and Lagrange multipliers	20%	3
5. Matrix operations, eigenvalues and engineering applications	20%	3

Instructional Method and Pedagogy: PPT, Tutorial, Video Presentation		
Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: **CO1:** Analyze limits, continuity, and differentiability of single-variable functions to solve engineering problems. **CO2:** Evaluate the convergence of sequences and series and apply power series for function approximation. **CO3:** Apply multivariable calculus concepts, including partial and total derivatives, in engineering applications. **CO4:** Solve optimization problems using partial derivatives, Lagrange multipliers, and approximation techniques. **CO5:** Apply matrix algebra, eigenvalues, and eigenvectors to solve systems of equations and engineering problems.	Cognitive	Analyze Evaluate Apply Apply Apply

Learning Resources	
1.	**Reference Books** 1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley. 2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers. 3. H.K. Dass & Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand. 4. Thomas G.B. & Finney R.L., Calculus and Analytic Geometry, Pearson. 5. Gilbert Strang, Introduction to Linear Algebra, Wellesley-Cambridge Press.
2.	**Journals & Periodicals** 1. SIAM Journal on Applied Mathematics 2. Journal of Engineering Mathematics 3. Applied Mathematics and Computation 4. International Journal of Mathematical Education in Science and Technology
3.	**Codes, Standards & Online Resources** 1. NPTEL – Engineering Mathematics – https://nptel.ac.in 2. MIT OpenCourseWare – Mathematics – https://ocw.mit.edu 3. Wolfram MathWorld – https://mathworld.wolfram.com 4. Society for Industrial and Applied Mathematics (SIAM) – https://www.siam.org 5. Wolfram Demonstrations Project – https://demonstrations.wolfram.com

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	**20 marks**

Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	**COURSE NAME:**	**SEMESTER:**
BTME106	**Workshop**	I

Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
0	2	0	**2**	0	1	0	**1**

Course Pre-requisites	NIL
Course Category	Engineering Science
Course focus	Skill Development
Rationale	Workshop Practice provides first-year engineering students with fundamental hands-on skills in manufacturing, fabrication, fitting, welding, sheet metal work, machining, and workshop safety. The course develops practical competencies in handling engineering tools, measuring instruments, and workshop equipment while promoting safety awareness, precision, teamwork, and professional work ethics. It forms the foundation for manufacturing and maintenance practices required across engineering disciplines.
Course Revision/ Approval Date:	24/06/2020
Course Objectives	The course aims to: 1. Familiarize students with workshop practices, safety procedures, and engineering tools. 2. Develop practical skills in fitting, welding, sheet metal, machining, and fabrication processes. 3. Train students in the safe operation of workshop equipment and measuring instruments. 4. Develop precision, workmanship, and problem-solving skills through practical exercises. 5. Build confidence in manufacturing simple engineering components using standard workshop practices.

Practical	Weightage	Contact Hours
Practical 1: Workshop orientation, safety practices, PPE, workshop layout, housekeeping, and measuring instruments.	10%	3
Practical 2: Fitting shop – marking, filing, hacksawing, drilling, tapping, and fabrication of a simple fitting job.	10%	3
Practical 3: Arc welding – identification of welding equipment, edge preparation, lap joint and butt joint fabrication.	10%	3
Practical 4: Sheet metal work – marking, cutting, bending, folding and fabrication of a simple sheet metal component.	10%	3
Practical 5: Carpentry – identification of tools, marking, cutting and preparation of basic wood joints.	10%	3
Practical 6: Smithy shop – heating, upsetting, bending, drawing-out and preparation of a simple forged component.	10%	3
Practical 7: Machine shop – introduction to lathe, facing, turning, drilling and basic machining operations.	10%	3
Practical 8: Assembly, fitting inspection, dimensional measurement and finishing of fabricated jobs.	10%	3
Practical 9: Integrated fabrication exercise using appropriate workshop processes with emphasis on quality and safety.	10%	3
Practical 10: Viva-voce, demonstration, maintenance of tools and workshop best practices.	10%	3

Instructional Method and Pedagogy:
The instructional methods and pedagogies for teaching ICT involve a combination of theoretical knowledge and practical application.

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: Demonstrate safe working practices and correctly use workshop tools and measuring instruments. CO2: Perform basic fitting, welding, sheet metal, carpentry, and smithy operations to fabricate simple engineering components. CO3: Operate basic machine shop equipment following standard workshop procedures and safety practices. CO4: Inspect fabricated components for dimensional accuracy and workmanship using appropriate measuring instruments.	Psychomotor & Affective	Apply Apply Apply Analyze

CO5: Demonstrate teamwork, professional ethics, and good workshop practices while completing engineering fabrication tasks.		Apply

Learning Resources	
1.	**Reference Books** 1. S.K. Hajra Choudhury, Elements of Workshop Technology, Vol. I & II, Media Promoters & Publishers. 2. W.A.J. Chapman, Workshop Technology, CBS Publishers. 3. D.K. Singh, Fundamentals of Manufacturing Engineering, Ane Books. 4. B.S. Raghuwanshi, A Course in Workshop Technology, Dhanpat Rai Publications. 5. P.N. Rao, Manufacturing Technology, McGraw-Hill.
2.	**Journals & Periodicals** 1. Journal of Manufacturing Processes 2. Procedia Manufacturing 3. Manufacturing Letters 4. International Journal of Advanced Manufacturing Technology
3.	**Codes, Standards & Online Resources** 1. OSHA – Machine Safety: https://www.osha.gov 2. NPTEL – Manufacturing Processes: https://nptel.ac.in 3. SME (Society of Manufacturing Engineers): https://www.sme.org 4. American Welding Society (AWS): https://www.aws.org 5. Bureau of Indian Standards (BIS): https://www.bis.gov.in

Evaluation Scheme	Total Marks	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks

	Discipline	05 marks
	Total	**50 Marks**

Semester II

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
											Theory Marks				Practical Marks	**Total Marks**
			L	P	T	***Total***	L	P	T	**Total**	MS	CEC	ES	***Total***		
1	AECC201	Communication Skills in English	2	-	-	***2***	2	-	-	**2**	20	40	40	***100***	--	**100**
2	BTCS210	Introduction to Artificial Intelligence and Generative AI	2	-	-	***2***	2	-	-	**2**	20	40	40	***100***	--	**100**
3	BTCS209	Python Programming	3	2	-	***5***	3	1	-	**4**	20	40	40	***100***	50	**150**
4	BTFS208	Industrial Internship	-	-	-	***-***	-	2	-	**2**	--	--	--	**--**	100	**100**
5	BTMA203	Mathematics – II	3	-	1	***4***	3	-	1	**4**	20	40	40	***100***	--	**100**
6	BTME202	Engineering Graphics	-	2	-	***2***	-	2	-	**2**	--	--	--	**--**	50	**50**
7	BTME209	Engineering Mechanics	3	2	-	***5***	3	1	-	**4**	20	40	40	***100***	50	**150**
8	BTPY115	Engineering Physics	3	2	-	***5***	3	1	-	**4**	20	40	40	***100***	50	**150**
9	VACC201	Tinkering & Mentoring	-	2	-	***2***	-	1	-	**1**	--	--	--	**--**	100	**100**
10	VACC202	Introduction to Indian Knowledge System	2	-	-	***2***	2	-	-	**2**	--	--	--	***100***	00	**100**
		Total				***49***				**48**						**1100**

Note: L = Lecture, **P** = Practice, **T**= Tutorial, **MS -** Mid Semester, **CEC -** Continuous Evaluation Component**, ES -** End Semester

COURSE CODE:	COURSE NAME:	SEMESTER:
AECC201	Communication Skills in English	II

Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
2	0	0	**2**	2	0	0	**2**

Course Pre-requisites	Basic English Grammar & Intermediate communication skills
Course Category	Ability Enhancement Compulsory Course
Course focus	Employability and Skill Development
Rationale	Communication Skills in English equips students with the linguistic and interpersonal competencies required for academic success, professional communication, and career development. The course develops listening, speaking, reading, writing, presentation, and digital communication skills necessary for effective interaction in multicultural and workplace environments. It also promotes confidence, critical thinking, teamwork, and lifelong learning through practical communication activities.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Develop effective listening, speaking, reading, and writing skills for academic and professional communication. 2. Strengthen English grammar, vocabulary, and language accuracy for workplace communication. 3. Enhance interpersonal, presentation, and group communication skills in multicultural environments. 4. Develop professional writing skills for business and technical communication. 5. Apply digital communication tools and modern communication practices for academic and professional purposes.

Course Content (Theory)	Weightage	Contact hours
Unit I: Fundamentals of Communication: Communication process; Types of communication; Verbal and non-verbal communication; Barriers to communication; Effective communication strategies; Interpersonal communication; Professional etiquette.	20%	6
Unit II: Grammar and Vocabulary Development: Sentence structure; Tenses; Modals; Active and passive voice; Common	20%	6

grammatical errors; Vocabulary building; Synonyms; Antonyms; Homophones; Technical vocabulary; Phrasal verbs.		
Unit III: Listening and Reading Skills: Active listening; Types of listening; Listening barriers; Reading strategies; Skimming; Scanning; Critical reading; Inferential reading; Reading comprehension; Note-making and summarization.	20%	6
Unit IV: Professional Writing and Speaking Skills: Formal letters; E-mails; Resume writing; Report writing; Article writing; Presentation skills; Public speaking; Group discussion; Interview skills; Self-introduction; Role play.	20%	6
Unit V: Digital and Professional Communication: Digital communication; E-mail etiquette; Blogs; LinkedIn profile basics; E-portfolio; Online forms; Virtual meetings; Presentation tools; AI-assisted communication; Professional ethics in digital communication.	20%	6

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:	Cognitive	
CO1: Demonstrate effective listening, speaking, reading, and writing skills in English for academic and professional communication.		Apply
CO2: Apply appropriate grammar, vocabulary, and language structures in oral and written communication.		Apply
CO3: Communicate confidently through presentations, interviews, group discussions, and workplace interactions.		Apply
CO4: Prepare professional documents such as reports, e-mails, resumes, and formal correspondence using appropriate communication practices.		Create
CO5: Utilize digital communication tools and ethical communication practices in academic and professional environments.		Apply

Learning Resources	
1.	**Reference Books** 1. Sanjay Kumar & Pushp Lata, Communication Skills, Oxford University Press. 2. Raman Sharma, Technical Communications: Principles and Practice, Oxford

	University Press. 3. Wren & Martin, High School English Grammar and Composition, S. Chand. 4. Edgar Thorpe & Showick Thorpe, Objective English, Pearson Education. 5. Meenakshi Raman & Sangeeta Sharma, Technical Communication: Principles and Practice, Oxford University Press.
2.	**Journals & Periodicals** 1. English for Specific Purposes 2. Journal of English for Academic Purposes 3. Business Communication Quarterly 4. International Journal of Applied Linguistics
3.	**Codes, Standards & Online Resources** 1. British Council – https://learnenglish.britishcouncil.org 2. Cambridge English – https://www.cambridgeenglish.org 3. Grammarly Writing Handbook – https://www.grammarly.com/blog 4. NPTEL – Soft Skills & Communication – https://nptel.ac.in 5. Purdue Online Writing Lab (OWL) – https://owl.purdue.edu

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	**COURSE NAME:**			**SEMESTER:**			
BTCs210	**Introduction to Artificial Intelligence and Generative AI**			II			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	0	0	**2**	2	0	0	**2**
Course Pre-requisites	Nil						

Course Category	Compulsory Course
Course focus	Artificial Intelligence, Generative AI and their applications in Fire & EHS Engineering
Rationale	The integration of Artificial Intelligence and Generative AI is essential for modern Fire and EHS engineering to enhance incident prediction, hazard detection, and compliance monitoring. This course introduces B.Tech. (F&EHS) students to Python-based data handling and advanced AI tools to optimize emergency response planning and workplace safety decision-making. By leveraging machine learning and generative workflows, students will develop the technical skills necessary to implement smart safety systems in the context of Industry 4.0.
Course Revision/ Approval Date:	14th May, 2026
Course Objectives	The course aims to: 1. Explain fundamental AI and Generative AI concepts within Fire and EHS engineering. 2. Develop basic Python programming skills for handling safety and environmental datasets. 3. Apply prompt engineering techniques for risk assessment and hazard prediction. 4. Utilize modern AI workflow tools such as N8N, Claude AI, and AI Studio for automating safety reporting and compliance. 5. Design AI-driven solutions for fire spread modeling, evacuation planning, and sustainability monitoring.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Foundation and Python Basics: Introduction to AI for Fire & EHS; definitions and safety applications; data sources (fire sensors, IoT, environmental systems); Python environment setup; basic variables, loops, functions, and libraries (NumPy, Pandas, Matplotlib) for risk assessment calculations.	27%	8
Unit 2: Generative AI & Prompt Engineering: Fundamentals of Generative AI (LLMs like ChatGPT, Claude AI); ethical use and bias; advanced Prompt Engineering techniques; workflow automation tools (NotebookLM, N8N, AI Studio); experiment tracking and evacuation planning optimization.	27%	8
Unit 3: AI in Fire & EHS Applications: Generative AI for fire spread modelling and hazard detection; emergency response planning; AI for sustainability (pollution monitoring, waste reduction); generating environmental compliance reports.	13%	4

Unit 4: Safety Data & Risk Forecasting: Machine learning for workplace hazard simulation and environmental sensor data interpretation; predictive analytics for accident prevention; occupational health monitoring; evacuation parameter optimization.	13%	4
Unit 5: Decision-Making & Industrial Case Studies: AI as a decision-support tool in EHS management; balancing safety, cost, and compliance; Industry 4.0 and sustainable safety transitions; ethical considerations; final mini-project presentations.	20%	6

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1: Explain the role of Artificial Intelligence and Generative AI in Fire Safety and EHS engineering processes.	Cognitive	Understand
CO2: Apply Python programming for processing and visualizing safety-related datasets.		Apply
CO3: Utilize prompt engineering and workflow automation tools for efficient safety reporting.		Apply
CO4: Analyze AI-based simulations for fire spread modeling and emergency evacuation.		Analyze
CO5: Evaluate AI-driven solutions for risk forecasting and sustainable environmental monitoring.		Evaluate

Learning Resources

1.	**Reference Books** 1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson. 2. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow, O'Reilly Media. 3. Ethan Mollick, Co-Intelligence: Living and Working with AI, Portfolio.
2.	**Journals & Periodicals** 1. Artificial Intelligence 2. Expert Systems with Applications 3. Safety Science 4. Journal of Loss Prevention in the Process Industries
3.	**Codes, Standards & Online Resources** 1. Python Software Foundation – https://www.python.org

	2. Python Documentation – https://docs.python.org/3 3. Jupyter Notebook Documentation – https://jupyter.org 4. NumPy Documentation – https://numpy.org 5. SciPy Documentation – https://scipy.org 6. Pandas Documentation – https://pandas.pydata.org 7. Matplotlib Documentation – https://matplotlib.org 8. CoolProp Documentation – https://coolprop.org 9. SymPy Documentation – https://www.sympy.org 10. ChemPy Documentation – https://pythonhosted.org/chempy

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	**COURSE NAME:**	**SEMESTER:**
BTCS209	**Python Programming**	II

Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	**5**	3	1	0	**4**

Course Pre-requisites	Basic computer fundamentals and mathematical concepts.
Course Category	Engineering Science
Course focus	Skill Development
Rationale	Python Programming provides students with a strong foundation in programming concepts, computational thinking, and problem-solving skills using one of the most widely adopted programming languages. The course enables learners to develop applications using Python, perform numerical computations, manage files, visualize engineering data, and utilize scientific libraries for solving engineering problems. It also

	introduces domain-specific Python applications and emerging technologies such as Artificial Intelligence (AI), Machine Learning (ML), and Internet of Things (IoT).
Course Revision/ Approval Date:	28/6/2025
Course Objectives	The course aims to: 1. Understand the fundamentals of Python programming and structured programming concepts. 2. Develop Python programs using functions, object-oriented programming, file handling, and built-in data structures. 3. Apply Python libraries for numerical computation, scientific computing, data visualization, and engineering analysis. 4. Utilize Python-based scientific libraries to solve engineering and domain-specific computational problems. 5. Develop computational thinking and programming skills for emerging applications in AI, ML, IoT, and engineering systems.

Course Content (Theory)	**Weightage**	**Contact hours**
Unit I: Introduction to Python: • Basic syntax and Structure of python programming • Variables and Identifiers • Built- In Data Types • Logical Expressions and Operators • If-Else, elif , Nested If-Else • While loop, Do-while, For loop, Nested loops • Break, Continue and pass Statements • Installation of Python, and IDLE • Installing Anaconda Navigator • Using Jupyter Notebook, Spyder & Pycharm.	20%	9
Unit II: Features of Python: • Defining a function, Python Built-in Functions, Calling a function, Types of functions, Function Arguments, Default Argument, Anonymous functions, Global and local variables. • String Manipulation - accessing Strings, Basic Operations, String slices and Function and Methods. • Tuple: Introduction, accessing tuples, Operations. • Dictionaries: Introduction, accessing values in dictionaries, Working with dictionaries, Properties. • Sets: Introduction, accessing values in sets, Working with sets, Properties. • Classes and Object-Oriented Programming, Abstract Data Types and Classes Inheritance, Encapsulation and Information Hiding.	20%	9
Unit III: File Handling and date time classes: • Reading from a file • Writing to a file • Other Operations on Files • Dates and Time: Basic date and time classes • Different time formats • Converting between formats, Formatting dates and times, • Parsing date/time information	20%	9
Unit IV: Python For Visualization & Plotting: • NumPy for vector/matrix operations (e.g., stoichiometry) • Pandas for handling chemical lab/plant data tables • Matplotlib/Seaborn for plotting graphs (e.g., conversion vs. time) • 2d and 3d plotting using Matplotlib. • Introduction to SciPy for solving numerical problems.	20%	9

Unit V: Application of Python programming: • Working with CoolProp, SymPy, ChemPy libraries • Calculating entropy, enthalpy using Python functions • Curve fitting experimental data using scipy.optimize • Use of Python Ordinary Differential Equation ODE Solvers. • Introduction of AI/ML & IoT in chemical engineering: AI-powered control systems; Real-time monitoring and adjustment of process variables using IoT based sensors; Corrosion prediction using AI algorithms and IoT Sensors.	20%	9

List of Practical	Weightage	Contact hours
1. a) Write a code showing the working of all Logical Expressions and Operators; **b)** Write a code showing the all Built- In Data Types and Usage of input output statements; **c)** Write a code showing the working of if else & nested if else; **d)** Write a code showing the working of while, do-while and for loop; **e)** Design a simple calculator using elif.	20%	6
2. a) Write a code to display greatest of three numbers using user defined function; **b)** Write a code to display the factorial of a number using recursive function; **c)** Write a code to display all the string manipulation functions; **d)** Write a code to display the working of lists, tuples, dictionary, sets with its associated methods & functions; **e)** Write a code to display the student details using a student class and its appropriate methods.	20%	6
3. a) Write a code to show working of all the file operations; **b)** Write a code to show working of all the Date and Time classes	20%	6
4. a) Given the lists x = np.arange(11) and $y=x^2$, create a 2 by 3 subplot where each subplot plots x versus y using plot, scatter, bar, loglog, semilogx, and semilogy. Title and label each plot appropriately; **b)** Use fft and ifft function from numpy to calculate the FFT amplitude spectrum and inverse FFT to obtain the original signal. Plot both results. Time the fft function using this 2000 length signal; **c)** Use numpy.linalg.solve to solve the following equations. $4x_1+3x_2-5x_3=2$, $-2x_1-4x_2+5x_3=5$, $8x_1+8x_2=-3$; **d)** Compute the root of the function $f(x)=x^3-100x^2-x+100$ using f_solve.	20%	6
5. a) Use the trapz function to approximate $\int_0^s \sin(x)\,dx$ for 11 equally spaced points over the whole interval; **b)** Use CoolProp to calculate the specific heat of saturated water vapor at 1 atm; **c)** Use SymPy to find derivative, integration, limits, quadratic equation. Take any simple equation for each; **d)** Use Chempy and printing a list of elements with their mass.	20%	6

Instructional Method and Pedagogy:
Lecture-based instruction, Project based learning, Flipped Classroom, Case Studies, Problem based learning, Collaborative Learning

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: Develop Python programs using appropriate programming constructs, control statements, and built-in data types. CO2: Develop applications using functions, object-oriented programming, data structures, and file handling techniques. CO3: Apply Python scientific libraries for numerical computation, data analysis, and visualization. CO4: Utilize Python libraries such as CoolProp, SymPy, ChemPy, SciPy, and related packages to solve engineering problems. CO5: Develop Python-based computational solutions for engineering applications involving AI, Machine Learning, and IoT concepts.	Cognitive	Apply Apply Apply Apply Create

Learning Resources	
1.	**Reference Books** 1. Y. Daniel Liang, Introduction to Programming Using Python, Pearson. 2. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press. 3. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, O'Reilly Media. 4. Kenneth A. Lambert, Fundamentals of Python: First Programs, Cengage Learning. 5. Eric Matthes, Python Crash Course, No Starch Press.
2.	**Journals & Periodicals** 1. Journal of Open Source Software (JOSS) 2. SoftwareX 3. IEEE Software 4. Journal of Systems and Software
3.	**Codes, Standards & Online Resources** 1. Python Software Foundation – https://www.python.org 2. Python Documentation – https://docs.python.org/3 3. Jupyter Notebook Documentation – https://jupyter.org 4. NumPy Documentation – https://numpy.org 5. SciPy Documentation – https://scipy.org 6. Pandas Documentation – https://pandas.pydata.org 7. Matplotlib Documentation – https://matplotlib.org 8. CoolProp Documentation – https://coolprop.org

	9. SymPy Documentation – https://www.sympy.org 10. ChemPy Documentation – https://pythonhosted.org/chempy

Evaluation Scheme	Total Marks	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

COURSE CODE:	COURSE NAME:			SEMESTER:			
BTMA203	**Mathematics-II**			II			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	2	**5**	3	0	1	**4**

Course Pre-requisites	Mathematics- I
Course Category	Basic Science
Course focus	Skill Development
Rationale	Mathematics-II provides the mathematical foundation required for engineering analysis and problem-solving. The course develops analytical skills in differential equations, Laplace transforms,

	multivariable calculus, vector calculus, and probability concepts. It enables students to formulate and solve engineering problems, analyze mathematical models, and apply computational techniques in various branches of engineering, science, and technology.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain and solve first-order and higher-order ordinary differential equations arising in engineering applications. 2. Apply Laplace transform techniques for solving engineering differential equations and initial value problems. 3. Develop analytical skills in multiple integration and coordinate transformations for engineering applications. 4. Apply vector calculus concepts to analyze scalar and vector fields encountered in engineering systems. 5. Strengthen mathematical problem-solving skills through tutorial-based analytical exercises and engineering applications.

Course Content (Theory)	**Weightage**	**Contact hours**
Unit I: Ordinary Differential Equations: Formation of differential equations; First-order ordinary differential equations; Variable separable equations; Homogeneous equations; Exact equations; Integrating factors; Linear and Bernoulli's equations; Orthogonal trajectories; Applications to engineering problems such as mixture and temperature models.	20%	9
Unit II: Higher-Order Differential Equations: Higher-order linear differential equations; Differential operators; Wronskian; Complementary function; Particular integral; Method of undetermined coefficients; Method of variation of parameters; Cauchy–Euler equations; Engineering applications.	20%	9
Unit III: Laplace Transforms and Applications: Laplace and inverse Laplace transforms; Properties of Laplace transforms; First and second shifting theorems; Transform of derivatives and integrals; Convolution theorem; Solution of initial and boundary value problems using Laplace transforms; Applications to heat, wave and Laplace equations.	20%	9
Unit IV: Multiple Integrals: Double integration; Triple integration; Change of order of integration; Double integrals in polar coordinates; Jacobians; Change of variables; Applications to area, surface area, volume and centroid calculations.	20%	9

Unit V: Vector Calculus: Vector-valued functions; Scalar and vector fields; Gradient; Directional derivatives; Divergence; Curl; Vector identities; Line integrals; Green's theorem; Engineering applications of vector calculus.	20%	9

Tutorial Activity	**Contact Hours**
Problem-solving on first-order differential equations	6
Problem-solving on higher-order differential equations	6
Numerical exercises on Laplace transforms	6
Problem-solving on multiple integration and Jacobians	6
Vector calculus and Green's theorem exercises	6

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: Solve first-order ordinary differential equations arising in engineering and scientific applications. CO2: Analyze and solve higher-order differential equations and engineering problems using analytical methods. CO3: Apply Laplace transform techniques to solve ordinary differential equations and engineering models. CO4: Evaluate engineering quantities using multiple integration techniques and coordinate transformations. CO5: Apply vector calculus concepts to analyze engineering fields and solve related mathematical problems.	Cognitive	Apply Analyze Apply Evaluate Apply

Learning Resources	
1.	**Reference Books** 1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley. 2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers. 3. T. Veerarajan, Engineering Mathematics, McGraw-Hill Education. 4. H. K. Dass & Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand. 5. Peter V. O'Neil, Advanced Engineering Mathematics, Cengage Learning.

2.	**Journals & Periodicals** 1. SIAM Journal on Applied Mathematics 2. Journal of Engineering Mathematics 3. Applied Mathematics and Computation 4. International Journal of Mathematical Education in Science and Technology
3.	**Codes, Standards & Online Resources** 1. NPTEL – Engineering Mathematics: https://nptel.ac.in 2. MIT OpenCourseWare – Mathematics: https://ocw.mit.edu 3. Wolfram MathWorld: https://mathworld.wolfram.com 4. Society for Industrial and Applied Mathematics (SIAM): https://www.siam.org 5. Wolfram Demonstrations Project: https://demonstrations.wolfram.com

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks	**20 marks**	
Theory: End Semester Marks	**40 marks**	
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	**COURSE NAME:**	**SEMESTER:**
BTME202	**Engineering Graphics**	II

Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
0	2	0	**2**	0	2	0	**2**

Course Pre-requisites	Higher Secondary School Certificate (10+2) with Mathematics.
Course Category	Engineering Science
Course focus	Skill Development
Rationale	Engineering Graphics is the universal language of engineers that facilitates the graphical representation and communication of engineering ideas, designs, and manufacturing details. The course develops

	visualization skills, spatial reasoning, and proficiency in engineering drawing standards, geometric constructions, orthographic projections, isometric views, sectional views, and computer-aided drafting (CAD). It enables students to interpret and prepare engineering drawings required for design, manufacturing, construction, and industrial applications.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain engineering drawing standards, conventions, scales, and geometrical construction techniques. 2. Develop visualization skills through projections of points, lines, planes, and solids. 3. Apply engineering drawing principles to prepare orthographic, sectional, development, and isometric drawings. 4. Develop practical drafting skills using engineering drawing instruments and CAD software. 5. Interpret engineering drawings and graphical representations for engineering design and manufacturing applications.

Practical	Weightage	Contact Hours
Practical 1: Introduction to drawing instruments, BIS SP 46 standards, sheet layout, lettering, dimensioning and scales.	10%	2
Practical 2: Geometrical constructions and engineering curves (Ellipse, Parabola, Hyperbola, Cycloid, Involute and Spiral).	10%	4
Practical 3: Projection of points and straight lines.	10%	4
Practical 4: Projection of planes.	10%	4
Practical 5: Projection of solids.	15%	4
Practical 6: Section of solids and true shape of sections.	15%	4
Practical 7: Development of lateral surfaces of prisms, pyramids, cylinders and cones.	10%	2
Practical 8: Orthographic projections and sectional views.	10%	2
Practical 9: Isometric projection and isometric drawing.	10%	2
Practical 10: Computer-Aided Drafting (CAD): Preparation of engineering drawings using AutoCAD (2D drafting, dimensioning, layers, annotation and plotting).	10%	2

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: Explain engineering drawing standards, conventions, scales, and geometrical construction techniques. CO2: Apply projection principles to represent points, lines, planes, and solids accurately. CO3: Prepare sectional views, surface developments, orthographic projections, and isometric drawings using standard engineering drawing practices. CO4: Develop engineering drawings using manual drafting techniques and CAD software in accordance with BIS standards. CO5: Interpret engineering drawings for engineering design, manufacturing, and construction applications.	Cognitive	Understand Apply Apply Create Analyze

Learning Resources	
1.	**Reference Books** 1. N.D. Bhatt, Engineering Drawing, Charotar Publishing House. 2. K. Venugopal, Engineering Drawing and Graphics, New Age International. 3. P.S. Gill, Engineering Drawing, S.K. Kataria & Sons. 4. D.A. Jolhe, Engineering Drawing with an Introduction to AutoCAD, Tata McGraw-Hill. 5. T. Jeyapoovan, Engineering Drawing and Graphics Using AutoCAD, Vikas Publishing House.
2.	**Journals & Periodicals** 1. Engineering Design Graphics Journal 2. Computer-Aided Design 3. International Journal of Engineering Graphics 4. CAD Journal
3.	**Codes, Standards & Online Resources** 1. BIS SP 46: General Principles for Preparation of Engineering Drawings – https://www.services.bis.gov.in 2. Bureau of Indian Standards (BIS) – https://www.bis.gov.in 3. Autodesk Education (AutoCAD Learning Resources) – https://www.autodesk.com/education 4. NPTEL – Engineering Graphics – https://nptel.ac.in 5. SolidWorks Education – https://www.solidworks.com/education

Evaluation Scheme	Total Marks	
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

COURSE CODE:	**COURSE NAME:**			**SEMESTER:**			
BTME209	**Engineering Mechanics**			II			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	**5**	3	1	0	**4**

Course Pre-requisites	Engineering Physics and Engineering Mathematics-I
Course Category	Engineering Science
Course focus	Skill Development
Rationale	Engineering Mechanics provides the fundamental principles required to analyze forces, equilibrium, friction, centroids, moments of inertia, and dynamics of particles and rigid bodies. The course develops analytical and problem-solving skills necessary for engineering design, structural analysis, machine elements, and safety engineering applications. Laboratory experiments reinforce theoretical concepts through experimental verification and engineering measurements.
Course Revision/ Approval Date:	5th March 2024
Course Objectives	The course aims to: 1. Apply the principles of statics to analyze force systems and equilibrium of engineering structures. 2. Determine centroids and moments of inertia of engineering sections used in design applications. 3. Analyze engineering problems involving friction and equilibrium. 4. Apply principles of kinematics and kinetics to analyze particle and

	rigid body motion. 5. Develop practical skills through experimental verification of engineering mechanics principles.

Course Content (Theory)	Weightage	Contact hours
Unit I: Engineering Statics and Force Systems: Force systems; Vector algebra; Moments of forces; Couple and equivalent force systems; Free body diagrams; Equilibrium of particles and rigid bodies; Support reactions; Internal forces; Shear force and bending moment concepts; Trusses and frames using method of joints and sections.	20%	9
Unit II: Centroid and Moment of Inertia: Centroid of lines, plane areas and composite sections; Centre of gravity; First and second moments of area; Radius of gyration; Parallel and perpendicular axis theorems; Product of inertia; Principal moments of inertia; Engineering applications.	20%	9
Unit III: Friction and Engineering Applications: Dry friction; Laws of friction; Angle of friction; Angle of repose; Wedge friction; Ladder friction; Belt friction; Screw friction; Rolling resistance; Engineering applications.	20%	9
Unit IV: Kinematics and Kinetics of Particles: Rectilinear and curvilinear motion; Velocity and acceleration; Newton's laws of motion; Work-energy principle; Impulse and momentum; Projectile motion; Engineering applications.	20%	9
Unit V: Dynamics of Rigid Bodies: Translation and rotation of rigid bodies; D'Alembert's principle; Chasles' theorem; Angular momentum; Work and energy methods; Impact and collision; Introduction to vibration concepts; Engineering applications.	20%	9

Practical	Weightage	Contact Hours
1. Verification of the law of parallelogram and polygon of forces	12.5%	4
2. Verification of Lami's theorem and principle of moments	12.5%	4
3. Determination of support reactions of simply supported beams	12.5%	4
4. Analysis of forces in truss or jib crane members	12.5%	4
5. Determination of centroid and moment of inertia using engineering models	12.5%	4
6. Determination of coefficient of friction on horizontal and inclined planes	12.5%	4
7. Determination of mass moment of inertia of a flywheel	12.5%	3
8. Engineering mechanics simulation/computer-aided analysis of force systems and equilibrium	12.5%	3

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: Apply principles of statics to analyze forces, moments, and equilibrium of engineering systems. CO2: Determine centroids and moments of inertia of engineering sections for structural and mechanical applications. CO3: Analyze engineering systems involving friction and equilibrium using appropriate analytical methods. CO4: Apply kinematic and kinetic principles to analyze the motion of particles and rigid bodies. CO5: Perform engineering mechanics experiments and interpret experimental results using standard laboratory procedures.	Cognitive	Apply Apply Analyze Apply Apply

Learning Resources

1.	**Reference Books** 1. Beer, F.P., Johnston, E.R., Vector Mechanics for Engineers: Statics and Dynamics, McGraw-Hill. 2. Meriam, J.L., Kraige, L.G., Engineering Mechanics: Statics and Dynamics, Wiley. 3. I.H. Shames, Engineering Mechanics: Statics and Dynamics, Pearson. 4. R.C. Hibbeler, Engineering Mechanics: Statics and Dynamics, Pearson. 5. S. Timoshenko & D.H. Young, Engineering Mechanics, McGraw-Hill.
2.	**Journals & Periodicals** 1. International Journal of Mechanical Engineering Education 2. Journal of Engineering Mechanics (ASCE) 3. Mechanics Research Communications 4. Engineering Structures
3.	**Codes, Standards & Online Resources** 1. ASCE – American Society of Civil Engineers: https://www.asce.org 2. MIT OpenCourseWare – Engineering Mechanics: https://ocw.mit.edu 3. Engineering LibreTexts – Mechanics: https://eng.libretexts.org

Evaluation Scheme	Total Marks

Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

COURSE CODE:	**COURSE NAME:**	**SEMESTER:**
BTPY115	**Engineering Physics**	I

Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	**5**	3	1	0	**4**

Course Pre-requisites	NIL
Course Category	Basic Science
Course focus	Skill Development
Rationale	Engineering Physics provides the scientific foundation required to understand physical principles governing modern engineering systems. The course develops analytical skills through the study of vibrations, electromagnetism, optics, lasers, and quantum physics while demonstrating their applications in engineering, instrumentation, communication, sensing, and advanced technologies. Laboratory experiments reinforce theoretical concepts through scientific observation, measurement, and experimental analysis.

Course Revision/ Approval Date:	5th March 2024
Course Objectives	The course aims to: 1. Explain the principles of oscillations, vibrations, and wave phenomena relevant to engineering systems. 2. Apply the concepts of electromagnetism and magnetic materials in engineering applications. 3. Analyze the principles and engineering applications of wave optics and photonic devices. 4. Explain the working principles and applications of lasers and modern optical technologies. 5. Understand the fundamentals of quantum physics and their applications in modern engineering and technology.

Course Content (Theory)	**Weightage**	**Contact hours**
Unit I: Oscillations, Vibrations and Noise: Noise and its sources; Noise terminology; Human perception of noise; Simple harmonic motion; Damped and forced vibrations; Resonance; Quality factor; Mechanical and electrical oscillation analogy; Mathematical modelling of vibrations; Engineering applications in machinery and structural systems.	20%	9
Unit II: Electromagnetism and Magnetic Materials: Electrostatics; Gauss's law; Polarization; Dielectric materials; Magnetization; Magnetic materials; Permeability; Susceptibility; Hysteresis; Maxwell's equations (introduction); Continuity equation; Electromagnetic engineering applications.	20%	9
Unit III: Wave Optics and Diffraction: Interference; Diffraction; Fraunhofer diffraction; Single and multiple slit diffraction; Diffraction grating; Resolving power; Bragg's law; X-ray diffraction; Engineering applications in optical instruments and material characterization.	20%	9
Unit IV: Polarization and Laser Physics: Polarization of light; Double refraction; Optical activity; Laser fundamentals; Population inversion; Types of lasers; Laser safety; Optical fibres (introduction); Photonic devices; Engineering applications of lasers in communication, sensing, manufacturing, and medicine.	20%	9
Unit V: Quantum Physics and Modern Engineering: Black body radiation; Planck's hypothesis; Photoelectric effect; de Broglie hypothesis; Wave-particle duality; Schrödinger wave equation (introductory); Particle in a box; Heisenberg uncertainty principle; Introduction to nanotechnology and quantum devices.	20%	9

Practical	**Weightage**	**Contact Hours**
1. Determination of frequency using Melde's apparatus and sonometer	12.5%	4

2. Determination of magnetic hysteresis characteristics and magnetic field using tangent galvanometer/deflection magnetometer	12.5%	4
3. Determination of wavelength using diffraction grating and dispersive power of grating	12.5%	4
4. Determination of wavelength and refractive index using Newton's rings	12.5%	4
5. Determination of specific rotation using polarimeter	12.5%	4
6. Determination of Planck's constant using photoelectric effect setup	12.5%	4
7. Laser beam divergence/optical fibre characterization (or virtual experiment)	12.5%	3
8. Simulation/virtual experiments on quantum physics, interference, diffraction, or optical systems	12.5%	3

Instructional Method and Pedagogy:
The pedagogy should emphasize the integration of theory and practical applications, promote active learning through interactive discussions and collaborative projects, and provide opportunities for students to explore and analyze complex engineering systems.

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: Explain the principles of oscillations, vibrations, and resonance in engineering systems. CO2: Apply the concepts of electromagnetism and magnetic materials in solving engineering problems. CO3: Analyze wave optics phenomena and their applications in engineering and photonic systems. CO4: Explain the operating principles and engineering applications of lasers and optical technologies. CO5: Apply the fundamental concepts of quantum physics to modern engineering and emerging technologies.	Cognitive	Understand Apply Analyze Understand Apply

Learning Resources	
1.	**Reference Books** 1. A.S. Vasudeva, Engineering Physics, S. Chand Publishing. 2. P.K. Palanisamy, Engineering Physics, Scitech Publications. 3. M.N. Avadhanulu & P.G. Kshirsagar, A Textbook of Engineering Physics, S. Chand. 4. H.J. Pain, The Physics of Vibrations and Waves, Wiley. 5. Arthur Beiser, Concepts of Modern Physics, McGraw-Hill.
2.	**Journals & Periodicals** 1. Applied Physics Letters 2. Journal of Applied Physics

	3. IEEE Photonics Journal 4. Optics and Lasers in Engineering
3.	**Codes, Standards & Online Resources** 1. NPTEL – Engineering Physics: https://nptel.ac.in 2. PhET Interactive Simulations: https://phet.colorado.edu 3. OpenStax Physics: https://openstax.org 4. Optica (formerly OSA): https://www.optica.org 5. IEEE Xplore Digital Library: https://ieeexplore.ieee.org

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

COURSE CODE:	**COURSE NAME:**			**SEMESTER:**			
VACC201	**Tinkering & Mentoring**			II			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
0	2	0	**2**	0	2	0	**1**
Course Pre-requisites	Nil						
Course Category	Value Added Course						

Course focus	Entrepreneurship, Innovation, Tinkering, Prototyping and Mentoring
Rationale	The course provides students with hands-on exposure to problem-solving, idea generation, prototyping and innovation through group-based tinkering projects. It develops entrepreneurial, creative and critical-thinking abilities while introducing students to intellectual property rights, ethical practices, industry standards, teamwork and communication. The mentoring-based approach enables students to connect ideas with practical applications and develop solutions to identified problems. This is consistent with the existing course objectives and project-oriented structure.
Course Revision/ Approval Date:	
Course Objectives	The course aims to: 1. **Develop** hands-on experience in problem-solving and prototyping through group-based tinkering projects. 2. **Develop** entrepreneurial, creative, and critical-thinking skills among students. 3. **Enhance** students' understanding of industry standards, intellectual property rights, and ethical practices. 4. **Foster** collaboration, teamwork, and communication skills through multidisciplinary group projects. 5. **Expose** students to real-world case studies, expert insights, and best practices in innovation and sustainability.

Course Content (Theory)	Pedagogy	Weightage	Contact hours
Unit 1 Introduction to Entrepreneurship: Understanding the concept, need, myths, and types of entrepreneurship. Importance of entrepreneurship in innovation and problem-solving.	Expert talks, brainstorming sessions, and case studies.	10%	3
Unit 2 Idea Generation and Feasibility Study: Identifying opportunities, developing Minimum Viable Products (MVP), assessing product-market fit, and pricing strategies.	Interactive mentoring sessions, group brainstorming, and discussions.	20%	6
Unit 3 Intellectual Property Rights (IPR): Overview of patents, copyrights, trademarks, and technology transfer. Importance of IPR in securing innovation.	Expert talks and group discussion on real-life case studies.	10%	3
Unit 4 Values, Ethics, and Standards: Importance of values in professional and personal growth. Sustainable solutions, eco-friendly systems, and understanding	Expert talks and group discussion	10%	3

of BIS standards and their role in innovation and industry.			
Unit 5: Tinkering and Prototyping: Hands-on project work in groups to develop solutions for identified problems. Projects will include: Physical Prototypes for engineering and science students. Conceptual Modules (e.g., software, programs) for IT students. Business Cases or Models for management students. Students will work closely with faculty mentors to brainstorm, design, and create functional prototypes or models.	Practical tinkering sessions, faculty mentoring	50%	15

Additional Information to enhance learning:
Expert Talks: Delivered by professionals and industry leaders on topics such as entrepreneurship, IPR, and sustainability.
Hands-On Tinkering Projects: Guided by faculty mentors, with resources provided by GUIITAR.

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the course, students will be able to: CO1: Explain entrepreneurial concepts including business plans, feasibility studies and product-market fit. CO2: Explain the significance of intellectual property rights, ethical practices and sustainability in innovation. CO3: Demonstrate effective teamwork, communication and leadership while participating in multidisciplinary projects. CO4: Apply theoretical knowledge to develop practical solutions through hands-on tinkering, prototyping and mentoring activities.	Cognitive Cognitive Affective Psychomotor	Understand Understand Valuing Guided Response

Learning Resources	
1.	**Reference Books** 1. Eric Ries, The Lean Startup. 2. Peter Thiel, Zero to One. 3. Prabuddha Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy.
2.	**Journals & Periodicals** 5. Harvard Business Review 6. MIT Sloan Management Review

	7. Business Standard 8. Economic Times 9. Forbes
3.	**Codes, Standards & Online Resources** 6. GSFC University – https://www.gsfcuniversity.ac.in/ 7. Harvard Business Review – https://hbr.org/ 8. MIT Sloan Management Review – https://sloanreview.mit.edu/ 9. World Intellectual Property Organization (WIPO) – https://www.wipo.int/ 10. Indian Patent Office – https://ipindia.gov.in/ 11. Bureau of Indian Standards (BIS) – https://www.bis.gov.in/ 12. TED – https://www.ted.com/

Evaluation Scheme	**Total Marks**	
Continuous Evaluation Component Marks	Attendance	10 marks
	Progress Report Presentation – Problem identification, Ideation & Initial Design	15 marks
	Progress Report Presentation - Progress Review and Prototype Development	15 marks
	Expert Session Takeaway Report	10 marks
	Total	**50 Marks**
End Semester Component	Final Project Presentation and Demonstration	30 marks
	Viva-Voce	20 marks
	Total	**50 Marks**

COURSE CODE:	**COURSE NAME:**			**SEMESTER:**			
VACC202	**Introduction to Indian Knowledge System**			II			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	0	0	**2**	2	0	0	**2**

Course Pre-requisites	Nil
Guidelines	Guidelines for Incorporating Indian Knowledge in Higher Education Curricula by UGC (Annexure 1)
Course Category	Value Added Compulsory Course (VACC) – IKS Aligned

Course focus	Indian Knowledge Systems (IKS), Value-Based Leadership and Ethical Development
Rationale	"बुदधि£ानेन शुÚयिÛत" (Buddhi Gyanen Shudhyanti) – Purification of mind and intellect through knowledge. Aligned with GSFC University's vision of fostering an innovation-driven, entrepreneurial, and sustainable mindset, this course introduces undergraduate students to India's rich intellectual heritage. It bridges classical wisdom with modern scientific paradigms, enabling industry readiness, environmental consciousness, and creative problem-solving.
Course Revision/ Approval Date:	14th May, 2026
Course Objectives	The course aims to: 1. Introduce the foundational frameworks, historical evolution, and philosophical pillars of the Indian Knowledge System (IKS). 2. Explore ancient India's contributions to mathematics, astronomy, linguistics, health sciences, and sustainable engineering, demonstrating their modern relevance. 3. Align traditional wisdom with modern applications through case studies, connecting ancestral knowledge with entrepreneurial and contemporary opportunities.

Course Content (Theory)	**Weightage**	**Contact hours**
Unit 1: Introduction to IKS: Definition and characteristics of Indian Knowledge Systems; historical evolution from ancient times to the 18th century CE; impact of colonial education policies and the need for revisiting traditional knowledge; traditional educational institutions including Gurukuls, Pathshalas, Takshashila and Nalanda; local heritage sites and their relevance.	20%	6
Unit 2: Introduction to Ancient Indian Mathematics and Astronomy: Mathematics: ancient numeral systems and mathematical concepts; Indian logic systems and epistemology; overview of Indian astronomy, celestial coordinate systems and calendar systems; astronomical instruments (Yantras) and their application of physics and chemistry.	20%	6
Unit 3: Introduction to Health and Medicine: In-depth study of Ayurveda, its diagnostic methods and therapeutic practices; holistic approach to health encompassing physical, mental and spiritual well-being; application of Ayurveda principles in contemporary healthcare systems; Ayurvedic perspectives on health, dietary regimes, disease management and wellness, including their intersections with botany and medical science.	20%	6
Unit 4: Introduction to Ancient Governance and Public Administration: Ancient Indian governance models and administrative structures; insights from texts such as Arthashastra on statecraft and economics; relevance of traditional governance principles in modern administrative practices; concept of kingship	20%	6

and duties of a monarch; three-tier political system: Dharmadanda, Rajdanda and Nyāyadanda; law and administration, crime suppression, defence systems and foreign policy; concept of wealth, ownership and distribution; Kautilya's Saptanga model; taxation, savings and expenditure in ancient Indian economy.		
Unit 5: Introduction to Ancient Arts and Culture: Traditional Indian art forms including sculpture, dance and music; cultural significance and philosophical underpinnings of these art forms; promotion of cultural heritage through education and practice; temple architecture; cave and monolithic architecture; architectural styles including Chalukya, Pallava, Chola, Hoysala, Mauryan and Vijayanagara; Buddhist and Jain art and architectural heritage.	20%	6

Instructional Method and Pedagogy:
Interactive lectures and discussions, Case-study-based learning, Heritage site visits and field documentation, Group activities and presentations, Innovation and design challenges, Role-play and simulation activities, Vedic mathematics and logic-based problem-solving activities, Comparative analysis of traditional and contemporary practices

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the course, students will be able to: CO1: Understand the foundational structure, historical timeline, and core texts of Indian Knowledge Systems. CO2: Explain ancient Indian contributions to sciences, structural design, public administration, and language mechanics. CO3: Analyze traditional systems of health, including Ayurveda, and ecological balance against contemporary scientific perspectives. CO4: Apply principles of Vastu Shastra, traditional statecraft, and Vedic logic to develop contemporary and sustainable solutions. CO5: Formulate innovative concepts or community-centric projects that synthesize historical knowledge with modern enterprise requirements.	Cognitive	Understand Understand Analyze Appy Create

Learning Resources

1.	**Reference Books** 1. Mahadevan, B., Sivakumar, V. R., & Bhat, M. (2022). Introduction to Indian Knowledge System: Concepts and Applications. PHI Learning. 2. Kapoor, K., & Singh, A. K. (2010). Indian Knowledge System (Vols. 1–2). D.K. Printworld. 3. Jha, A. (2014). Traditional Knowledge System in India. Alpha Science International.
2.	**Journals & Periodicals** 1. Indian Journal of Traditional Knowledge

	2. Journal of Ayurveda and Integrative Medicine 3. Indian Journal of History of Science 4. Journal of Cultural Heritage
3.	**Codes, Standards & Online Resources** 1. IKS Division, Ministry of Education, Government of India – https://iksindia.org 2. National Digital Library of India (NDLI) – https://ndl.iitkgp.ac.in 3. Bharat Vidya / Bhandarkar Oriental Research Institute – https://www.bharatvidya.in 4. SWAYAM – https://swayam.gov.in 5. NPTEL – https://nptel.ac.in

Activities / Experiential Learning	
Activity	**Suggested Practice**
1. Mind-to-Market Innovation Labs	Concept re-engineering of traditional methodologies and development of modern technology/start-up/product concepts.
2. Tarka Shastra & Mathematics Hackathons	Vedic mathematics problem-solving and Paninian linguistic logic activities.
3. Heritage Lab & Eco-Architecture Field Work	Documentation and structural/spatial analysis of local heritage structures and sustainability benchmarking.
4. Arthashastra Governance Simulations	Role-play and simulation of corporate crisis management and regulatory decision-making using Kautilyan frameworks.
5. Charaka & Sushruta Preventive Health Trackers	Study of traditional health concepts and analysis of their relationship with contemporary health practices.
6. Ancient Aesthetics & Metallurgy Showcases	Exploration of traditional aesthetics, material science, metallurgy and their contemporary applications.

Evaluation Scheme	
Component	**Marks**
Mind-to-Market Innovation Project & Pitch	20
Heritage Lab Field Visit & Analytical Report	15
IKS Case Study Analysis (Comparative Study)	15
Vedic Math & Computational Logic Challenge	15
Socratic Classroom Dialogues & Active Participation	15
End-Semester Integrative Term Project/Paper	20
Total	**100**

Semester III

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
											Theory Marks				Practical Marks	**Total Marks**
			L	P	T	***Total***	L	P	T	**Total**	MS	CEC	ES	***Total***		
1	AECC311	Entrepreneurship Development	2	-	-	***2***	2	-	-	**2**	20	40	40	***100***	--	**100**
2	BTFS311	Safety Management I	3	-	-	***3***	3	-	-	**3**	20	40	40	***100***	--	**100**
3	BTFS313	Town Planning & Building Design	3	2	-	***5***	3	1	-	**4**	20	40	40	***100***	50	**150**
4	BTFS314	Strength of Materials	3	2	-	***5***	3	1	-	**4**	20	40	40	***100***	50	**150**
5	BTFS315	Machine Design & Industrial Drafting	4	2	-	***6***	4	1	-	**5**	20	40	40	***100***	50	**150**
6	BTFS316	Fire drills & Practical	-	4	-	***4***	-	2	-	**2**	--	--	--	**--**	50	**50**
7	BTFS317	Industrial Internship	-	-	-	***-***	-	2	-	**2**	--	--	--	**--**	100	**100**
8	BTFS318	Fire Service Operations	3	-	-	***3***	3	-	-	**3**	20	40	40	***100***	--	**100**
9	BTMA301	Mathematics III	3	-	1	***4***	3	-	1	**4**	20	40	40	***100***	--	**100**
		Total				***32***				**29**						**1000**

Note: L = Lecture, **P** = Practice, **T=** Tutorial, **MS -** Mid Semester, **CEC -** Continuous Evaluation Component**, ES -** End Semester

COURSE CODE:	COURSE NAME:			SEMESTER:			
AECC311	Entrepreneurship Development			III			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	0	0	**2**	2	0	0	**2**
Course Pre-requisites	Nil						
Course Category	Ability Enhancement Compulsory Course						
Course focus	The course focuses on developing entrepreneurial mindset, innovation, creativity, critical thinking, and startup development skills through experiential and industry-oriented learning. It enables students to identify real-world problems, validate customer needs, design innovative solutions, develop prototypes, and understand business modelling, marketing strategies, financial planning, and venture pitching. The course emphasizes practical learning, teamwork, leadership, and innovation-driven entrepreneurship aligned with emerging industry and startup ecosystem requirements.						
Rationale	The course is designed to foster entrepreneurial thinking, innovation, leadership, and problem-solving skills among students through practice oriented, experiential, application-based learning. It enables learners to identify opportunities, validate customer needs, develop innovative solutions, and understand startup creation, business modelling, financial planning, and venture feasibility. The course also supports employability, self-employment, and startup creation in alignment with NEP 2020 and the innovation ecosystem.						
Course Revision/ Approval Date:	**14th May, 2026**						
Course Objectives	The course aims to: 1. To understand entrepreneurship, innovation, and opportunity identification processes. 2. To enable students to identify and validate real-world problems and customer needs. 3. To equip students with skills to develop innovative solutions and prototype-based approaches for venture creation. 4. To impart knowledge of business models, marketing strategies, and financial planning for venture creation. 5. To develop competencies in venture feasibility analysis, teamwork, and effective communication through presentations.						

Course Content (Theory)	Weightage	Contact hours
Orientation 1. Introduction to entrepreneurship, innovation, and subject expectations 2. Understanding the Venture Journey and learning approach **Topics 1: Problem Identification** 1. Develop Macro Industry–Problem Perspective: Industry analysis, domains, trends, and opportunity identification 2. Assemble Real-World Problems: Identifying real-life problems using market and user insights 3. Examine Chosen Problems: Filtering problems based on relevance, impact, and feasibility 4. Analyze Problems: Root cause analysis (5-Why), impact assessment, and problem validation	15%	4
Topics 2: Customer Identification & Needs Validation 1. Identify Customer Segments: Market segmentation (demographic, psychographic, behavioural, geographic) 2. Assess Jobs-To-Be-Done (JTBD) framework: Understanding customer needs and motivations 3. Develop Customer Persona: Creating detailed customer profiles 4. Understand Customer Validation: Surveys, interviews, and validation techniques 5. Validate Customer–Problem Fit: Matching problem with real customer need 6. Pivot/Refine Customer–Problem Fit: Iterative improvement based on feedback	10%	3
Topics 3: Solution Idea Generation 1. Examine Ideation Techniques: Brainstorming, design thinking, creativity tools 2. Generate Solution Ideas: Developing innovative and feasible solutions	8%	2
Topics 4: Opportunity and Competition Mapping 1. Identify Global Competitors: Competitive landscape analysis 2. Review Industry Trends & Estimate Market: Size (TAM, SAM, SOM) and Basics of Market Assessment 3. Introduction to Financial Planning: Basic financial concepts for startups	8%	2
Topics 5: Prototype Development & MVP 1. Overview of Prototypes & MVP 2. Build Initial Prototype (PoC) 3. Prototype for Early Validation: Testing and iteration with users	10%	3

Topics 6: Opportunity (Feasibility) Assessment 1. Map Relative Market Position 2. Estimate Opportunity Size: Feasibility analysis and validation	8%	2
Topics 7: Business Modelling 1. Examine Revenue Models 2. Revenue Models (continued) 3. Review and Organize Lean Canvas 4. Develop Lean Canvas for Startup	10%	3
Topics 8: Marketing and Sales Strategy 1. Understand Marketing & Sales Fundamentals 2. Recommend Go-To-Market (GTM) Strategy 3. Map Sales Process	8%	2
Topics 9: Financial Management for Profitability 1. Deep Dive into Financial Planning including Cash Flow and Break-Even Analysis 2. Analyze Path to Profitability 3. Bootstrapping and Funding Options: Venture capital, angel funding, government schemes	10%	3
Topics 10: Team and Talent Requirements 1. Identifying Co-founders and Mentors 2. Building an Initial Team: Roles, responsibilities, and team dynamics	5%	2
Topics 11: Venture Idea, Pitch Readiness and Responsible Entrepreneurship 1. Scaling Opportunity & Growth Orientation 2. Persuasive Storytelling for Entrepreneurial Pitching o Pitch structure and communication skills o Overview of support ecosystems and schemes: Incubation Centres, Startup India, Stand-Up India, Startup Gujarat, MSMEs, Student Startup and Innovation Policy (SSIP), and MUDRA Scheme.	8%	4

Instructional Method and Pedagogy:

The course will employ a combination of instructional methods, including lectures, case studies, group discussions, role plays, games, quizzes, presentations, hackathons, field visits, startup interviews as experiential learning activities, and venture creation activities to enhance entrepreneurial thinking, innovation, and practical problem-solving skills among students.

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:	Cognitive	

CO1: **Analyze** industry trends and entrepreneurial opportunities. CO2: **Identify and validate** customer segments, needs, and problem–solution fit using appropriate tools and techniques. CO3: **Develop** innovative solutions and prototypes. CO4: **Apply** business models, marketing strategies, and financial planning for venture creation. CO5: **Evaluate** venture feasibility using data driven pitch presentations.		Analyze Apply Create Apply Evaluate

Learning Resources	
1.	**Reference Books** 1. Entrepreneurship; Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha; McGraw Hill Education. 2. Entrepreneurial Development; S. S. Khanka; S. Chand Publications. 3. The Lean Startup; Eric Ries; Crown Business. 4. Business Model Generation; Alexander Osterwalder and Yves Pigneur; Wiley Publications. 5. Entrepreneurship: Successfully Launching New Ventures; Bruce R. Barringer and R. Duane; Pearson Education. 6. Entrepreneurship: Theory, Process and Practice; Donald F Kuratko; Cengage Learning. 7. Innovation and Entrepreneurship; Peter F. Drucker; Harper Business. 8. The Startup Owner's Manual; Steve Blank and Bob Dorf; Gildan Media (Publisher) 9. Managing Innovation; Tidd, J. & Bessant, J.; Wiley Publications. 10. Technology Ventures, Thomas H. Byers, Richard C. Dorf and Andrew J. Nelson; McGraw Hill.
2.	**Journals & Periodicals** 1. Journal of Entrepreneurship – SAGE Publications 2. Entrepreneurship Theory and Practice – Wiley Publications 3. International Journal of Innovation Management – World Scientific Publishing 4. Harvard Business Review – Harvard Business Publishing 5. Journal of Small Business Management – Wiley Publications 6. Technovation – Elsevier Publications 7. Journal of Business Venturing – Elsevier Publications 8. International Entrepreneurship and Management Journal – Springer Publications 9. Small Business Economics – Springer Publications 10. Indian Management – All India Management Association (AIMA)
3.	**Other Electronic Resources** 1. Wadhwani Foundation Entrepreneurship Learning Portal 2. Startup India Portal 3. MSME Ministry Portal 4. Invest India 5. Google for Startups 6. GUITAR council, GSFC University

Evaluation Scheme	**Total Marks**

Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Participation and Entrepreneurial Engagement	05 marks
	Conceptual and Application-Based Quizzes	10 marks
	Rubric-Based Venture Pitch Evaluation (Viva)	15 marks
	Total	**40 Marks**

COURSE CODE:		**COURSE NAME:**		**SEMESTER:**			
BTFS311		**Safety Management I**		**III**			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	**3**	3	0	0	**3**

Course Pre-requisites	Fundamentals of Fire & Environment, Health, Safety
Course Category	Professional Core
Course focus	Skill Development
Rationale	The primary objective of safety management is to ensure the safety and well-being of individuals. By implementing effective safety measures, organizations demonstrate their commitment to protecting human life and minimizing harm. Compliance with safety regulations and standards is not only a moral obligation but also a legal requirement for organizations. Governments and regulatory bodies impose safety regulations to protect workers, consumers, and the public. Safety management provides a framework for organizations to identify and address potential hazards, ensuring compliance with applicable laws and regulations. Accidents and incidents can have severe financial implications for organizations. They can result in property damage, production delays, litigation costs, fines, and reputational damage.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	To enable the student to: 1. Explain the evolution of safety concepts, accident causation theories and modern Occupational Health, Safety and Environment (OHSE) philosophy. 2. Explain the principles of safety management, organizational structure, leadership and communication for effective safety performance.

	3. Apply management functions, safety management systems and training techniques in workplace safety management. 4. Explain the role of employee participation, safety promotion and economic aspects in improving organizational safety performance. 5. Apply Safety Management Information Systems (MIS) and digital tools for monitoring, analysis and continual improvement of safety performance.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Safety Fundamentals: Evolution of safety concepts. Need, nature and importance of safety management. Development from accident prevention to Occupational Health, Safety and Environment (OHSE).Challenges of Industrial Safety. Safety terminology including incident, accident, near miss, hazard, risk and Major Accident Hazard (MAH). Accident causation theories (Heinrich Domino Theory, Bird's Triangle, Swiss Cheese Model). Five Fundamentals and Five Es of Accident Prevention. Introduction to Safety Philosophy and Safety Culture.	20%	10
Unit 2: Safety Organization & Leadership: Planning, organizing and directing for safety. Safety policy formulation and implementation. Management by Objectives (MBO). Structure and functions of SHE department. Roles of management, supervisors, workers and trade unions. Leadership styles in safety management. Communication, group dynamics and team building for effective safety management.	20%	10
Unit 3: Safety Control & Training: Controlling functions in safety management. Management by Exception (MBE). Safety performance monitoring and auditing. Safety standards and management systems (ISO 45001, ISO 14001,IS 14489,ILO,WHO). Safety education and training. Training needs assessment, training cycle, modern training methods, competency development, Behaviour-Based Safety (BBS), multimedia and digital learning tools. Employee participation and Safety committee	20%	09
Unit 4: Safety Promotion & Economics: Employee participation in safety. Safety committees. Safety promotion and publicity programs. Safety suggestion schemes, incentives, awards and recognition. Compliance and behavioral interventions. Economics of safety including direct and indirect accident costs, cost-benefit analysis, safety budgeting and financial justification of safety programs.	20%	08
Unit 5: Safety Information Systems: Safety Management Information System (MIS). Sources, collection, compilation, analysis and benchmarking of SHE information. Computerized MIS, software applications, data management, limitations and failure of MIS.	20%	08

Integration of departmental MIS. Digital safety management, dashboards and future trends in SHE information systems.		

Instructional Method and Pedagogy: PPT, Video Presentation, Chalk board, Case study

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: **CO1: Explain** the evolution of safety concepts, accident causation theories and modern OHSE philosophy. **CO2: Explain** organizational structure, leadership, communication and management principles in safety management. **CO3: Apply** safety management functions, safety management systems and training methods for workplace safety. **CO4: Explain** employee participation, safety promotion and economic principles in organizational safety management. **CO5: Apply** Safety Management Information Systems (MIS) and digital tools for monitoring and improving safety performance.	Cognitive	Understand Understand Apply Understand Apply

Learning Resources	
1.	Reference Books:. 1. Roger L. Brauer, Safety and Health for Engineers, 3rd Edition, Wiley. 2. National Safety Council, Accident Prevention Manual for Business & Industry: Administration & Programs, 14th Edition. 3. International Labour Organization (ILO), Encyclopaedia of Occupational Health and Safety, 4th Edition, ILO, Geneva. 4. Charles D. Reese, Occupational Health and Safety Management: A Practical Approach, 4th Edition, CRC Press. 5. R. K. Jain, Industrial Safety, Health and Environment Management Systems, Khanna Publishers. 6. David L. Goetsch, Occupational Safety and Health for Technologists, Engineers and Managers, 9th Edition, Pearson.
2.	**Journals & Periodicals** 1. Safety Science (Elsevier) 2. Journal of Safety Research (Elsevier) 3. Safety and Health at Work (Elsevier) 4. International Journal of Occupational Safety and Ergonomics (Taylor & Francis) 5. Journal of Occupational Health (Wiley)
3.	**Codes, Standards & Online Resources** 1. ISO 45001:2018 – Occupational Health and Safety Management Systems - https://www.iso.org/iso-45001-occupational-health-and-safety.html

	2. ISO 14001:2015 – Environmental Management Systems - https://www.iso.org/iso-14001-environmental-management.html 3. Occupational Safety, Health and Working Conditions Code, 2020 - https://labour.gov.in 4. International Labour Organization (ILO) – Safety and Health at Work - https://www.ilo.org/safework 5. Occupational Safety and Health Administration (OSHA) - https://www.osha.gov 6. National Institute for Occupational Safety and Health (NIOSH) - https://www.cdc.gov/niosh 7. Bureau of Indian Standards (BIS) - https://www.bis.gov.in 8. International Organization for Standardization (ISO) - https://www.iso.org

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	**COURSE NAME:**			**SEMESTER:**			
BTFS313	**Town Planning and Building Design**			**III**			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	**5**	3	1	0	**4**

Course Pre-requisites	Engineering Graphics
Course Category	Engineering Science
Course focus	Skill Development
Rationale	To create functional, sustainable, and aesthetically pleasing communities. It involves the careful consideration of various factors, including population growth, land use, transportation, infrastructure, environmental impact, and social needs. Own planning aims to optimize land use by allocating different areas for residential, commercial, industrial, and recreational purposes. This ensures that land is utilized effectively and

	minimizes sprawl, reducing the need for long commutes and preserving natural areas. Proper town planning considers the provision of essential infrastructure and services such as roads, utilities (water, electricity, gas), schools, hospitals, parks, and public spaces. By strategically locating these facilities, planners can improve accessibility, enhance quality of life, and promote community well-being. An effective town plan incorporates transportation systems that facilitate easy movement within and between communities.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	To enable the student to: 1. Explain building drawings, symbols, conventions and building services used in planning. 2. Explain building planning principles, National Building Code provisions and development control regulations. 3. Explain the principles of town planning and housing development. 4. Analyze hazard, risk and vulnerability considerations in land use and urban planning. 5. Explain planning requirements for public buildings with emphasis on fire, life safety and accessibility.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Building Drawings & Services: Types of building drawings, appropriate scales and standard paper sizes. Index map, key plan, site plan and layout plan. Types of projections adopted in building drawings. Symbols, conventions and abbreviations for electrical fittings, water supply, sanitary fittings and construction materials. Classification of buildings. Introduction to building services including water supply, drainage, electrification, lighting, ventilation, staircases, fire safety provisions, thermal insulation and acoustics.	20%	8
Unit 2: Building Planning & Regulations: Principles of building planning and architectural composition. National Building Code (NBC 2016) and General Development Control Regulations (GDCR). Building by-laws for residential, commercial, institutional and industrial buildings. Floor Space Index (FSI), setbacks and open space requirements. Planning of detached, semi-detached, row houses and apartments. Introduction to CAD/BIM applications in building planning. Working drawings and perspective views.	20%	12
Unit 3: Town Planning & Housing: Principles and objectives of town planning. Planning surveys and site selection. Topography, drainage, water supply and transportation planning. Urban road hierarchy and communication networks. Housing development including detached, semi-detached, group housing, apartments, warehousing and commercial complexes. Housing layouts considering site orientation, aesthetics and fire safety requirements.	20%	12
Unit 4: Risk-Informed Urban Planning: Hazard, risk and vulnerability assessment in urban planning. Risk-informed land use planning and	20%	8

zoning. Components of town planning including neighbourhood planning, Central Business District (CBD), road networks and development controls. Slum formation and redevelopment. Smart and sustainable cities. Disaster-resilient urban planning and climate-resilient infrastructure.		
Unit 5: Planning of Public Buildings: Planning considerations for educational institutions, hospitals, hotels, office buildings, shopping complexes, cinema theatres and high-rise buildings. Occupancy classification, means of egress, accessibility, fire and life safety requirements as per National Building Code. Case studies on planning and fire safety provisions in public buildings.	20%	5

List Of Practical	**Weightage**	**Contact hours**
1. Four A1 Size Drawing sheet: Residential Planning: Single storied Building: Plans, elevation, section lay-out plan, key plan, site plan, area table, schedule of opening. Scale-1:100.	20%	6
2. Residential Planning: Two storied Building: Plans, elevation, section, lay- out plan, key plan, site plan, area table, schedule of opening. Scale-1:100.	20%	6
3. Public Building school plan: Ground Floor plan, typical floor plan, elevation, section, lay-out plan, key plan, site plan, area table, schedule of opening.	20%	6
4. Public Building public health center plan: Ground Floor plan, typical floor plan elevation, section, lay-out plan, key plan, site plan, area table, schedule of opening.	20%	6
5. Working Drawing: sheet should accommodate min. six types with sectional details. (Furniture plan, Drainage lay out, Toilet Detail, Woodwork detail, Kitchen detail Electrical plan etc). Perspective Drawing: Two-point perspective of sheet -1 planning.	20%	6

Instructional Method and Pedagogy: Power Point Presentation ,Case study

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: **CO1: Explain** building drawings, symbols, conventions and building services used in planning. **CO2: Explain** building planning principles, NBC provisions and development control regulations. **CO3: Explain** town planning concepts and housing development principles. **CO4: Analyze** hazard, risk and vulnerability aspects in urban and land use planning.	Cognitive	Understand Understand Understand Analyze

CO5: Explain planning requirements for public buildings with emphasis on fire and life safety.		Understand

Learning Resources	
1.	Reference Books:. 1. Town Planning by G. K. Hiraskar 2. National Building Code-2005, New Delhi 3. Building Planning, Designing and scheduling by Gurucharan Singh, Standard Book House, New Delhi 4. General Development Control Regulations published by AUDA and GICEA 5. Town Planning by S.C. Rangwala, Charotar publishing House, Anand
2.	**Journals & Periodicals**
3.	**Codes, Standards & Online Resources**

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

COURSE CODE:	**COURSE NAME:**	**SEMESTER:**
BTFS314	**Strength of Materials**	III

Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	**5**	3	1	0	**4**

Course Pre-requisites	**Engineering Mechanics**
Course Category	Engineering Science
Course focus	Skill Development
Rationale	The strength of materials is crucial for ensuring the structural integrity of various applications, such as buildings, bridges, aircraft, vehicles, and machinery. By analyzing and predicting the strength of materials, engineers can design structures that can safely carry anticipated loads and stresses without collapsing or deforming excessively. Understanding the strength of materials is essential for ensuring the safety and reliability of structures and components. By accurately assessing the strength properties of materials, engineers can determine their maximum load- carrying capacities and establish appropriate safety factors to prevent catastrophic failures. Different materials exhibit varying strengths, and selecting the appropriate material for a particular application requires a thorough understanding of their strength properties.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain the fundamental concepts of stress, strain and elastic behaviour of materials. 2. Analyze compound stress–strain systems and determine principal stresses and strains. 3. Analyze internal forces in beams subjected to various loading conditions. 4. Apply bending theory to determine stresses and deflection in beams. 5. Analyze torsional behaviour and combined bending–torsion of circular shafts.

Course Content (Theory)	**Weightage**	**Contact hours**
Unit 1: Simple Stress & Strain: Introduction to stress and strain. Stress–strain behaviour of materials. Elasticity and plasticity. Hooke's law. Working stress. Lateral strain, Poisson's ratio and volumetric strain. Bars of varying sections. Composite bars. Temperature stresses. Strain energy and resilience. Gradual, sudden, impact and shock loading. Engineering applications.	20%	9 hours
Unit 2: Compound Stress & Strain: Two-dimensional stress–strain system. Stress transformation. Principal stresses and principal planes. Mohr's Circle. Principal strains and principal axes. Relationship between elastic constants. Engineering applications.	20%	9 hours
Unit 3: Shear Force & Bending Moment: Shear force and bending moment diagrams for cantilever, simply supported, fixed and overhanging beams. Concentrated loads, UDL and UVL. Maximum	20%	9 hours

shear force, maximum bending moment and point of contraflexure. Engineering applications.		
Unit 4: Beam Bending & Deflection: Theory of simple bending. Assumptions. Neutral axis. Bending stresses. Section modulus of standard sections. Design of simple beam sections. Shear stress distribution in beam sections. Beam deflection using standard methods. Engineering applications.	20%	9 hours
Unit 5: Torsion of Shafts: Theory of pure torsion. Torsion equation. Solid and hollow shafts. Torsional rigidity. Power transmission by shafts. Shafts in series and parallel. Combined bending and torsion. Engineering applications.	20%	9 hours

List Of Practical	**Weightage**	**Contact hours**
1. To study the Universal Testing Machine (UTM) and perform the tensile test	20%	5
2. To perform compression test on Compression Testing Machine (CTM).	15%	5
3. To study the Izod Impact Testing machine and perform Izod impact test.	15%	4
4. To study the Charpy Impact Testing machine and perform Charpy impact test.	15%	4
5. To study the Brinell Hardness testing machine and perform Brinell hardness test.	15%	4
6. To perform torsion test on mild steel rod.	10%	4
7. To perform the bending test on UTM.	10%	4

Instructional Method and Pedagogy: PPT, Chalkboard, Animated Videos, Tutorial

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to:	Cognitive	
CO1: Analyze simple stress–strain behaviour and strain energy in structural members.		Analyze
CO2: Analyze compound stress–strain systems and determine principal stresses and strains.		Analyze
CO3: Analyze shear force and bending moment in beams under different loading conditions.		Analyze
CO4: Apply bending theory to determine stresses and deflection of beams.		Apply

CO5: Analyze torsional behaviour and combined bending–torsion of circular shafts.		Analyze

Learning Resources	
1.	**Reference Books** 1. Timoshenko, S. and Young, D. H., Elements of Strength of Materials, DVNC, New York, USA. 2. Hibbeler, R. C. Mechanics of Materials, East Rutherford, NJ: Pearson Prentice Hall, 2004 3. Ferdinand P. Beer, E. Russel Jhonston Jr., John T. DEwolf, Mechanics of Materials, TMH 2002. 4. Egar P. Popov and Toader A . Balan, Engineering Mechanics of Solids, Pretice Hall of India Pvt Ltd, New Delhi, 2002. 5. Ramamrutham S, Strength of materials, Dhanpat Rai, New Delhi. 6. Bhavikatti S, Strength of Materials, Vikas Publication House, New Delhi,2007 7. R. K. Bansal, Strength of materials, Laxmi Publication
2.	**Journals & Periodicals** 1. Mechanics Based Design of Structures and Machines 2. Engineering Structures 3. Journal of Computational Design and Engineering
3.	**Codes, Standards & Online Resources**

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

COURSE CODE:	COURSE NAME:	SEMESTER:
BTFS315	**Machine Design & Industrial Drafting**	III

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
4	2	0	**6**	4	1	0	**5**

Course Pre-requisites	Engineering Mechanics
Course Category	Engineering Science
Course focus	Skill Development
Rationale	Machine design aims to create machines and mechanical systems that fulfill specific functions and requirements. By considering the intended purpose, engineers can design machines that operate efficiently and reliably. Industrial drafting, on the other hand, helps in visualizing and documenting the design, ensuring that all components fit together and function properly. Machine design focuses on optimizing the efficiency and performance of machines. By considering factors such as power transmission, motion control, material selection, and manufacturing processes, engineers can design machines that maximize output while minimizing energy consumption and operational costs. Industrial drafting helps in visualizing the design layout, identifying potential bottlenecks, and optimizing the arrangement of components to achieve better performance. Machine design and industrial drafting serve as a common language between engineers, manufacturers, and other stakeholders involved in the production process. Drafting standards, such as those specified by ISO (International Organization for Standardization), ensure consistency and clarity in conveying design information.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain fundamental concepts, procedures and material selection criteria in machine design. 2. Analyze stresses and failure considerations in machine elements under different loading conditions. 3. Apply design principles to common machine components such as joints, shafts, keys and couplings. 4. Apply industrial drafting standards and CAD tools to prepare production drawings. 5. Design basic machine elements and pressure vessels using relevant standards and codes.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Machine Design Fundamentals: Design philosophy and design procedure; Design considerations and selection criteria; Conventional and CAD-based design; Engineering materials, material selection and IS designation; Factor of safety; Types of stresses (tensile, compressive, shear, bending, bearing, crushing, eccentric, principal, residual and thermal stresses); Stress concentration and methods of stress relief; Introduction to Design for Manufacturability (DFM) and Design for Reliability (DFR).	20%	12
Unit 2: Design of Joints: Cotter joints (spigot and socket, sleeve and gib & cotter joints); Knuckle joints and failure modes; Turnbuckles; Riveted joints (types, strength, efficiency and boiler joints); Welded joints (types, stresses, design under direct, shear, torsional and eccentric loading); Welding symbols and engineering applications.	20%	12
Unit 3: Design of Shafts: Classification and selection of shafts; Design of solid and hollow shafts; Shafts under torsion, bending and combined loading; Shafts subjected to axial and fluctuating loads; Design for rigidity, stiffness and critical speed; Flexible shafts; Introduction to standard design practices for shafts.	20%	12
Unit 4: Keys, Couplings & Levers: Classification and design of keys; Design of levers (safety valve lever, bell crank lever and rocker arm); Design of rigid couplings (muff, clamp and flange couplings); Flexible couplings and Oldham coupling; Design considerations and engineering applications.	20%	12
Unit 5: Pressure Vessel Design: Classification of pressure vessels; Design of thin cylindrical and spherical pressure vessels; Thick and compound cylinders; Cylinders subjected to internal and external pressure; Joint efficiency and end closures; Failure theories; Prestressed cylinders; Introduction to ASME Boiler & Pressure Vessel Code (BPVC) and relevant Indian Standards.	20%	12
List Of Practical	**Weightage**	**Contact hours**
1. Preparation of orthographic and sectional views of basic machine components using standard drawing conventions.	20%	5
2. Assembly drawings of engine components such as cylinder, piston, connecting rod, crankshaft, stuffing box, crosshead and eccentric.	20%	5
3. Assembly drawings of machine elements such as screw jack, machine vice, plummer block and tailstock.	20%	5
4. Assembly drawings of valves including steam stop valve, spring-loaded safety valve, feed check valve and air cock.	20%	5
5. Preparation of production drawings incorporating limits, fits, tolerances, geometric dimensioning and tolerancing (GD&T), bill of materials (BOM) and surface finish symbols.	20%	10

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
CO1: Explain design concepts, material properties and stress considerations in machine elements	Cognitive	Understand
CO2: Analyze stresses and failure modes in machine components under different loading conditions		Analyze
CO3: Apply design procedures to joints, shafts, keys and couplings		Apply
CO4: Apply CAD tools and drafting standards to prepare industrial production drawings		Apply
CO5: Design basic machine elements and pressure vessels using standard design practices		Create

Learning Resources

1.	**Reference Books** 1. P. C. Sharma and D. K. Agarwal, Machine Design, S. K. Kataria & Sons. 2. R. S. Khurmi and J. K. Gupta, A Textbook of Machine Design, S. Chand Publishing. 3. V. B. Bhandari, Design of Machine Elements, McGraw Hill Education. 4. N. D. Bhatt and V. M. Panchal, Machine Drawing, Charotar Publishing House. 5. K. L. Narayana, P. Kannaiah and K. Venkata Reddy, Machine Drawing, New Age International Publishers. 6. Joseph Edward Shigley, Charles R. Mischke and Richard G. Budynas, Shigley's Mechanical Engineering Design, McGraw Hill Education.
2.	**Journals & Periodicals** 1. Journal of Mechanical Design (ASME) 2. Mechanism and Machine Theory (Elsevier) 3. Journal of Computational Design and Engineering 4. Engineering Optimization 5. Engineering with Computers
3.	**Other Electronic Resources** 1. ASME Boiler and Pressure Vessel Code (BPVC) – Official Information and Standards 2. ASME Y14 Standards (Engineering Drawing & GD&T) – Official Standards Portal

Evaluation Scheme	Total Marks	
Theory: Mid semester Marks	**20 marks**	
Theory: End Semester Marks	**40 marks**	
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks

	Article review	10 marks
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

COURSE CODE:		**COURSE NAME:**		**SEMESTER:**			
BTFS316		**Fire Drill Practical**		III			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
0	4	0	**4**	0	2	0	**2**
Course Pre-requisites	Fundamentals In Fire & Environment, Health, Safety						
Course Category	Program Core – Laboratory / Skill-based						
Course focus	Development of practical firefighting skills, rescue techniques, operation of fire protection equipment, emergency response, teamwork, leadership, and compliance with standard fire service practices through hands-on training and simulated emergency drills.						
Rationale	Fire drills and practical training are essential for developing the operational competencies required by fire and safety professionals. This course provides systematic hands-on training in firefighting, rescue operations, fire protection systems, emergency response, and industrial fire safety through progressive practical sessions. The curriculum develops technical proficiency in operating firefighting equipment, conducting rescue operations, responding to emergencies, and managing fire incidents while emphasizing discipline, teamwork, communication, leadership, safety practices, and adherence to national and international fire service standards. The course bridges theoretical concepts with field applications, preparing students for careers in industrial fire services, municipal fire brigades, airport fire services, emergency response organizations, and disaster management.							

Course Revision/ Approval Date:	
Course Objectives	The course aims to: 1. Develop competency in firefighting drills, rescue techniques, and emergency response operations using standard firefighting procedures. 2. Demonstrate safe operation, inspection, maintenance, and application of firefighting equipment, appliances, and fire protection systems. 3. Apply standard operating procedures for fire suppression, rescue, evacuation, and emergency response in residential, commercial, and industrial environments. 4. Develop teamwork, leadership, communication, discipline, and decision-making skills during firefighting and rescue operations. 5. Perform firefighting, rescue, and emergency management activities in accordance with national and international fire service standards and professional ethics.

Course Content (Theory)	**Weightage**	**Contact hours**
1. Drill Commands & Manual Drill: Aim of drill; Principles of instruction; Words of command; Position of fireman; Saluting; Manual drill	10%	8
2. PPE, Squad Drill & Inspection: Personal protective equipment; Squad drill; Inspection procedures	10%	8
3. Portable Fire Extinguishers: Introduction; Classification; Operation of portable fire extinguishers	15%	7
4. Knots & Lines: Fire service ropes; Knots; Line handling	10%	7
5. Hose & Hydrant Drill: Hose drill; Three-men hydrant drill	20%	10
6. Casualty Handling & Equipment Maintenance: Picking up an insensible person; Examination and cleaning of fire service equipment	10%	7
7. Fire & Emergency Evacuation Drill: Apartment building evacuation drill	15%	6
8. Rescue Appliances Demonstration: Rescue equipment and appliance demonstrations	10%	7

Instructional Method and Pedagogy:
Demonstration, Hands-on Practice, Drill Simulation, Group Exercise, Field Visit

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to:		

CO1 Demonstrate drill commands, discipline, teamwork, and safe operation of basic firefighting equipment during fire service activities.	Psychomotor	Apply
CO2 Perform firefighting, rescue, evacuation, and casualty handling operations using appropriate equipment and standard operating procedures.	Psychomotor	Apply
CO3 Operate and inspect portable and fixed fire protection systems, firefighting appliances, ladders, pumps, and rescue equipment during emergency response.	Psychomotor	Apply
CO4 Analyze emergency situations and execute appropriate firefighting, rescue, and incident response techniques while ensuring personal and team safety.	Cognitive	Analyze
CO5 Demonstrate professional competency, leadership, communication, discipline, and ethical practices while participating in fire drills, mock exercises, and emergency management activities.	Affective	Apply

Learning Resources	
1.	**Reference Books** 1. Fire Service Manual – Volume I: Fire Service Drill, Ministry of Home Affairs, Government of India. 2. Fire Service Manual – Volume II: Fire Service Equipment, Ministry of Home Affairs, Government of India. 3. IFSTA, Essentials of Fire Fighting, 7th Edition, Fire Protection Publications. 4. Arthur E. Cote (Ed.), NFPA Fire Protection Handbook, Latest Edition. 5. V. K. Jain, Fire Safety in Buildings, New Age International Publishers.
2.	**Journals & Periodicals** 1. Fire Technology 2. Fire Safety Journal 3. Journal of Fire Sciences 4. Fire Engineering Magazine
3.	**Codes, Standards & Online Resources** 1. National Building Code of India 2016 – Part 4: Fire and Life Safety - https://www.bis.gov.in/national-building-code/ 2. National Fire Protection Association (NFPA) – Codes & Standards - https://www.nfpa.org/codes-and-standards 3. International Fire Service Training Association (IFSTA) - https://www.ifsta.org 4. Society of Fire Protection Engineers (SFPE) - https://www.sfpe.org

Evaluation Scheme	**Total Marks**	
Practical Marks	Attendance	05 marks

	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

COURSE CODE:	**COURSE NAME:**			**SEMESTER:**			
BTMA301	**Mathematics – III**			III			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	1	**4**	3	0	1	**4**

Course Pre-requisites	Mathematics II
Course Category	Basic Science
Course focus	Skill Development
Rationale	Mathematics-III equips students with advanced mathematical techniques required for modelling, analyzing, and solving complex engineering problems. The course introduces complex analysis, partial differential equations, Fourier series, probability, and statistics, which are extensively applied in engineering, data analysis, signal processing, heat transfer, reliability engineering, and computational sciences. The tutorial component enhances analytical thinking and problem-solving skills through structured numerical exercises.
Course Revision/ Approval Date:	5th March 2024
Course Objectives	The course aims to: 1. Apply complex variable theory and contour integration techniques to engineering problems. 2. Solve partial differential equations arising in engineering and physical systems. 3. Represent periodic functions using Fourier series and apply them in engineering analysis. 4. Apply probability concepts to engineering uncertainty and reliability analysis.

	5. Analyze engineering data using statistical techniques and probability distributions.

Course Content (Theory)	Weightage	Contact hours
Unit I: Complex Analysis: Complex numbers; Polar form; Analytic functions; Cauchy-Riemann equations; Harmonic functions; Cauchy's integral theorem; Cauchy's integral formula; Taylor and Laurent series; Singularities; Residue theorem; Evaluation of real integrals.	20%	9
Unit II: Partial Differential Equations: Formation of partial differential equations; First-order PDEs; Linear and non-linear PDEs; Method of separation of variables; One-dimensional heat equation; Wave equation; Two-dimensional heat equation; Engineering applications.	20%	9
Unit III: Fourier Series: Periodic functions; Fourier series; Euler's formulae; Half-range sine and cosine series; Harmonic analysis; Fourier series solutions of engineering problems; Applications in signal processing and heat transfer.	20%	9
Unit IV: Probability Theory: Probability concepts; Conditional probability; Bayes' theorem; Random variables; Probability distributions; Mathematical expectation; Variance; Engineering applications in reliability and risk analysis.	20%	9
Unit V: Statistics and Engineering Data Analysis: Measures of central tendency and dispersion; Correlation; Regression; Binomial, Poisson and Normal distributions; Sampling concepts; Statistical quality control (introductory); Engineering applications.	20%	9

Tutorial Activity	Weightage	Contact Hours
1. Problem solving on complex analysis and contour integration	20%	3
2. Numerical problems on partial differential equations	20%	3
3. Tutorial on Fourier series and engineering applications	20%	3
4. Probability and random variable exercises	20%	3
5. Statistical analysis and probability distribution problems	20%	3

Instructional Method and Pedagogy:
Chalk board, Tutorial

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain

After successful completion of the above course, students will be able to: CO1 Apply complex variable techniques and residue theory to solve engineering problems. CO2 Solve partial differential equations governing engineering and physical systems. CO3 Represent periodic functions using Fourier series and apply them to engineering applications. CO4 Apply probability concepts and random variables in engineering uncertainty and reliability analysis. CO5 Analyze engineering data using statistical methods and probability distributions for informed decision-making.	Cognitive	Apply Apply Apply Apply Analyze

Learning Resources	
1.	**Reference Books** 1. Erwin Kreyszig, *Advanced Engineering Mathematics*, 10th Edition, Wiley. 2. R.V. Churchill & J.W. Brown, *Complex Variables and Applications*, McGraw-Hill. 3. W.E. Boyce & R.C. DiPrima, *Elementary Differential Equations and Boundary Value Problems*, Wiley. 4. Sheldon M. Ross, *Introduction to Probability and Statistics for Engineers and Scientists*, Academic Press. 5. B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers.
2.	**Journals & Periodicals** 1. SIAM Journal on Applied Mathematics 2. Journal of Engineering Mathematics 3. Applied Mathematics and Computation 4. Communications in Statistics – Theory and Methods
3.	**Codes, Standards & Online Resources** 1. NPTEL – Advanced Engineering Mathematics: https://nptel.ac.in 2. MIT OpenCourseWare – Mathematics: https://ocw.mit.edu 3. Wolfram MathWorld: https://mathworld.wolfram.com 4. Society for Industrial and Applied Mathematics (SIAM): https://www.siam.org 5. Wolfram Demonstrations Project: https://demonstrations.wolfram.com

Evaluation Scheme	Total Marks	
Theory: Mid semester Marks	**20 marks**	
Theory: End Semester Marks	**40 marks**	
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks

	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

Semester IV

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
											Theory Marks				Practical Marks	**Total Marks**
			L	P	T	***Total***	L	P	T	**Total**	MS	CEC	ES	***Total***		
1	AECC411	Environmental Studies	2	-	-	***2***	2	-	-	**2**	20	40	40	***100***	--	**100**
2	BTFS411	Building Fire Prevention & Protection measures	3	-	-	***3***	3	-	-	**3**	20	40	40	***100***	--	**100**
3	BTFS412	Hazard Identification, Risk Assessment & Control Techniques	3	-	1	***4***	3	-	1	**4**	20	40	40	***100***	--	**100**
4	BTFS413	Safety in Construction Industry	3	-	-	***3***	3	-	-	**3**	20	40	40	***100***	--	**100**
5	BTFS414	Basics of Occupational Health	3	-	-	***3***	3	-	-	**3**	20	40	40	***100***	--	**100**
6	BTFS415	Fire drills & Practical	-	4	-	***4***	-	2	-	**2**	--	--	--	**--**	50	**50**
7	BTFS416	Fluid mechanics & Pumping machinery	3	2	-	***5***	3	1	-	**4**	20	40	40	***100***	50	**150**
8	BTFS409	Industrial Internship	-	-	-	***-***	-	2	-	**2**	--	--	--	**--**	100	**100**
		Total				***24***				**23**						**800**

Note: L = Lecture, **P** = Practice, **T**= Tutorial, **MS** – Mid Semester, **CEC** – Continuous Evaluation Component**, ES** – End Semester

COURSE CODE:	COURSE NAME:	SEMESTER:
AECC411	**Environmental Studies**	IV

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	0	0	**2**	2	0	0	**2**

Course Pre-requisites	Nil
Course Category	Ability Enhancement Compulsory Course (AECC)
Course focus	Environmental awareness, sustainability, skill development, problem-solving and responsible citizenship
Rationale	This course introduces learners to the fundamental concepts of environmental science, sustainability, ecological balance, environmental pollution, biodiversity conservation, climate change and sustainable development. It develops environmental awareness, ethical responsibility and problem-solving abilities among students from multidisciplinary backgrounds in alignment with NEP 2020 and Sustainable Development Goals (SDGs).
Course Revision/ Approval Date:	
Course Objectives	To enable the student to: 1. Develop understanding of environmental systems, ecosystems and biodiversity. 2. Explain environmental pollution, climate change and resource management issues. 3. Analyze environmental challenges using scientific, technological and managerial perspectives. 4. Promote environmental ethics, sustainability practices and responsible citizenship. 5. Apply sustainable solutions for environmental conservation and societal well-being.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Fundamentals of Environmental Studies and Ecosystems: Definition, scope and importance of environmental studies; Components of environment: atmosphere, hydrosphere, lithosphere, biosphere; Ecosystem structure and functions; Food chain, food web and ecological pyramids; Energy flow in ecosystems; Biogeochemical cycles; Ecological succession.	20%	6

Unit 2: Natural Resources and Biodiversity Conservation: Renewable and non-renewable resources; Water resources, forest resources, mineral resources and energy resources; Biodiversity: types and importance; Threats to biodiversity; In-situ and ex-situ conservation; Environmental ethics and sustainable lifestyles.	20%	6
Unit 3: Environmental Pollution and Waste Management: Air pollution, water pollution, soil pollution, noise pollution and thermal pollution; Sources, effects and control measures; Solid waste management; E-waste and biomedical waste; Industrial pollution; Environmental health hazards.	20%	6
Unit 4: Climate Change, Sustainability and Environmental Management: Global warming and climate change; Greenhouse gases and carbon footprint; Ozone layer depletion; Sustainable Development Goals (SDGs); Environmental Impact Assessment (EIA); Disaster management and environmental risk; Green technologies and circular economy.	20%	6
Unit 5: Environmental Policies, Ethics and Community Participation: Environmental protection acts and policies; National and international environmental movements; Environmental ethics and social responsibility; Public awareness and environmental education; Role of individuals, industries, NGOs and government; Community participation and green campus initiatives.	20%	6

Instructional Method and Pedagogy:
Interactive lectures, experiential learning, field-based learning, case study analysis, problem-based learning, group discussion, collaborative learning, ICT-enabled teaching, environmental audit activities, community engagement, sustainability projects and awareness campaign design.

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the course, students will be able to:	Cognitive	
CO1: Explain ecosystem structure, biodiversity and environmental components.		Understand
CO2: Identify causes and impacts of environmental pollution and climate change.		Understand
CO3: Analyze environmental problems and propose sustainable mitigation strategies.		Analyze
CO4: Apply principles of environmental conservation, waste management and sustainability in real-life situations.		Apply

CO5: Demonstrate environmental ethics, social responsibility and participatory approaches toward sustainable development.		Apply/Affective

Learning Resources	
1.	**Reference Books** 1. Bharucha, E. (2005). Environmental Studies for Undergraduate Courses of All Branches of Higher Education. Universities Press (India) Pvt. Ltd., Hyderabad, in association with University Grants Commission. ISBN: 9788173715402. 2. Bharucha, E. (2023/2024 Edition). Textbook of Environmental Studies for Undergraduate Courses: As per UGC Guidelines and NEP 2020. Oxford University Press, New Delhi. 3. Textbook of Environmental Education for Undergraduates: In Line with NEP 2020 and UGC Guidelines and Curriculum Framework for Environmental Education at Undergraduate Level (June 2023). Atlantic Publishers & Distributors Pvt. Ltd., New Delhi, 2025. ISBN: 9788126939169. 4. Miller, G. T., & Spoolman, S. (2019). Environmental Science (16th Edition). Cengage Learning, Boston. ISBN: 9781337562072. 5. Cunningham, W. P., & Cunningham, M. A. (2021). Principles of Environmental Science: Inquiry and Applications (9th Edition). McGraw Hill Education, New York. ISBN: 9781260579710. 6. Henry, J. G., & Heinke, G. W. (2016). Environmental Science and Engineering (3rd Edition). Pearson Education, India. ISBN: 9789332557109. 7. Rajagopalan, R. (2018). Environmental Studies: From Crisis to Cure (4th Edition). Oxford University Press, New Delhi. 8. Kaushik, A., & Kaushik, C. P. (2021). Environmental Studies (6th Edition). New Age International Publishers, New Delhi. ISBN: 9789390591190. 9. Sharma, P. D. (2022). Ecology and Environment (14th Edition). Rastogi Publications, Meerut. 10. University Grants Commission. (2023). Guidelines and Curriculum Framework for Environment Education at Undergraduate Level. UGC, New Delhi. 11. Ministry of Education. (2020). National Education Policy 2020. Government of India, New Delhi. 12. United Nations. Transforming Our World: The 2030 Agenda for Sustainable Development. United Nations, New York.
2.	**Journals & Periodicals** Environment and ecology journals, UGC/AICTE/Ministry of Environment updates, institutional library resources.
3.	**Codes, Standards & Online Resources** UGC, MoEFCC, CPCB, IPCC, UNEP, UN SDG portal, National Digital Library and verified open educational resources.

Evaluation Scheme	Total Marks	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	COURSE NAME:			SEMESTER:			
BTFS411	**Building Fire Prevention & Protection measures**			IV			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	**3**	3	0	0	**3**

Course Pre-requisites	Town planning & building design.
Course Category	Professional Core
Course focus	Skill development
Rationale	Fire safety in buildings is achieved through an integrated approach involving fire prevention, passive fire protection, life safety provisions, and fire protection systems. Proper planning, occupancy classification, building services, safe means of egress, and compliance with fire safety regulations are essential for minimizing fire risk and ensuring occupant safety. This course provides students with the knowledge required to understand building fire safety principles, fire prevention measures, life safety systems, fire protection installations, and statutory requirements for designing and evaluating fire-safe buildings.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain fire safety principles, occupancy classification and building planning requirements for fire prevention.

	2. Explain fire prevention measures associated with building services and hazardous areas. 3. Apply life safety principles for safe means of egress and occupant evacuation. 4. Evaluate passive and active fire protection systems used in buildings. 5. Evaluate building fire safety management practices and compliance with applicable fire safety codes.

Course Content (Theory)	Weightage	Contact hours
Unit I: Fire Safety Planning: Fire safety objectives; Occupancy classification as per NBC 2016; Building characteristics; Fire load; Fire risk classification; Site planning; Zoning regulations; Building setbacks; Fire separation distance; Type of construction; Fire resistance rating; Compartmentation; Fire walls; Smoke compartments; Exposure protection.	20%	9
Unit II: Building Services & Fire Prevention: Fire prevention in electrical systems; HVAC systems; Service shafts and ducts; Vertical openings; Escalators and lifts; Gas supply systems; Utility services; Hazardous storage areas; Pipelines; Pressure vessels; Structural fire safety; Fire stopping; Protection of service penetrations.	20%	9
Unit III: Means of Egress & Life Safety: Means of egress; Occupant load calculation; Exit access; Exits; Exit discharge; Doors; Staircases; Ramps; Refuge areas; Horizontal exits; Emergency lighting; Exit signage; Smoke management; Accessibility provisions; NBC requirements for life safety.	20%	9
Unit IV: Fire Protection Systems: Portable fire extinguishers; Hydrant systems; Wet and dry risers; Automatic sprinkler systems; Water spray systems; Water mist systems; Foam systems; Clean agent systems; Fire detection and alarm systems; Smoke detection; Voice evacuation systems; Fire command centre; Inspection, testing and maintenance.	20%	9
Unit V: Fire Safety Management: Building fire safety management; Fire prevention programme; Fire emergency organization; Emergency response plan; Fire evacuation procedures; Roles and responsibilities of emergency teams; Fire drills; Fire safety inspections; Fire safety audit; Documentation; Building fire safety compliance.	20%	9

Instructional Method and Pedagogy:
PPT, Case Studies, Site Visits, Video Presentation, Chalk board

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain

After successful completion of the above course, students will be able to: CO1: Explain building planning principles, occupancy classification and fire prevention requirements. CO2: Explain fire prevention measures associated with building services and hazardous areas. CO3: Apply life safety principles for designing safe means of egress and occupant evacuation. CO4: Evaluate passive and active fire protection systems used in buildings. CO5: Evaluate building fire safety management practices and compliance with fire safety codes.	Cognitive	Understand Understand Apply Evaluate Evaluate

Learning Resources	
1.	**Reference Books** 1. National Building Code of India 2016, Part 4 – Fire and Life Safety, BIS. 2. SFPE, SFPE Handbook of Fire Protection Engineering, 6th Edition. 3. Arthur E. Cote, NFPA Fire Protection Handbook, Latest Edition. 4. Lon H. Ferguson, Fundamentals of Fire Protection for the Safety Professional, Bernan Press. 5. V. K. Jain, Fire Safety in Buildings, New Age International. 6. Barendra Mohan Sen, Fire Protection and Prevention – The Essential Handbook, UBS Publishers.
2.	**Journals & Periodicals** 1. Fire Safety Journal 2. Fire Technology 3. Journal of Fire Sciences 4. Case Studies in Fire Safety 5. Safety Science
3.	**Codes, Standards & Online Resources** 1. National Building Code of India (NBC 2016), Part 4 – Fire and Life Safety - https://www.bis.gov.in/national-building-code/ 2. Bureau of Indian Standards (BIS) - https://www.bis.gov.in 3. National Fire Protection Association (NFPA) – Codes & Standards - https://www.nfpa.org/codes-and-standards 4. Society of Fire Protection Engineers (SFPE) - https://www.sfpe.org 5. International Code Council (ICC) - https://www.iccsafe.org 6. National Disaster Management Authority (NDMA) - https://ndma.gov.in 7. Fire Dynamics Simulator (FDS) – NIST - https://pages.nist.gov/fds-smv

Evaluation Scheme	**Total Marks**
Theory: Mid semester Marks	**20 marks**

Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:		**COURSE NAME:**		**SEMESTER:**			
BTFS412		**Hazard Identification, Risk assessment & Control Techniques**		IV			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	1	**4**	3	0	1	**4**

Course Pre-requisites	Safety management I
Course Category	Professional core
Course focus	Skill development
Rationale	Hazard Identification, Risk Assessment and Control (HIRAC) forms the foundation of modern safety management by enabling systematic identification, evaluation and control of workplace and process hazards. Effective risk assessment helps organizations prevent accidents, reduce occupational injuries, improve decision-making, ensure regulatory compliance and enhance overall organizational resilience. This course introduces students to qualitative, semi-quantitative and quantitative risk assessment techniques, consequence analysis, reliability assessment and risk evaluation methodologies used in industrial safety, process safety and occupational health. It also develops analytical and problem-solving skills through practical case studies and tutorial-based risk assessments.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain the concepts of hazards, risks, hazard identification and risk management in industrial systems. 2. Explain qualitative, semi-quantitative and quantitative risk assessment techniques. 3. Apply systematic hazard analysis methodologies to identify and

	evaluate industrial hazards. 4. Analyze the consequences of fire, explosion and toxic release scenarios using appropriate assessment techniques. 5. Evaluate risks and recommend suitable control measures based on risk evaluation criteria and decision-making tools.

Course Content (Theory)	Weightage	Contact hours
Unit I: Hazard & Risk Fundamentals: Hazard; Risk; Hazard identification; Hazard analysis; Risk analysis; Risk assessment; Risk management; Difference between hazard and risk; Hazard-risk relationship; Hazard prioritization; Risk matrix; Hazard progression model; Risk communication; ALARP principle.	10%	5
Unit II: Risk Assessment Techniques: Qualitative, semi-quantitative and quantitative risk assessment; Hazard-Mishap Probability; HIRA (Five-Step Risk Assessment); Job Safety Analysis (JSA); What-If Analysis; Checklist Analysis; Bow-Tie Analysis; Questionnaires; Risk Ranking; Risk Matrix; Practical applications and worked examples.	20%	9
Unit III: Systematic Hazard Analysis: Failure Mode and Effects Analysis (FMEA); Failure Mode, Effects and Criticality Analysis (FMECA); Preliminary Hazard Analysis (PHA); Hazard Analysis (HAZAN); Hazard and Operability Study (HAZOP); Guide words; Worksheets; Team approach; Applications; Advantages and limitations; Case studies.	30%	14
Unit IV: Consequence Analysis: Fire consequence analysis; Explosion consequence analysis; Toxic release analysis; Thermal radiation; Vapour Cloud Explosion (VCE); BLEVE; Toxic dispersion; Dow Fire and Explosion Index (F&EI); Mond Index; Reliability assessment of vessels and safety devices; Introduction to consequence modelling.	20%	9
Unit V: Risk Evaluation & Decision Making: Fault Tree Analysis (FTA); Event Tree Analysis (ETA); Layers of Protection Analysis (LOPA); Failure rate data; Reliability data; Gas dispersion models; Fire and explosion modelling; Frequency and consequence assessment; Individual and societal risk; F-N Curves; Risk acceptance criteria; Risk control hierarchy; Computer applications in risk assessment.	20%	8

Tutorial Activity	Weightage	Hours
1. HIRA for laboratory and workplace hazards	20%	3
2. Preparation of Risk Matrix and Risk Register	20%	3
3. HAZOP worksheet development for a process	20%	3

4. FMEA/FMECA case study and risk prioritization	20%	3
5. Consequence analysis, FTA/ETA and Bow-Tie case study	20%	3

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: Explain the concepts of hazards, risks, hazard identification and risk management. CO2: Apply qualitative, semi-quantitative and quantitative risk assessment techniques to evaluate workplace and process hazards. CO3: Analyze industrial hazards using systematic hazard analysis techniques such as HIRA, FMEA, FMECA, HAZOP, FTA and ETA. CO4: Analyze fire, explosion and toxic release consequences using appropriate assessment methods and consequence models. CO5: Evaluate risk acceptability and recommend suitable risk control measures using risk evaluation criteria and decision-making tools.	Cognitive	Understand Apply Analyze Analyze Evaluate

Learning Resources

1.	**Reference Books** 1. Frank P. Lees, Lees' Loss Prevention in the Process Industries, 4th Edition, Elsevier. 2. Daniel A. Crowl & Joseph F. Louvar, Chemical Process Safety: Fundamentals with Applications, Pearson. 3. Trevor Kletz, HAZOP and HAZAN, IChemE. 4. Clifton A. Ericson II, Hazard Analysis Techniques for System Safety, Wiley. 5. CCPS, Guidelines for Hazard Evaluation Procedures, AIChE. 6. CCPS, Guidelines for Risk-Based Process Safety, AIChE.
2.	**Journals & Periodicals** 1. Process Safety Progress 2. Journal of Loss Prevention in the Process Industries 3. Safety Science 4. Reliability Engineering & System Safety 5. Journal of Safety Research
3.	**Codes, Standards & Online Resources** 1. ISO 31000:2018 – Risk Management Guidelines - https://www.iso.org/iso-31000-risk-management.html 2. IEC 31010 – Risk Assessment Techniques - https://webstore.iec.ch 3. CCPS – Center for Chemical Process Safety - https://www.aiche.org/ccps

	4. AIChE Academy – Process Safety Resources - https://www.aiche.org/academy 5. Occupational Safety and Health Administration (OSHA) - https://www.osha.gov 6. National Institute for Occupational Safety and Health (NIOSH) - https://www.cdc.gov/niosh 7. Bureau of Indian Standards (BIS) - https://www.bis.gov.in

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:		**COURSE NAME:**		**SEMESTER:**			
BTFS413		**Safety in Construction Industry**		IV			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	**3**	3	0	0	**3**
Course Pre-requisites	Town planning & building design						
Course Category	Professional core						
Course focus	Employability, Skill Development and Industry Readiness						
Rationale	The construction industry is one of the most hazardous sectors due to its dynamic work environment, high-risk activities, heavy equipment, work at height, excavation, confined spaces, demolition, and multiple contractor involvement. Effective construction safety management is essential to prevent accidents, protect workers, ensure legal compliance, and improve project performance. This course provides knowledge of construction methods, hazard identification, risk assessment, accident prevention, occupational health, permit-to-work systems, and statutory safety						

	requirements applicable to construction projects. It equips students with the competencies required to manage safety in residential, commercial, industrial, and infrastructure construction projects.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain construction methods, activities, equipment, and associated safety requirements. 2. Analyze hazards and risks associated with construction operations and recommend appropriate control measures. 3. Evaluate causes of construction accidents and apply accident investigation techniques. 4. Apply safety principles for demolition, permit-to-work systems, and high-risk construction activities. 5. Evaluate occupational health requirements, statutory provisions, and safety management practices applicable to the construction industry.

Course Content (Theory)	Weightage	Contact hours
Unit I: Construction Engineering & Methods: Construction materials; Modern construction materials; Building construction methods; Excavation; Drilling and blasting; Trenching; Shoring and strutting; Piling; Structural steel erection; Welding and cutting safety; Scaffolding; Formwork and centering; Ladders; Concrete works; Wall and floor openings; Staircases; Railings; Smart buildings and sustainable construction practices.	20%	9
Unit II: Construction Hazards & Risk Control: Construction site planning; Initial site assessment; Work at height; Fall protection systems; Fragile roofs; Falling objects; Excavation safety; Electrical safety; Fire prevention; Manual and mechanical material handling; Traffic management; Construction machinery; Chemical hazards; Biological hazards; Noise and vibration; Construction risk assessment and control measures.	20%	9
Unit III: Construction Accident Management: Construction industry statistics; Causes of construction accidents; Human factors; Unsafe acts and unsafe conditions; Organizational factors; Ergonomics; Weather-related hazards; Accident investigation; Root Cause Analysis (RCA); Case studies; Lessons learned; Safety performance indicators.	20%	9
Unit IV: Demolition Safety & Permit-to-Work: Demolition planning; Structural stability assessment; Demolition methods; Public protection; Dust and debris control; Permit-to-work systems; Hot work	20%	9

permit; Excavation permit; Work at height permit; Confined space entry permit; Lifting permit; Electrical isolation; Lockout-Tagout (LOTO); Contractor safety management.		
Unit V: Occupational Health & Construction Regulations: Occupational health hazards; Occupational diseases; Personal Protective Equipment (PPE); Welfare facilities; First aid; Emergency preparedness; Building and Other Construction Workers (BOCW) Act, 1996; BOCW Rules; Occupational Safety, Health and Working Conditions Code, 2020; IS and NB Codes safety provisions; Construction safety audits and inspections.	20%	9

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: Explain construction methods, equipment, and safety requirements applicable to construction projects. CO2: Analyze hazards and recommend appropriate risk control measures for construction activities. CO3: Evaluate construction accidents using accident investigation and root cause analysis techniques. CO4: Apply safety principles and permit-to-work systems for demolition and other high-risk construction activities. CO5: Evaluate occupational health requirements, statutory provisions, and safety management practices applicable to the construction industry.	Cognitive	Understand Analyze Evaluate Apply Evaluate

Learning Resources

1.	**Reference Books** 1. Phil Hughes & Ed Ferrett, Introduction to Health and Safety in Construction, Routledge. 2. Charles D. Reese, Construction Safety Handbook, CRC Press. 3. J. J. Keller & Associates, OSHA Construction Safety Handbook. 4. Sidney M. Levy, Project Management in Construction, McGraw-Hill. 5. V. J. Davies & K. Tomasin, Construction Safety Handbook, Thomas Telford.
2.	**Journals & Periodicals** 1. Safety Science 2. Journal of Construction Engineering and Management 3. Automation in Construction

	4. International Journal of Construction Management
3.	**Codes, Standards & Online Resources** 1. Building and Other Construction Workers (BOCW) Act, 1996 - https://labour.gov.in 2. Occupational Safety, Health and Working Conditions Code, 2020 - https://labour.gov.in 3. National Building Code of India (NBC 2016) - https://www.bis.gov.in/national-building-code/ 4. Occupational Safety and Health Administration (OSHA) – Construction - https://www.osha.gov/construction

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	**COURSE NAME:**			**SEMESTER:**			
BTFS414	**Basics of Occupational Health**			IV			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	**3**	3	0	0	**3**

Course Pre-requisites	Fundamentals of Fire & Environment, Health, Safety
Course Category	Professional Core
Course focus	Employability, Skill Development and Occupational Health Competency
Rationale	Occupational health is an integral component of Environment, Health and Safety (EHS) management that focuses on protecting workers from occupational diseases, injuries, and workplace health hazards.

	Understanding human anatomy, occupational illnesses, industrial hygiene, workplace health surveillance, and applicable legal requirements enables safety professionals to develop healthy workplaces, improve employee well-being, and ensure compliance with occupational health regulations. This course provides fundamental knowledge of occupational health principles and their application in industrial environments.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain the structure and functions of major human organ systems relevant to occupational health. 2. Develop an understanding of occupational health principles, occupational diseases, and workplace health hazards. 3. Analyze the effects of physical, chemical, biological, ergonomic, and psychosocial hazards on worker health. 4. Apply occupational health management practices, medical surveillance, and workplace health promotion measures.

Course Content (Theory)	Weightage	Contact hours
Unit I: Human Anatomy & Physiology – I: Introduction to anatomy and physiology; Cell structure and functions; Musculoskeletal system; Blood composition and functions; Nervous system; Cardiovascular system; Respiratory system; Occupational relevance of respiratory and circulatory disorders.	20%	9
Unit II: Human Anatomy & Physiology – II: Digestive system; Liver and pancreas; Gastrointestinal tract; Eye and vision; Ear and hearing; Skin; Excretory system; Reproductive system; Human body response to occupational exposures.	20%	9
Unit III: Occupational Health Fundamentals: Principles of occupational health; WHO definition; Evolution of occupational health; Occupational health services; Occupational diseases; Occupational health hazards; Physical, chemical, biological, ergonomic and psychosocial hazards; Worker well-being and quality of work life.	20%	9
Unit IV: Occupational Diseases & Workplace Hazards: Occupational diseases; Dust-related diseases; Noise-induced hearing loss; Vibration syndrome; Heat and cold stress; Chemical poisoning; Occupational cancers; Biological hazards; Ergonomic disorders; Stress and mental health; Workplace health risk assessment and preventive measures.	20%	9
Unit V: Occupational Health Management: Occupational health	20%	9

programmes; Medical examination; Pre-placement and periodic health surveillance; Biological monitoring; Fitness for work; Return-to-work assessment; Occupational health records; Workplace wellness programmes; Occupational Safety, Health and Working Conditions Code, 2020; ILO and WHO guidelines.		

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: Explain the structure and functions of major human organ systems relevant to occupational health. CO2: Explain occupational health principles, occupational diseases, and workplace health hazards. CO3: Analyze the effects of workplace hazards on human health and recommend preventive measures. CO4: Apply occupational health management practices, health surveillance, and workplace wellness programmes. CO5: Evaluate occupational health legislation, standards, and best practices for protecting worker health.	Cognitive	Understand Understand Analyze Apply Evaluate

Learning Resources

1.	**Reference Books** 1. Barry S. Levy & David H. Wegman, Occupational Health: Recognizing and Preventing Work-related Disease and Injury, Oxford University Press. 2. Peter Baxter, Hunter's Diseases of Occupations, CRC Press. 3. Julia Smedley, Oxford Handbook of Occupational Health, Oxford University Press. 4. B.D. Chaurasia, Human Anatomy, Vol. I & II, CBS Publishers. 5. David Grantham, Occupational Health & Hygiene: Guidebook for WHSO.
2.	**Journals & Periodicals** 1. Occupational and Environmental Medicine 2. Journal of Occupational Health 3. Safety and Health at Work 4. Journal of Occupational and Environmental Hygiene
3.	**Codes, Standards & Online Resources** 1. Occupational Safety, Health and Working Conditions Code, 2020 - https://labour.gov.in 2. International Labour Organization (ILO) – Occupational Safety and Health -

	https://www.ilo.org/safework 3. World Health Organization (WHO) – Occupational Health - https://www.who.int/health-topics/occupational-health 4. National Institute for Occupational Safety and Health (NIOSH) - https://www.cdc.gov/niosh

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	**COURSE NAME:**			**SEMESTER:**			
BTFS415	**Fire Drill Practicals**			IV			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
0	4	0	**4**	0	2	0	**2**

Course Pre-requisites	Fire Drill Practical – I
Course Category	Program Core – Laboratory / Skill-based
Course focus	Development of practical firefighting skills, rescue techniques, operation of fire protection equipment, emergency response, teamwork, leadership, and compliance with standard fire service practices through hands-on training and simulated emergency drills.
Rationale	Fire drills and practical training are essential for developing the operational competencies required by fire and safety professionals. This course provides systematic hands-on training in firefighting, rescue operations, fire protection systems, emergency response, and industrial fire safety through progressive practical sessions. The curriculum develops technical proficiency in operating firefighting equipment, conducting rescue operations, responding to emergencies, and managing fire incidents while emphasizing discipline, teamwork, communication,

	leadership, safety practices, and adherence to national and international fire service standards. The course bridges theoretical concepts with field applications, preparing students for careers in industrial fire services, municipal fire brigades, airport fire services, emergency response organizations, and disaster management.
Course Revision/ Approval Date:	
Course Objectives	The course aims to: 1. Develop competency in firefighting drills, rescue techniques, and emergency response operations using standard firefighting procedures. 2. Demonstrate safe operation, inspection, maintenance, and application of firefighting equipment, appliances, and fire protection systems. 3. Apply standard operating procedures for fire suppression, rescue, evacuation, and emergency response in residential, commercial, and industrial environments. 4. Develop teamwork, leadership, communication, discipline, and decision-making skills during firefighting and rescue operations. 5. Perform firefighting, rescue, and emergency management activities in accordance with national and international fire service standards and professional ethics.

Course Content (Theory)	**Weightage**	**Contact hours**
1. **Rope Applications & Fire Survival:** Rope applications; Fire blanket; Personal fire survival	10%	8
2. **SCBA & Portable Fire Extinguishers:** Respiratory protective equipment; Operation of portable fire extinguishers	15%	8
3. **Casualty Transport:** Casualty handling; Stretcher drill; Ambulance drill	15%	8
4. **Hydrant Operations:** Four-men hydrant drill	15%	8
5. **Pumping & Rescue:** Pumping signals; Lowering an insensible person	15%	8
6. **Commercial Building Evacuation:** Fire and evacuation drill	10%	7
7. **Rescue Techniques:** Rescue methods demonstration	10%	7
8. **Firefighting Tools & Rescue Equipment:** Handling of firefighting and rescue equipment	10%	6

Instructional Method and Pedagogy:
Demonstration, Hands-on Practice, Drill Simulation, Group Exercise, Field Visit

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**

After successful completion of the above course, students will be able to:		
CO1 Demonstrate drill commands, discipline, teamwork, and safe operation of basic firefighting equipment during fire service activities.	Psychomotor	Apply
CO2 Perform firefighting, rescue, evacuation, and casualty handling operations using appropriate equipment and standard operating procedures.	Psychomotor	Apply
CO3 Operate and inspect portable and fixed fire protection systems, firefighting appliances, ladders, pumps, and rescue equipment during emergency response.	Psychomotor	Apply
CO4 Analyze emergency situations and execute appropriate firefighting, rescue, and incident response techniques while ensuring personal and team safety.	Cognitive	Analyze
CO5 Demonstrate professional competency, leadership, communication, discipline, and ethical practices while participating in fire drills, mock exercises, and emergency management activities.	Affective	Apply

Learning Resources	
1.	**Reference Books** 1. Fire Service Manual – Volume I: Fire Service Drill, Ministry of Home Affairs, Government of India. 2. Fire Service Manual – Volume II: Fire Service Equipment, Ministry of Home Affairs, Government of India. 3. IFSTA, Essentials of Fire Fighting, 7th Edition, Fire Protection Publications. 4. Arthur E. Cote (Ed.), NFPA Fire Protection Handbook, Latest Edition. 5. V. K. Jain, Fire Safety in Buildings, New Age International Publishers.
2.	**Journals & Periodicals** 1. Fire Technology 2. Fire Safety Journal 3. Journal of Fire Sciences 4. Fire Engineering Magazine
3.	**Codes, Standards & Online Resources** 1. National Building Code of India 2016 – Part 4: Fire and Life Safety - https://www.bis.gov.in/national-building-code/ 2. National Fire Protection Association (NFPA) – Codes & Standards - https://www.nfpa.org/codes-and-standards 3. International Fire Service Training Association (IFSTA) - https://www.ifsta.org 4. Society of Fire Protection Engineers (SFPE) - https://www.sfpe.org

Evaluation Scheme	**Total Marks**

Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

COURSE CODE:		**COURSE NAME:**		**SEMESTER:**			
BTFS416		**Fluid mechanics & Pumping machinery**		IV			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	**5**	3	1	0	**4**

Course Pre-requisites	Engineering Fundamentals
Course Category	Engineering Science
Course focus	Engineering Fundamentals, Fire Hydraulics and Pumping Systems
Rationale	Fluid mechanics and pumping machinery form the foundation for understanding the behaviour of fluids and the operation of hydraulic systems used in industrial processes, water distribution, and fire protection engineering. Knowledge of fluid flow principles, hydraulic losses, flow measurement, and pump performance is essential for designing, operating, and maintaining fire water supply systems, hydrant networks, sprinkler systems, and industrial pumping installations. This course provides theoretical and practical knowledge of fluid mechanics, hydraulic machinery, and fire pumping systems to support engineering analysis and industrial applications.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain the fundamental properties of fluids and the principles governing fluid statics and fluid dynamics. 2. Apply fluid flow principles to analyze pressure losses, flow behaviour, and hydraulic systems. 3. Evaluate fluid measurement techniques and hydraulic performance using engineering principles. 4. Explain the construction, operation, performance, and selection of hydraulic pumps used in industrial and fire protection systems.

	5. Apply fluid mechanics principles to fire water distribution systems and pumping installations.

Course Content (Theory)	Weightage	Contact hours
Unit I: Fluid Properties & Pipe Flow: Fluid properties; Dimensions and units; Dimensional analysis; Buckingham π theorem; Similitude; Pipe flow; Major and minor losses; Hydraulic and Energy Grade Lines (HGL & EGL); Pipes in series and parallel; Branching of pipes; Water hammer.	20%	9
Unit II: Fluid Kinematics & Hydraulics: Types of fluid flow; Laminar and turbulent flow; Reynolds number; Streamlines; Pathlines; Continuity equation; Open channel flow; Flow through hoses and nozzles; Pressure measurement; Hydraulic principles for fire water systems.	20%	9
Unit III: Fluid Dynamics & Flow Measurement: Bernoulli's equation; Momentum equation; Energy equation; Pressure measurement; Pitot tube; Piezometer; Venturimeter; Orifice meter; Rotameter; Flow measurement techniques; Hydraulic calculations for fire protection systems.	20%	9
Unit IV: Hydraulic Machinery: Hydraulic turbines (basic concepts); Positive displacement pumps; Reciprocating pumps; Centrifugal pumps; Pump characteristics; Pump efficiency; Cavitation; NPSH; Velocity triangles; Pump selection and performance.	20%	9
Unit V: Fire Pumps & Water Supply Systems: Fire water pump house; Jockey pumps; Main fire pumps; Diesel engine driven pumps; Electric motor driven pumps; Fire water storage; Fire hydrant systems; Sprinkler pumping systems; Pump operation sequence; Pressure requirements; Pump inspection, testing and maintenance.	20%	9

Practical	Weightage	Contact Hours
1. Minor head loss in pipe fittings	10%	3
2. Friction factor in smooth and rough pipes	10%	3
3. Reynolds number determination	10%	3
4. Venturimeter calibration	10%	3
5. Rotameter calibration	10%	3
6. Orifice coefficient determination	10%	3
7. Performance test on centrifugal pump	20%	6
8. Performance test on reciprocating pump	20%	6
9. Fire pump performance characteristics	10%	3

Instructional Method and Pedagogy:

PPT, Tutorial, Video Presentation		
Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: Explain the properties of fluids and analyze fluid flow through pipes and hydraulic systems. CO2: Apply fluid kinematics and hydraulic principles to evaluate pressure, velocity, and discharge in fluid flow systems. CO3: Analyze fluid flow using Bernoulli's equation and standard flow measurement devices. CO4: Evaluate the performance characteristics and selection of hydraulic pumps for engineering applications. CO5: Apply fluid mechanics principles for the design, operation, and maintenance of fire water pumping systems.	Cognitive	Understand Apply Analyze Evaluate Apply

Learning Resources	
1.	**Reference Books** 1. Yunus A. Çengel & John M. Cimbala, Fluid Mechanics: Fundamentals and Applications, McGraw-Hill. 2. R. K. Rajput, Fluid Mechanics and Hydraulic Machines, S. Chand. 3. V. L. Streeter & E. B. Wylie, Fluid Mechanics, McGraw-Hill. 4. Modi & Seth, Hydraulics and Fluid Mechanics, Standard Book House. 5. NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection.
2.	**Journals & Periodicals** 1. Journal of Hydraulic Engineering (ASCE) 2. Journal of Fluids Engineering (ASME) 3. Fire Technology 4. Fire Safety Journal
3.	**Codes, Standards & Online Resources** 1. NFPA 20 – Standard for the Installation of Stationary Pumps for Fire Protection - https://www.nfpa.org 2. National Building Code of India 2016 – Part 4: Fire and Life Safety - https://www.bis.gov.in/national-building-code/ 3. Hydraulic Institute Standards - https://www.pumps.org 4. Bureau of Indian Standards (BIS) - https://www.bis.gov.in 5. Engineering Toolbox – Fluid Mechanics - https://www.engineeringtoolbox.com

Evaluation Scheme	**Total Marks**

Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

Semester V

Sr. No.	Course Code *(Click here to locate)*	Course Name *(Click here to download the document)*	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
											Theory Marks				Practical Marks	**Total Marks**
			L	P	T	***Total***	L	P	T	**Total**	MS	CEC	ES	***Total***		
1	AECC601	Indian Constitution	2	-	-	***2***	2	-	-	**2**	20	40	40	***100***	--	**100**
2	BTFS519	Legislations related to Fire & EHS	3	-	-	***3***	3	-	-	**3**	20	40	40	***100***	--	**100**
3	BTFS512	Safety Management II	3	-	-	***3***	3	-	-	**3**	20	40	40	***100***	--	**100**
4	BTFS513	First Aid & Basic Life Support	2	2	-	***4***	2	1	-	**3**	20	40	40	***100***	50	**150**
5	BTFS515	Introduction to Fire Dynamics	3	2	-	***5***	3	1	-	**4**	20	40	40	***100***	50	**150**
6	BTFS516	Fire drills & Practicals	-	4	-	***4***	-	2	-	**2**	--	--	--	**--**	50	**50**
7	BTFS517	Industrial Internship	-	-	-	**-**	-	2	-	**2**	--	--	--	**--**	100	**100**
8	BTFS518	Fire Protection Systems	3	-	-	***3***	3	-	-	**3**	20	40	40	***100***	--	**100**
9	NPTEL NOC01	NPTEL ONLINE COURSE	2	-	-	***2***	2	-	-	**2**	--	--	--	***100***	--	**100**
		Total				***26***				**24**						**950**

Note: L = Lecture, **P** = Practice, **T**= Tutorial, **MS -** Mid Semester, **CEC -** Continuous Evaluation Component**, ES -** End Semester

COURSE CODE:	COURSE NAME:	SEMESTER:
AECC601	**Indian Constitution**	V

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	0	0	**2**	2	0	0	**2**

Course Pre-requisites	Nil
Course Category	Ability Enhancement Compulsory Course (AECC)
Course focus	Employability | Skill Development | Constitutional Literacy
Rationale	The Constitution of India is the supreme law of the country and forms the foundation of democratic governance, rule of law, justice, equality, liberty, and fraternity. This course provides students with an understanding of constitutional philosophy, governance structure, fundamental rights and duties, the functioning of constitutional institutions, and the role of citizens in strengthening democracy. It develops constitutional awareness, ethical citizenship, and civic responsibility necessary for responsible professionals and informed citizens.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain the philosophy, features, and significance of the Constitution of India. 2. Interpret Fundamental Rights, Directive Principles of State Policy, and Fundamental Duties. 3. Understand the structure and functioning of the Union, State Governments, and Judiciary. 4. Analyze the role of constitutional and democratic institutions in ensuring good governance. 5. Appreciate constitutional values, citizen responsibilities, and contemporary constitutional developments.

Course Content (Theory)	Weightage	Contact hours
Unit I: Introduction to the Constitution of India: Historical background; Constituent Assembly; Making of the Constitution; Sources; Salient features; Preamble; Constitutional philosophy; Union and federal structure; Basic Structure Doctrine; Constitutional amendments.	20%	6

Unit II: Fundamental Rights, Duties & Directive Principles: Fundamental Rights; Right to Constitutional Remedies; Directive Principles of State Policy (DPSP); Fundamental Duties; Equality, liberty, justice and fraternity; Social justice; Constitutional values; Landmark constitutional amendments.	20%	6
Unit III: Union, State Government & Judiciary: President; Vice-President; Prime Minister and Council of Ministers; Parliament; Governor; Chief Minister and State Legislature; Supreme Court; High Courts; Judicial review; Judicial activism; Separation of powers; Rule of law.	20%	6
Unit IV: Constitutional Bodies & Democratic Governance: Election Commission; Comptroller and Auditor General (CAG); Union Public Service Commission (UPSC); Finance Commission; National Human Rights Commission (NHRC); Local Self-Government; 73rd & 74th Constitutional Amendments; Panchayati Raj; Urban Local Bodies; Good Governance; Transparency and Accountability.	20%	6
Unit V: Citizenship, Governance & Contemporary Constitutional Issues: Citizenship; Fundamental responsibilities of citizens; Right to Information (RTI); Public Interest Litigation (PIL); Digital governance; E-Governance; Environmental protection under the Constitution; Gender justice; Constitutional ethics; Contemporary constitutional challenges and case studies.	20%	6

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1 Explain the philosophy, features, and significance of the Constitution of India.	Cognitive	Understand
CO2 Interpret Fundamental Rights, Directive Principles, Fundamental Duties, and constitutional values.		Understand
CO3 Explain the structure and functions of the Union Government, State Government, and Judiciary.		Understand
CO4 Analyze the role of constitutional institutions in promoting democratic governance and accountability.		Analyze
CO5 Appreciate constitutional values, responsible citizenship, and contemporary constitutional issues in democratic governance.		Evaluate

Learning Resources	
1.	**Reference Books** 1. Durga Das Basu, Introduction to the Constitution of India, LexisNexis. 2. M. V. Pylee, India's Constitution, S. Chand. 3. J. N. Pandey, Constitutional Law of India, Central Law Agency. 4. D. D. Basu, Shorter Constitution of India, LexisNexis. **5.** B. K. Sharma, Introduction to the Constitution of India, Prentice Hall India.
2.	**Journals & Periodicals** 1. Journal of Constitutional Studies 2. Indian Journal of Public Administration 3. Economic and Political Weekly (EPW) 4. Indian Law Review
3.	**Codes, Standards & Online Resources** 1. Constitution of India – Legislative Department, Government of India - https://legislative.gov.in/constitution-of-india/ 2. India Code Portal - https://www.indiacode.nic.in 3. Supreme Court of India - https://www.sci.gov.in 4. Election Commission of India - https://eci.gov.in 5. National Portal of India - https://www.india.gov.in

Evaluation Scheme	Total Marks	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	COURSE NAME:	SEMESTER:
BTFS511 (Batch 2019-2024) BTFS 318 (Batch 2025 onwards)	**Fire Service Operations**	V

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	**3**	3	0	0	**3**

Course Pre-requisites	Fire Drills & Practical
Course Category	Professional Core
Course focus	Employability
Rationale	The rationale behind fire service operations is to protect life, property, and the environment from the devastating effects of fires and other emergencies. Fire service operations are designed to provide a range of services aimed at preventing, mitigating, and responding to fire incidents and other emergencies effectively. The key rationales behind fire service operations are Life Safety, Property Protection, Environmental Stewardship, Fire Prevention and Education, Emergency Response Coordination, Training and Readiness, Community Service. Overall, the rationale behind fire service operations revolves around safeguarding life, protecting property, and preserving the environment. Through prevention, preparedness, and effective emergency response, fire service operations strive to minimize the impact of fires and emergencies on individuals and communities
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain the organization, structure, legislation and administration of fire services in India. 2. Explain fire service communication systems, mobilization procedures and emergency response operations. 3. Apply the principles of the Incident Command System (ICS) for effective emergency management. 4. Apply operational risk assessment and risk management principles during fire and rescue operations. 5. Explain the selection and application of firefighting, rescue equipment and rescue techniques in emergency situations.

Course Content (Theory)	Weightage	Contact hours

Unit I: Fire Service Organization & Administration: Role, functions and organization of Fire Services in India; Fire service legislation; Role of Central Government, State Government and Local Authorities in fire service planning; Gujarat Fire Service organization; Capabilities and infrastructure of Fire Services; Fire service hierarchy, ranks, organograms, powers and responsibilities of various positions.	10%	5
Unit II: Fire Service Communication & Response: Fire calls and emergency response procedures; Communication systems and communication equipment; Fire control room operations; Mobilization procedures; Vehicle tracking and monitoring systems; Radio communication procedures; Fire appliances including water tender, foam tender, DCP tender, water bowser, disaster/HazMat cum emergency rescue tender, crash fire tender, turntable ladder, hydraulic platform and Rapid Intervention Vehicles (RIV); Operational applications of fire appliances.	20%	10
Unit III: Incident Command System: Importance and principles of Incident Command System (ICS); Operational environment; Leadership during emergency operations; Organization at the incident ground; Levels of command; Roles and responsibilities of fire service personnel; Sectorization; Span of control; Inter-agency liaison and coordination; Incident Action Planning.	20%	10
Unit IV: Operational Risk Management: Operational risk philosophy; Generic, dynamic and analytical risk assessment; Managing operational risk; Tactical modes; Announcement and recording of tactical mode; Responsibilities within tactical mode; Risk control measures; Role of Safety Officer; Closing stages of an incident; Risk assessment for confined space rescue, collapsed structures, lift and escalator rescue, transportation accidents, industrial fires, hazardous material transportation incidents and aircraft accidents.	25%	10
Unit V: Firefighting & Rescue Equipment: Conventional firefighting and rescue equipment used by Fire and Rescue Services (FRS); Ladders (extension, turntable), hydraulic platforms; Fireman's axe, wrench, crowbar, tripod, rescue harness, pulleys, karabiners, thermal imaging (infra-red) camera and Personal Protective Equipment (PPE); Constructional features and operational applications; Fire service ropes; Rope rescue; Knots and hitches and their applications; Advanced hydraulic rescue equipment including cutters, spreaders, hydraulic rams, high-pressure lifting bags, hydraulic jacks and wedges.	25%	10

Instructional Method and Pedagogy:
PPT, Video Presentation, Tutorial, Site Visits

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain

After successful completion of the above course, students will be able to: CO1: Explain the organization, administration and regulatory framework of fire services in India. CO2: Explain communication systems, mobilization procedures and emergency response operations. CO3: Apply Incident Command System principles during emergency operations. CO4: Apply operational risk assessment and risk control measures in fire and rescue services. CO5: Apply firefighting and rescue equipment and operational techniques in emergency situations.	Cognitive	Understand Understand Apply Apply Apply

Learning Resources	
1.	**Reference Books** 1. Fire Service Manual, Volume 1, Communications and Mobilizing, HMSO Publications 2. Fire Service Manual, Volume 2, Fire Service Operations, Compartment Fires and Tactical Ventilation, HMSO Publications. 3. Fire Service Manual, Volume 2, Fire Service Operations, Electricity, HMSO Publications 4. Fire Service Manual, Volume 2, Operational, Firefighting foam, HMSO Publications 5. Fire Service Manual, Volume 2, Fire Service Operations, Petrochemical Incidents, HMSO Publications 6. Fire Service Manual Volume 1 - Fire Service Technology Equipment and Media - Hydraulics_ Pumps and Water Supplies. 7. Barendra Mohan Sen, Fire protection and prevention the essential handbook, UBS publishers. 8. Paul Spurgeon (2012) Fire service hydraulics and pump operations, Pennwell publications.
2.	**Journals & Periodicals** 1. Fire Technology (Springer) 2. Fire Safety Journal (Elsevier) 3. International Journal of Emergency Services 4. Journal of Loss Prevention in the Process Industries 5. Safety Science
3.	**Codes, Standards & Online Resources** 1. National Building Code of India (NBC 2016) – Part 4: Fire and Life Safety 2. National Fire Service College (NFSC), Nagpur 3. National Disaster Management Authority (NDMA) 4. National Fire Protection Association (NFPA) – Codes & Standards 5. Occupational Safety and Health Administration (OSHA) – Fire Safety 6. International Association of Fire Chiefs (IAFC) 7. National Institute of Disaster Management (NIDM)

Evaluation Scheme	Total Marks

Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	**COURSE NAME:**	**SEMESTER:**
BTFS512	**Safety Management II**	V

Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	**3**	3	0	0	**3**

Course Pre-requisites	Safety Management I
Course Category	Professional Core
Course focus	Employability
Rationale	The rationale behind safety management is to prevent accidents, injuries, and other incidents that may harm individuals, damage property, or disrupt operations within an organization. Safety management systems are put in place to identify potential hazards, assess risks, and implement appropriate measures to control and mitigate those risks The key aspects of the rationale behind safety management are Protecting human life and well-being, Reducing financial losses Ensuring legal compliance Enhancing productivity and efficiency, Building trust and reputation, Continuous improvement Overall, the rationale behind safety management is centered on protecting human life, minimizing financial losses, complying with legal requirements, improving productivity, enhancing reputation, and fostering a culture of safety and continuous improvement. By prioritizing safety, organizations create a secure and sustainable environment for their employees and stakeholders, leading to long-term success.
Course Revision/ Approval Date:	**5th March 2024**

Course Objectives	The course aims to: 1. Explain accident classification, safety performance indices and statistical methods used in occupational safety. 2. Explain disablement, compensation provisions and applicable legal requirements. 3. Apply accident and incident investigation, reporting and analysis techniques for identifying root causes. 4. Apply safety appraisal methods and control techniques to improve industrial safety performance. 5. Explain total loss control principles and accident prevention strategies for organizational safety management.

Course Content (Theory)	**Weightage**	**Contact hours**
Unit I: Accident Statistics & Safety Performance: Classification of accidents; Reportable, non-reportable, fatal, non-fatal, near-miss and lost-time accidents; Disabling injuries; Accidents reportable under the Factories Act, Employees' State Insurance (ESI) Act and Electricity Act; Safety performance indices including Frequency Rate, Severity Rate, Incidence Rate, Frequency Severity Index and Safety Score; Worked examples and interpretation of safety statistics.	20%	9
Unit II: Disablement & Compensation: Types of disablement; Temporary and permanent disablement; Partial and total disablement; Compensation principles under the Employees' Compensation Act, 1923; Time charge schedules; National and international practices; Worked examples.	20%	9
Unit III: Accident Investigation & Reporting: Accident and incident investigation; Objectives, philosophy, process and types of investigations; Immediate, underlying and root causes; Corrective and preventive actions (CAPA); Investigation agencies; Accident investigation forms; Report preparation; Statutory reporting requirements; Dangerous occurrence reporting; Accident data classification, analysis, tabulation and record management.	20%	9
Unit IV: Safety Appraisal & Control Techniques: Plant safety rules; Safe Operating Procedures (SOPs); Safety checklists; Permit-to-Work (PTW) system; Plant safety inspections; Safety sampling; Safety surveys; Job Safety Analysis (JSA); Safety inventory system; Product safety; Safety tag systems.	20%	9
Unit V: Total Loss Control & Prevention: Principles of total loss control; Loss prevention concepts; Safety procedures and practices; Safety training and monitoring; Loss control policy; Assignment of duties and responsibilities; Claims analysis; Safety audits and	20%	9

inspections; Accident reporting and investigation; Safety communication; Emergency preparedness and contingency planning.		

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation, Chalk board

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: **Explain** accident types and safety performance indices used in industries. CO2: **Explain** disablement types and compensation provisions. CO3: **Apply** accident and incident investigation, reporting and analysis methods. CO4: **Apply** safety appraisal and control techniques in industrial environments. CO5: **Explain** total loss control concepts and accident prevention strategies.	Cognitive	Understand Understand Apply Apply Understand

Learning Resources

1.	**Reference Books** 1. K. U. Mistry, Handbook of Industrial Safety. 2. Krishnan N. V., Safety Management in Industry. 3. Heinrich H. W., Industrial Accident Prevention. 4. P. K. Singh, Accident & Incident Investigation. 5. Frank E. Bird Jr. & George L. Germain, Practical Loss Control Leadership. 6. James T. O'Reilly, Accident Investigation Techniques.
2.	**Journals & Periodicals** 1. Safety Science 2. Journal of Safety Research 3. Process Safety Progress 4. Journal of Loss Prevention in the Process Industries 5. International Journal of Occupational Safety and Ergonomics
3.	**Codes, Standards & Online Resources** 1. Factories Act, 1948 2. Occupational Safety, Health and Working Conditions (OSHWC) Code, 2020 3. Employees' Compensation Act, 1923 4. National Safety Council (India) 5. International Labour Organization (ILO) – Occupational Safety & Health

	6. Occupational Safety and Health Administration (OSHA) 7. National Institute for Occupational Safety and Health (NIOSH) 8. ISO 45001:2018 Occupational Health and Safety Management Systems

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	**COURSE NAME:**	**SEMESTER:**
BTFS513	**First Aid & Basic Life Support**	V

Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	2	0	**4**	2	1	0	**3**

Course Pre-requisites	Basics of Occupational Health
Course Category	Professional Core
Course focus	Skill development
Rationale	The rationale behind first aid and basic life support (BLS) is to provide immediate and essential care to individuals who are injured, ill, or experiencing a life-threatening emergency. First aid and BLS aim to preserve life, prevent further harm, and promote recovery until professional medical help arrives. The key rationales behind first aid and basic life support are Preservation of Life, Prevention of Deterioration, Reduction of Pain and Suffering, Promotion of Recovery, Limitation of Further Injury, Provision of Psychological Support, Bridge to Advanced Medical Care, Community Empowerment. Overall, the rationale behind first aid and basic life support is to provide immediate and essential care in emergency situations, with the goals of preserving life, preventing deterioration, promoting recovery, and reducing pain and suffering. These interventions play a crucial role in increasing the chances of survival and

	minimizing the long-term impact of injuries or illnesses until professional medical assistance is available.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain the principles, objectives and responsibilities of first aid and basic life support. 2. Explain first aid procedures for common injuries, burns, fractures, bleeding and poisoning. 3. Apply basic life support techniques including CPR, choking management and Automated External Defibrillator (AED) use. 4. Apply first aid measures for medical emergencies, chemical exposures and environmental injuries. 5. Explain casualty management, triage and search and rescue principles during emergencies and mass casualty incidents.

Course Content (Theory)	Weightage	Contact hours
Unit I: Introduction to First Aid: Principles, aims and benefits of first aid; Basic anatomy and physiology; Role and responsibilities of a first aider; Types of emergencies; Initial scene assessment; Primary survey; Personal safety; Physical fitness and ethics of a first aider.	20%	6
Unit II: First Aid for Injuries: First aid kit and its contents; Dressings and bandages; First aid for wounds, cuts, burns (thermal, chemical and electrical); Fractures and dislocations (skull, spine, ribs, upper and lower limbs); Internal and external bleeding; Bleeding control techniques.	20%	6
Unit III: Basic Life Support (BLS): Primary assessment (ABC approach); Cardiopulmonary Resuscitation (CPR); Care of unconscious casualty; Choking management; Poisoning and antidotes; Routes of exposure to toxic substances; Automated External Defibrillator (AED); Occupational injuries and adverse health effects.	20%	6
Unit IV: First Aid for Medical & Chemical Emergencies: First aid for respiratory emergencies; Chemical exposure (ammonia, chlorine, hydrogen sulphide and other hazardous substances); Skin injuries and allergic reactions; Eye injuries due to chemicals, flying particles, arc flash and thermal radiation; Management of heat stress, cold stress and diarrhoea.	20%	6
Unit V: Casualty Management & Mass Casualty Incidents: Principles of casualty management; Mass casualty incidents; Communication and incident management; Triage systems; Search and rescue techniques; Patient lifting and transportation; Psychological first aid; Teamwork and coordination during emergencies.	20 %	6

List of Practical	Weightage	Contact hours
1. Human body anatomy demonstration; Examination of pulse, respiration, chest movement and joint movements.	20%	3
2. Demonstration of first aid kit, dressings and bandaging techniques; Management of wounds and bleeding.	20%	3
3. Practice of first aid for burns, fractures, head injuries, bleeding and poisoning; CPR and AED demonstration.	20%	3
4. Practice of first aid for respiratory emergencies, chemical exposure, eye injuries, skin injuries, heat stress and cold stress.	20%	3
5. Casualty lifting, moving techniques, stretcher drill and triage demonstration.	20%	3

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation, Demonstration, Animated Videos, Notes

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1: Explain first aid terminology, principles and basic life support concepts.	Cognitive	Understand
CO2: Explain common injuries, illnesses and emergency medical conditions.		Understand
CO3: Apply appropriate first aid and basic life support procedures in emergency situations.		Apply
CO4: Explain casualty management and triage principles during emergencies.		Understand
CO5: Apply casualty management, triage and patient transportation techniques during emergency and mass casualty incidents.		Apply

Learning Resources	
1.	**Reference Books** 1. Indian Red Cross Society & St. John Ambulance Association, First Aid Manual. 2. L. G. Gupta & Abhitabh Gupta, First Aid, Jaypee Brothers. 3. American Heart Association (AHA), Basic Life Support (BLS) Provider Manual. 4. European Resuscitation Council (ERC), ERC Guidelines for Resuscitation. 5. B. D. Chaurasia, Handbook of General Anatomy. 6. Yoram Kluger et al., WSES Handbook of Mass Casualty Incident Management.
2.	**Journals & Periodicals** 1. Resuscitation 2. Journal of Emergency Nursing 3. Injury 4. Emergency Medicine Journal

	5. Prehospital and Disaster Medicine
3.	**Codes, Standards & Online Resources** 1. American Heart Association (BLS Guidelines) – https://cpr.heart.org 2. European Resuscitation Council – https://erc.edu 3. Indian Red Cross Society – https://indianredcross.org 4. St. John Ambulance India 5. World Health Organization – Emergency Care – https://www.who.int 6. Occupational Safety and Health Administration (OSHA) – https://www.osha.gov 7. National Disaster Management Authority (NDMA) – https://ndma.gov.in 8. International Liaison Committee on Resuscitation (ILCOR) – https://www.ilcor.org

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

COURSE CODE:	**COURSE NAME:**	**SEMESTER:**
BTFS515	**Introduction to Fire Dynamics**	V

Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**

3	2	0	**5**	3	1	0	**4**

Course Pre-requisites	Building Fire Prevention & Protection Measures
Course Category	Professional Core
Course focus	Skill development
Rationale	The rationale behind the introduction to fire dynamics is to provide a fundamental understanding of the science and behavior of fires. Fire dynamics is the study of how fires start, develop, and spread, and it is essential for firefighters, fire investigators, fire safety engineers, and other professionals involved in fire prevention, suppression, and mitigation. The key rationales behind the introduction to fire dynamics are fire Behavior Prediction, Firefighter Safety, Fire Investigation, Fire Protection Engineering, Fire Prevention, Firefighter Training and Tactics, Research and Innovation Overall, the rationale behind the introduction to fire dynamics is to provide individuals with a solid foundation of knowledge about the science and behavior of fires. This knowledge is critical for effective firefighting, fire investigation, fire protection engineering, fire prevention, and advancing the field of fire science and engineering through research and innovation
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain the principles of heat transfer, thermodynamics and combustion governing fire behaviour. 2. Explain ignition and combustion characteristics of solid, liquid and gaseous fuels. 3. Analyze fire growth, flame spread, heat release rate and smoke generation. 4. Analyze heat transfer during fires and its effects on structures, materials and occupants. 5. Apply experimental methods to evaluate fire dynamics and combustion characteristics.

Course Content (Theory)	**Weightage**	**Contact hours**
Unit I: Heat Transfer & Combustion Fundamentals: Fundamentals of heat transfer mechanisms in solids and fluids; Material and energy balances; Fundamentals of combustion; Chemical thermodynamics; Chemical kinetics; Premixed and diffusion combustion; Flame propagation; Combustion efficiency; Physico-chemical properties of combustible materials.	20%	9
Unit II: Combustion Thermodynamics: Steady-state and transient heat conduction; Heat generation; Thermal insulation; Selection criteria; Critical and optimum insulation thickness; Extended surfaces (fins); Thermochemistry; Conservation equations; Combustion chemistry; Adiabatic flame temperature calculations.	20%	9

Unit III: Ignition & Fire Spread: Ignition of solid, liquid and gaseous fuels; Fire characteristics of gaseous fuels; Premixed and diffusion flames; Liquid pool fires; Burning rate; Flame spread; Gasification; Charring; Melting; Spontaneous ignition; Fire spread mechanisms.	20%	9
Unit IV: Fire Growth & Smoke Dynamics: Heat of combustion; Heat Release Rate (HRR); Fire growth stages; Flashover; Fire plumes; Flame height; Smoke generation; Smoke movement; Smoke toxicity; Visibility assessment; Smoke calculations.	20%	9
Unit V: Heat Transfer in Fires: Conductive, convective and radiative heat transfer during fires; Heat transfer to surrounding materials and structures; Thermal properties of construction materials; Fire resistance concepts; Heat transfer calculations for metals, composites, insulators and building materials.	20%	9

List Of Practical	**Weightage**	**Contact hours**
1. Steady-state conduction; Composite wall heat transfer; Forced and natural convection; Radiation heat transfer; Thermal insulation studies.	20%	6
2. Determination of calorific value; Flash point and fire point; Ignition characteristics of solid fuels.	20%	6
3. Pool fire experiments; Spill fire behaviour; Ignition of flammable vapour–air mixtures.	20%	6
4. Heat Release Rate (HRR); Smoke generation and smoke movement studies.	20%	6
5. Thermal properties of construction materials; Heat transfer calculations; Fire dynamics case studies.	20%	6

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation

Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: Explain heat transfer and combustion principles governing fire behaviour. CO2: Explain ignition and combustion characteristics of solid, liquid and gaseous fuels. CO3: Analyze fire growth, flame spread, heat release rate and smoke behaviour. CO4: Analyze heat transfer during fires and its effects on structures, materials and occupants. CO5: Apply experimental techniques to evaluate fire dynamics and combustion characteristics.	Cognitive	Understand Understand Analyze Analyze Apply

Learning Resources	
1.	**Reference Books** 1. Donald Q. Kern; Process Heat Transfer; Tata McGraw Hill. 2. Alan J. Chapman; Heat Transfer; Collier McMillan. 3. Rao Y.V.C; Heat Transfer; PHI 4. Quintiere, J. G., Fundamentals of Fire Phenomena, John Wiley & Sons, Chichester, UK, 2006 5. Drysdale D, An Introduction to Fire Dynamics, 3rd Edition, John Wiley & Sons 6. iNenno, P.J. (Ed.), SFPE Handbbok of Fire Protection Engineering (4th Edition), NFPA, Quincy, MA,2008
2.	**Journals & Periodicals** 1. Fire Safety Journal (Elsevier) 2. Fire Technology (Springer) 3. Journal of Fire Sciences 4. Combustion and Flame 5. Proceedings of the Combustion Institute
3.	**Codes, Standards & Online Resources** 1. NFPA Fire Protection Handbook – https://www.nfpa.org 2. SFPE – Society of Fire Protection Engineers – https://www.sfpe.org 3. National Institute of Standards and Technology (NIST) – Fire Research – https://www.nist.gov/fire 4. Fire Dynamics Simulator (FDS) – NIST – https://pages.nist.gov/fds-smv 5. National Fire Protection Association (NFPA Codes & Standards) – https://www.nfpa.org/codes-and-standards 6. International Association for Fire Safety Science (IAFSS) – https://www.iafss.org 7. National Building Code of India 2016 – Part 4 (Fire & Life Safety) – https://www.bis.gov.in/national-building-code/

Evaluation Scheme	Total Marks	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks

	Total	**50 Marks**

COURSE CODE:		**COURSE NAME:**			**SEMESTER:**		
BTFS516		**Fire Drill Practical**			V		
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
0	4	0	**4**	0	2	0	**2**
Course Pre-requisites		Fire Drill Practical II					
Course Category		Program Core – Laboratory / Skill-based					
Course focus		Development of practical firefighting skills, rescue techniques, operation of fire protection equipment, emergency response, teamwork, leadership, and compliance with standard fire service practices through hands-on training and simulated emergency drills.					
Rationale		Fire drills and practical training are essential for developing the operational competencies required by fire and safety professionals. This course provides systematic hands-on training in firefighting, rescue operations, fire protection systems, emergency response, and industrial fire safety through progressive practical sessions. The curriculum develops technical proficiency in operating firefighting equipment, conducting rescue operations, responding to emergencies, and managing fire incidents while emphasizing discipline, teamwork, communication, leadership, safety practices, and adherence to national and international fire service standards. The course bridges theoretical concepts with field applications, preparing students for careers in industrial fire services, municipal fire brigades, airport fire services, emergency response organizations, and disaster management.					
Course Objectives		The course aims to: 1. Develop competency in firefighting drills, rescue techniques, and emergency response operations using standard firefighting procedures. 2. Demonstrate safe operation, inspection, maintenance, and application of firefighting equipment, appliances, and fire protection systems. 3. Apply standard operating procedures for fire suppression, rescue, evacuation, and emergency response in residential, commercial, and industrial environments. 4. Develop teamwork, leadership, communication, discipline, and					

	decision-making skills during firefighting and rescue operations. 5. Perform firefighting, rescue, and emergency management activities in accordance with national and international fire service standards and professional ethics.

Course Content (Theory)	Weightage	Contact hours
1. **Hydrants, Monitors & Nozzles:** Campus fire water system; Fire nozzles; Branches; Monitors	15%	8
2. **Fire Pumps & Water Tender:** Fire pump house; Motor fire engine; Water tender drill	15%	8
3. **Trailer Pump & Drafting:** Trailer pump; Water drafting and suction operations	15%	8
4. **Foam Firefighting Systems:** Foam tank operation; Inline inductor operation	15%	8
5. **Chemical Foam Firefighting:** Chemical foam generation and application	10%	7
6. **Fixed Fire Protection Systems:** Fixed fire protection system components	10%	7
7. **Water Spray & Water Curtain Systems:** Water spray and exposure protection systems	10%	7
8. **Utilities & Yard Safety:** Wind sock; Lightning arrester; Yard safety systems	10%	7

Instructional Method and Pedagogy:
Demonstration, Hands-on Practice, Drill Simulation, Group Exercise, Field Visit

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1 Demonstrate drill commands, discipline, teamwork, and safe operation of basic firefighting equipment during fire service activities.	Psychomotor	Apply
CO2 Perform firefighting, rescue, evacuation, and casualty handling operations using appropriate equipment and standard operating procedures.	Psychomotor	Apply
CO3 Operate and inspect portable and fixed fire protection systems, firefighting appliances, ladders, pumps, and rescue equipment during emergency response.	Psychomotor	Apply

CO4 Analyze emergency situations and execute appropriate firefighting, rescue, and incident response techniques while ensuring personal and team safety. CO5 Demonstrate professional competency, leadership, communication, discipline, and ethical practices while participating in fire drills, mock exercises, and emergency management activities.	Cognitive Affective	Analyze Apply

Learning Resources	
1.	**Reference Books** 1. Fire Service Manual – Volume I: Fire Service Drill, Ministry of Home Affairs, Government of India. 2. Fire Service Manual – Volume II: Fire Service Equipment, Ministry of Home Affairs, Government of India. 3. IFSTA, Essentials of Fire Fighting, 7th Edition, Fire Protection Publications. 4. Arthur E. Cote (Ed.), NFPA Fire Protection Handbook, Latest Edition. 5. V. K. Jain, Fire Safety in Buildings, New Age International Publishers.
2.	**Journals & Periodicals** 1. Fire Technology 2. Fire Safety Journal 3. Journal of Fire Sciences 4. Fire Engineering Magazine
3.	**Codes, Standards & Online Resources** 1. National Building Code of India 2016 – Part 4: Fire and Life Safety - https://www.bis.gov.in/national-building-code/ 2. National Fire Protection Association (NFPA) – Codes & Standards - https://www.nfpa.org/codes-and-standards 3. International Fire Service Training Association (IFSTA) - https://www.ifsta.org 4. Society of Fire Protection Engineers (SFPE) - https://www.sfpe.org

Evaluation Scheme	**Total Marks**	
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

COURSE CODE:	COURSE NAME:	SEMESTER:
BTFS518	**Fire Protection Systems**	V

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	**3**	3	0	0	**3**

Course Pre-requisites	Building Fire Prevention & Protection Measures
Course Category	Professional Core
Course focus	Fire Protection Engineering, System Design and Life Safety
Rationale	Fire Protection Systems are essential engineering controls for the prevention, detection, control, and suppression of fires in residential, commercial, industrial, and hazardous occupancies. The course provides knowledge of fire protection principles, system selection, design considerations, applicable standards, inspection, testing, maintenance, and special fire suppression systems. It enables students to evaluate, design, and manage fire protection systems for safeguarding life, property, and business continuity in compliance with national and international codes.
Course Revision/ Approval Date:	**14th May 2026**
Course Objectives	The course aims to: 1. Explain the principles, components, and applications of active fire protection systems. 2. Analyze occupancy hazards and select appropriate fire protection systems based on applicable codes and standards. 3. Apply basic design principles for water-based fire protection systems. 4. Evaluate inspection, testing, maintenance, and performance requirements of fire protection systems. 5. Explain the working principles and applications of fire detection, alarm, and special fire suppression systems.

Course Content (Theory)	Weightage	Contact hours
Unit I: Fire Protection Fundamentals: Principles of fire protection; Fire extinguishing media; Fire suppression mechanisms; Selection of extinguishing media; Fire hazard classification; Occupancy classification; Active and passive fire protection; Overview of NBC 2016 Part 4, IS Codes, NFPA Standards and OISD Guidelines.	20%	9
Unit II: Portable Fire Extinguishers: Classification of portable fire extinguishers; Types and construction; Fire classes; Selection and	20%	9

placement; IS 15683 requirements; Inspection, testing and maintenance; Refilling procedures; Safety precautions; Fire extinguisher signage and colour coding.		
Unit III: Water-Based Fire Protection Systems: Fire water storage; Fire pumps; Jockey pumps; Fire hydrant systems; Wet and dry risers; Hose reels; Landing valves; Yard hydrants; Fire brigade inlet; Water monitors; Basic hydraulic design considerations; Water demand calculations; Applicable IS and NFPA standards.	20%	9
Unit IV: Automatic Fire Suppression Systems: Automatic sprinkler systems; Sprinkler types and classifications; Sprinkler piping arrangements; Deluge systems; Pre-action systems; Water mist systems; Medium and High Velocity Water Spray Systems (MVWS & HVWS); Foam systems; System selection; Basic design principles; Inspection, testing and maintenance (ITM) requirements.	20%	9
Unit V: Fire Detection, Alarm & Special Systems: Fire detection principles; Heat, smoke and flame detectors; Manual Call Points (MCP); Fire Alarm Control Panel (FACP); Notification appliances; Detector spacing and placement; Addressable and conventional fire alarm systems; Clean agent systems; CO_2 systems; Kitchen hood suppression systems; Special hazard protection systems; Integration with Building Management Systems (BMS).	20%	9

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1 Explain the principles, components, and applications of fire protection systems used in various occupancies. CO2 Analyze occupancy hazards and select suitable portable and water-based fire protection systems based on applicable standards. CO3 Apply basic design principles for water-based and automatic fire suppression systems. CO4 Evaluate inspection, testing, maintenance, and performance requirements of fire protection systems in accordance with codes and standards.	Cognitive	Understand Analyze Apply Evaluate

CO5 Explain the working principles and applications of fire detection, alarm, and special fire suppression systems for different hazards.		Understand

Learning Resources	
1.	**Reference Books** 1. Arthur E. Cote, NFPA Fire Protection Handbook, Latest Edition. 2. Robert M. Gagnon, Designer's Guide to Automatic Sprinkler Systems, NFPA. 3. Dougal Drysdale, An Introduction to Fire Dynamics, Wiley. 4. Fire Service Manual, Volume 3: Fire Safety and Fire Protection of Buildings. 5. SFPE, Handbook of Fire Protection Engineering, Latest Edition.
2.	**Journals & Periodicals** 1. Fire Technology 2. Fire Safety Journal 3. Journal of Fire Sciences 4. Fire Engineering Magazine
3.	**Codes, Standards & Online Resources** 1. National Building Code of India 2016 – Part 4: Fire and Life Safety - https://www.bis.gov.in/national-building-code/ 2. NFPA Codes & Standards (NFPA 10, 13, 14, 15, 20, 22, 24, 25, 72, 2001) - https://www.nfpa.org/codes-and-standards 3. Bureau of Indian Standards (BIS) - https://www.bis.gov.in 4. Oil Industry Safety Directorate (OISD) Standards - https://www.oisd.gov.in 5. Society of Fire Protection Engineers (SFPE) - https://www.sfpe.org

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks	**20 marks**	
Theory: End Semester Marks	**40 marks**	
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	COURSE NAME:	SEMESTER:
BTFS519 (Batch 2025 onwards)	**Legislations related to Fire & Safety, Health Environment**	V

BTFS312 (Batch 2019-2024)							
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	**3**	3	0	0	**3**

Course Pre-requisites	Fundamentals of Fire & Environment, Health, Safety
Course Category	Professional Core
Course focus	Skill Development
Rationale	The primary objective of fire safety legislations is to protect human life and property from the devastating effects of fires. These laws require the implementation of preventive measures, such as fire detection systems, fire suppression equipment, and evacuation plans, to minimize the risk of fire incidents and provide a safe environment for people to live and work. Legislation related to environmental protection aims to prevent and mitigate environmental damage caused by human activities. These laws establish standards and regulations for industrial processes, waste management, emissions control, and pollution prevention to safeguard air, water, and soil quality. Health and safety legislations are designed to ensure that workplaces are safe and free from hazards that could cause harm to employees. These laws require employers to identify and assess workplace risks, implement measures to control hazards, provide appropriate training and personal protective equipment, and establish protocols for reporting and investigating accidents or incidents.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	To enable the student to: 1. Explain the scope, applicability and statutory requirements of industrial safety and fire safety legislations. 2. Explain legislations governing hazardous chemicals, petroleum, explosives, gas cylinders and pressure vessels. 3. Explain environmental protection and pollution control legislations applicable to industries. 4. Explain occupational safety legislations governing construction, docks, boilers, electricity and mining sectors. 5. Describe the roles, responsibilities and enforcement mechanisms of statutory regulatory authorities related to industrial safety and environmental protection.

Course Content (Theory)	Weightage	Contact hours
Unit 1: Industrial Safety Legislations: Introduction to Industrial Safety Legislations; Factories Act, 1948 and salient provisions (or overview of Occupational Safety, Health and Working Conditions (OSHWC) Code, 2020); Gujarat Factories Rules, 1963 (Latest Amendments); Gujarat Fire Prevention and Life Safety Measures Act, 2013 and Rules, 2016; Scope, Applicability and Compliance Requirements	20%	10
Unit 2: Hazardous Substance Legislations: Explosives Act, 1884 and Explosives Rules, 2008; Petroleum Act, 1934 and Petroleum Rules, 2002 (Latest Amendments); Gas Cylinders Rules, 2016; Static and Mobile Pressure Vessels (Unfired) Rules, 2016; Calcium Carbide Rules, 1987; Fire Insurance Assessment	20%	10
Unit 3: Environmental Legislations: Environment (Protection) Act, 1986; Water (Prevention and Control of Pollution) Act, 1974; Air (Prevention and Control of Pollution) Act, 1981; Manufacture, Storage and Import of Hazardous Chemicals (MSIHC) Rules, 1989; Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996	20%	10
Unit 4: Occupational Safety Legislations: Boilers Act. Electricity Act, 2003. Building and Other Construction Workers Act, 1996. Dock Workers (Safety, Health and Welfare) Act, 1986. Mines Act. Public Liability Insurance Act, 1991. Safety and welfare provisions applicable to various industrial sectors.	20%	10
Unit 5: Regulatory Framework: Directorate of Industrial Safety and Health (DISH); Petroleum and Explosives Safety Organisation (PESO); Ministry of Environment, Forest and Climate Change (MoEF&CC); Central Pollution Control Board (CPCB); Gujarat Pollution Control Board (GPCB); (Optional additions) National Disaster Management Authority (NDMA) and National Green Tribunal (NGT)	20%	5

Instructional Method and Pedagogy: Power Point Presentation ,Case study

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: **CO1: Explain** industrial safety and fire safety legislations applicable to industries. **CO2: Explain** statutory provisions governing hazardous	Cognitive	Understand

substances and pressure systems. **CO3: Explain** environmental protection legislations applicable to industrial operations. **CO4: Explain** occupational safety legislations applicable to different industrial sectors. **CO5: Describe** the functions and enforcement responsibilities of regulatory authorities involved in safety and environmental protection.		Understand Understand Understand Understand

Learning Resources	
1.	Reference Books:. 1. Factories Act – 1948 & Gujarat Factories Rules – 1963 with latest amendment 2. Environment Protection Act 3. Petroleum Acts & Rules 4. Boiler Acts 5. Electricity Acts & Rules 6. Building & other Construction workers Act 1986
2.	**Journals & Periodicals**
3.	**Codes, Standards & Online Resources**

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

Semester VI

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
											Theory Marks				Practical Marks	**Total Marks**
			L	P	T	***Total***	L	P	T	**Total**	MS	CEC	ES	***Total***		
1.	AECC501	Disaster Risk Management	2	-	-	***2***	2	-	-	**2**	20	40	40	***100***	--	**100**
2.	BTFS601	Safety Engineering	3	-	-	***3***	3	-	-	**3**	20	40	40	***100***	--	**100**
3.	BTFS603	Industrial Hygiene & Toxicology	3	2	-	***5***	3	1	-	**4**	20	40	40	***100***	50	**150**
4.	BTFS608	Fire System Design	2	2	-	***4***	2	1	-	**3**	20	40	40	***100***	50	**150**
5.	BTFS609	Environmental Pollution & Control Measures	3	2	-	***5***	3	1	-	**4**	20	40	40	***100***	50	**150**
6.	BTFS605 **A** **B** **C**	Professional Elective – I A - Smoke Control Systems B - Behaviour Based Safety C - Climate Change & Sustainability	3	-	-	***3***	3	-	-	**3**	20	40	40	***100***	--	**100**
7.	BTFS606	Fire drills & Practical – IV	-	4	-	***4***	-	2	-	**2**	--	--	--	**--**	50	**50**
8.	BTFS607	Industrial Internship	-	-	-	***-***	-	2	-	**2**	--	--	--	**--**	100	**100**
9.	BTOE (*) **07** **08**	Open Elective* 07 - Industrial Safety 08 - Fire Science	3	-	-	***3***	3	-	-	**3**	20	40	40	***100***	--	**100**
		Total				***26***				**26**						**900**

Note: L = Lecture, **P** = Practice, **T**= Tutorial, **MS -** Mid Semester, **CEC -** Continuous Evaluation Component**, ES -** End Semester

COURSE CODE:	COURSE NAME:	SEMESTER:
AECC501	**Disaster Risk Management**	VI

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	0	0	**2**	2	0	0	**2**

Course Pre-requisites	Nil
Course Category	Engineering Science Course
Course focus	Awareness building and analytical understanding of disaster risk management
Rationale	Disaster Risk Management (DRM) focuses on reducing the adverse impacts of natural and man-made disasters on life, property, infrastructure, and the environment. With increasing disaster risks associated with climate change, urbanization, and technological hazards, understanding disaster risks and management strategies is essential for engineers. This course introduces students to disaster concepts, disaster management frameworks, national and international policies, and the role of science and technology in disaster mitigation. It aims to build awareness, preparedness, and resilience and promote sustainable development through proactive disaster risk reduction.
Course Revision/ Approval Date:	
Course Objectives	The course aims to: 1. Introduce concepts, terminology and types of disasters. 2. Create awareness of disaster risk, vulnerability and impacts through case studies. 3. Explain disaster management frameworks and strategies at national and international levels. 4. Familiarize students with the role of science and technology in disaster mitigation and preparedness.

Course Content (Theory)	Weightage	Contact hours
Unit I: Introduction to Disasters and Risk Concepts: Concepts and definitions of disaster, hazard, vulnerability, risk and capacity. Disaster and development. Types of disasters: geological, hydro-meteorological, biological, technological and man-made. Global disaster trends, emerging risks, climate change and urban disasters.	25%	7 hours
Unit II: Disaster Management Cycle and Frameworks: Paradigm shift in disaster management. Disaster management cycle: prevention, mitigation, preparedness, response, relief, rehabilitation and recovery.	25%	7 hours

Risk assessment, risk mapping and early warning systems. International frameworks: IDNDR, Yokohama Strategy, Hyogo Framework and Sendai Framework.		
Unit III: Disaster Management in India: Disaster profile of India. Major disasters in India and lessons learnt. Disaster Management Act, 2005 – institutional and financial mechanisms. National Disaster Management Policy, plans and guidelines. Roles of central, state and local governments, NGOs and international agencies. Disaster management during the COVID-19 pandemic.	25%	7 hours
Unit IV: Science, Technology and Disaster Case Studies: Role of science and technology in disaster management. Use of GIS, GPS and remote sensing. Disaster communication and early warning dissemination. Disaster-resilient planning, structural and non-structural mitigation measures. Selected national and international disaster case studies including COVID-19.	25%	7 hours

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:	Cognitive	
CO1: Explain disaster concepts, terminology and types of disasters.		Understand
CO2: Describe the disaster management cycle and international frameworks.		Understand
CO3: Explain disaster management policies, institutions and practices in India.		Understand
CO4: Analyze the role of science and technology in disaster mitigation using case studies.		Analyze

Learning Resources

1.	**Reference Books** 1. Coppola, D.P., *Introduction to International Disaster Management*, Elsevier. 2. Carter, N., *Disaster Management: A Disaster Manager's Handbook*, ADB. 3. Asthana, N.C., *Disaster Management*, Aavishkar Publishers. 4. Gupta, A.K., *Environmental Knowledge for Disaster Risk Management*, NIDM
2.	**Journals & Periodicals** 1. *International Journal of Disaster Risk Reduction* 2. *Disaster Prevention and Management*
3.	**Codes, Standards & Online Resources** 1. National Disaster Management Authority (NDMA) - https://www.ndma.gov.in/ 2. Disaster Management Division, Ministry of Home Affairs, Government of India

	– https://www.ndmindia.mha.gov.in/ndmi/Home 3. National Institute of Disaster Management (NIDM) – https://nidm.gov.in/ 4. United Nations Office for Disaster Risk Reduction (UNDRR) – https://www.undrr.org/

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	**COURSE NAME:**			**SEMESTER:**			
BTFS601	**Safety Engineering**			VI			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	**3**	3	0	0	**3**

Course Pre-requisites	Safety Management II
Course Category	Professional Core
Course focus	Industrial Safety Engineering, Hazard Control and Risk Management
Rationale	Safety Engineering applies engineering principles to identify, evaluate, and control workplace hazards, ensuring safe design, operation, and maintenance of industrial systems. The course develops competency in plant safety, machinery safety, material handling, work-at-height, confined space safety, electrical safety, and industrial risk management. It enables students to integrate engineering controls, statutory requirements, and best safety practices to prevent accidents, protect workers, and improve operational reliability across industrial sectors.

Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain the principles of safety engineering, plant layout, and workplace safety management. 2. Analyze hazards associated with machinery, work equipment, and material handling operations. 3. Apply engineering controls and safe work practices for industrial operations and high-risk activities. 4. Evaluate hazards associated with work at height, confined spaces, and different industrial work environments. 5. Apply electrical safety principles, hazardous area classification, and statutory safety requirements in industrial facilities.

Course Content (Theory)	Weightage	Contact hours
Unit I: Plant Layout & Housekeeping: Plant location and layout principles; Siting criteria; Environmental and meteorological considerations; Separation distances; Factory layout; Fire protection layout; Housekeeping principles; 5S methodology; Workplace inspection; Safety audits; Preventive and Predictive maintenance; Colour coding and workplace organization.	20%	9
Unit II: Machine & Equipment Safety: Machine hazards; Work equipment safety; Safe use of hand and portable power tools; Machine guarding; Interlocks; Built-in safety devices; Lockout-Tagout (LOTO); Zero Mechanical State (ZMS); Inspection, testing and preventive maintenance; Ergonomic considerations.	20%	9
Unit III: Material Handling Safety: Manual material handling; Ergonomic lifting techniques; Mechanical material handling equipment; Cranes; Hoists; Forklifts; Rigging; Slings; Safe lifting practices; Storage and stacking; Load handling hazards; Inspection and statutory examination of lifting equipment.	20%	9
Unit IV: High-Risk Work Safety: Work at height; Fall protection systems; Scaffolding; Ladders; Permit-to-work; Confined space entry; Underground work; Lone working; Slips, trips and falls; Emergency rescue; Contractor safety; Behaviour-Based Safety (BBS).	20%	9
Unit V: Electrical & Hazardous Area Safety: Electrical hazards; Earthing and bonding; Electrical protective devices; Circuit breakers; Transformers; Hazardous area classification; Explosion protection techniques; Intrinsically safe equipment; Flameproof equipment; Static electricity; Electrical safety standards and statutory requirements.	20%	9

Instructional Method and Pedagogy: PPT, Tutorial, Video Presentation		
Course Outcomes:	**Blooms' Taxonomy Domain**	**Blooms' Taxonomy Sub Domain**
After successful completion of the above course, students will be able to: CO1: Explain the principles of safety engineering, plant layout, and workplace safety management. CO2: Analyze hazards associated with machinery, work equipment, and material handling operations and recommend appropriate control measures. CO3: Apply engineering controls and safe work practices for material handling and industrial operations. CO4: Evaluate hazards associated with work at height, confined spaces, and other high-risk industrial activities. CO5: Apply electrical safety principles, hazardous area classification, and statutory safety requirements for industrial facilities.	Cognitive	Understand Analyze Apply Evaluate Apply

Learning Resources	
1.	**Reference Books** 1. Roger L. Brauer, Safety and Health for Engineers, 3rd Edition, Wiley. 2. Frank P. Lees, Lees' Loss Prevention in the Process Industries, 4th Edition, Elsevier. 3. John Ridley & John Channing, Safety at Work, 9th Edition, Butterworth-Heinemann. 4. Charles D. Reese, Occupational Health and Safety Management: A Practical Approach, CRC Press. 5. National Safety Council, Accident Prevention Manual for Business & Industry, Latest Edition.
2.	**Journals & Periodicals** 1. Safety Science 2. Journal of Safety Research 3. Process Safety Progress 4. Journal of Loss Prevention in the Process Industries
3.	**Codes, Standards & Online Resources** 1. ISO 45001:2018 – Occupational Health and Safety Management Systems - https://www.iso.org/iso-45001-occupational-health-and-safety.html 2. Occupational Safety, Health and Working Conditions Code, 2020 - https://labour.gov.in

	3. Occupational Safety and Health Administration (OSHA) - https://www.osha.gov 4. National Fire Protection Association (NFPA) - https://www.nfpa.org

Evaluation Scheme	Total Marks	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE:	COURSE NAME:			SEMESTER:			
BTFS603	**Industrial Hygiene & Toxicology**			VI			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	**5**	3	1	0	**4**

Course Pre-requisites	Basics of Occupational Health
Course Category	Professional Core
Course focus	Occupational Exposure Assessment, Industrial Hygiene and Toxicological Risk Management
Rationale	Industrial Hygiene and Toxicology focuses on the anticipation, recognition, evaluation, and control of workplace health hazards arising from chemical, physical, biological, and ergonomic agents. The course develops competencies in exposure assessment, industrial ventilation, occupational monitoring, toxicological evaluation, and health risk assessment. It equips students with the knowledge and practical skills required to protect worker health, ensure regulatory compliance, and implement effective occupational hygiene programs across industrial sectors.
Course Revision/ Approval Date:	**5th March 2024**

Course Objectives	The course aims to: 1. Explain the principles, scope, and professional practices of industrial hygiene and occupational toxicology. 2. Analyze occupational exposures using appropriate workplace monitoring and sampling techniques. 3. Apply industrial ventilation and engineering controls to minimize workplace health hazards. 4. Evaluate toxic substances based on their properties, exposure pathways, toxicokinetics, and health effects. 5. Assess occupational health risks using toxicological principles, exposure limits, and regulatory standards.

Course Content (Theory)	**Weightage**	**Contact hours**
Unit I: Fundamentals of Industrial Hygiene: Principles and scope of industrial hygiene; Role of industrial hygienist; Occupational health; Workplace health hazards; Chemical, physical, biological and ergonomic hazards; Exposure pathways; Hierarchy of controls; Occupational hygiene program; Regulatory framework; Roles of Safety Officer, Factory Medical Officer and Industrial Hygienist.	20%	9
Unit II: Occupational Exposure Assessment: Occupational Exposure Limits (OELs); TLV, PEL, REL, STEL, Ceiling Limits; Personal and area sampling; Real-time monitoring; Integrated sampling; Air sampling instruments; Sampling strategies; Exposure calculations; Vapour pressure; Workplace air monitoring; Exposure modelling; Biological Exposure Indices (BEI).	20%	9
Unit III: Industrial Ventilation & Exposure Control: General ventilation; Local Exhaust Ventilation (LEV); Dilution ventilation; Hood design; Duct design; Air cleaning devices; Industrial air conditioning; Airflow measurements; Ventilation calculations; Engineering controls; Administrative controls; Respiratory Protective Equipment (RPE); Testing and maintenance of ventilation systems.	20%	9
Unit IV: Principles of Toxicology: Fundamentals of toxicology; Toxic agents; Dose-response relationship; ADME; Routes of exposure; Acute and chronic toxicity; Local and systemic toxicity; LD_{50}; LC_{50}; Biological monitoring; Target organ toxicity; Mutagenicity; Carcinogenicity; Teratogenicity; Reproductive toxicity.	20%	9
Unit V: Occupational Toxicology & Health Risk Assessment: Toxicity of metals, gases, vapours, dusts, fumes and nanoparticles; Occupational respiratory diseases; Occupational skin diseases; Biological hazards; Occupational Health Risk Assessment (OHRA); Environmental Risk Assessment (ERA); Exposure control strategies; Hazard communication; Case studies in occupational toxicology.	20%	9

Practical Exercise	**Weightage**	**Contact Hours**
1. Measurement of workplace illumination using Lux Meter	10%	3

2. Workplace noise assessment using Sound Level Meter	10%	3
3. Air velocity measurement using Anemometer	10%	3
4. Heat stress assessment using WBGT Meter	10%	3
5. Ionizing radiation measurement using Dosimeter	10%	3
6. Electromagnetic field measurement	10%	3
7. Airborne contaminant sampling using Personal Air Sampling Pump	20%	6
8. Toxic gas monitoring using Dräger tubes and Gas Detectors	20%	6

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: Explain the principles of industrial hygiene, occupational health hazards, and workplace exposure pathways. CO2: Analyze occupational exposures using workplace monitoring, sampling techniques, and exposure assessment methods. CO3: Apply industrial ventilation principles and engineering controls to minimize workplace health hazards. CO4: Evaluate toxic substances based on toxicokinetics, toxicodynamics, dose-response relationships, and target organ toxicity. CO5: Assess occupational health risks using toxicological principles, exposure limits, biological monitoring, and regulatory requirements.	Cognitive	Understand Analyze Apply Evaluate Evaluate

Learning Resources

1.	**Reference Books** 1. Barbara A. Plog & Patricia J. Quinlan, Fundamentals of Industrial Hygiene, 7th Edition, National Safety Council. 2. Casarett & Doull, Toxicology: The Basic Science of Poisons, McGraw-Hill. 3. M. H. Fulekar, Industrial Hygiene and Chemical Safety, Wiley India. 4. Raja Sekhar Mamillapalli & Visweswara Rao, Occupational Health and Hygiene in Industries, BSP Books. 5. Patty's Industrial Hygiene, Wiley.
2.	**Journals & Periodicals** 1. Journal of Occupational and Environmental Hygiene

	2. Annals of Work Exposures and Health 3. Toxicology Letters 4. Journal of Occupational Health
3.	**Codes, Standards & Online Resources** 1. ACGIH – Threshold Limit Values (TLVs) & Biological Exposure Indices (BEIs) - https://www.acgih.org 2. NIOSH Manual of Analytical Methods (NMAM) - https://www.cdc.gov/niosh/nmam 3. Occupational Safety and Health Administration (OSHA) - https://www.osha.gov 4. AIHA – American Industrial Hygiene Association - https://www.aiha.org

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

COURSE CODE:	**COURSE NAME:**			**SEMESTER:**			
BTFS609	**Environmental Pollution & Control Measures**			VI			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	**5**	3	1	0	**4**

Course Pre-requisites	Environmental Studies
Course Category	Professional Core
Course focus	Environmental Pollution Prevention, Waste Management and Sustainable Environmental Protection
Rationale	Environmental Pollution and Control Measures provides comprehensive knowledge of environmental pollution, pollution monitoring, pollution prevention, waste management, hazardous waste management, environmental legislation and sustainable environmental practices. The course enables students to identify, evaluate and control environmental pollution arising from industrial and urban activities while complying with national and international environmental regulations. It also develops competencies in environmental monitoring, pollution control technologies, hazardous waste management, and environmental sustainability required for Fire, Health, Safety and Environmental professionals.
Course Revision/ Approval Date:	**14th May 2026**
Course Objectives	The course aims to: 1. Explain the sources, characteristics and impacts of environmental pollution and environmental quality parameters. 2. Apply suitable pollution monitoring and pollution control techniques for air, water and solid waste. 3. Evaluate environmental pollution prevention, waste minimization and cleaner production practices. 4. Analyze hazardous waste management practices including treatment, storage, transportation and disposal. 5. Interpret environmental legislation, standards and sustainable environmental management practices applicable to industries.

Course Content (Theory)	Weightage	Contact hours
Unit I: Environmental Pollution Fundamentals: Environment and ecosystem; Environmental pollution; Sources, classification and characteristics of pollutants; Air, water, soil, noise, thermal and radioactive pollution; Environmental quality standards; Environmental monitoring; Climate change; Global warming; Ozone depletion; Sustainable development; Environmental ethics.	20%	9
Unit II: Water Pollution & Control: Sources and characteristics of wastewater; Water quality parameters; Water pollution indicators; Sampling techniques; Wastewater treatment processes; Primary, secondary and tertiary treatment; Sludge treatment; Industrial	20%	9

wastewater treatment; Advanced treatment technologies; Water reuse and recycling; Effluent standards.		
Unit III: Air Pollution & Control: Sources of air pollution; Air pollutants; Atmospheric dispersion; Meteorological parameters; Ambient air quality monitoring; Stack monitoring; Air Quality Index (AQI); Particulate matter; Gaseous pollutants; Air pollution control equipment; Indoor air quality; Noise pollution and control measures.	20%	9
Unit IV: Solid & Hazardous Waste Management: Municipal solid waste; Industrial solid waste; Hazardous waste classification and characteristics; Biomedical waste; Plastic waste; E-waste; Battery waste; Construction and demolition waste; Waste segregation; Collection; Storage; Packaging; Labeling; Transportation; Recycling; Resource recovery; Composting; Incineration; Pyrolysis; Gasification; Landfills; Treatment, Storage and Disposal Facilities (TSDF); Waste minimization; Cleaner production; Circular economy principles.	20%	9
Unit V: Environmental Management & Regulations: Environmental Impact Assessment (EIA); Environmental Management System (ISO 14001); Environmental auditing; Hazardous and Other Wastes (Management & Transboundary Movement) Rules, 2016; Biomedical Waste Management Rules; Plastic Waste Management Rules; E-Waste Management Rules; Battery Waste Management Rules; Solid Waste Management Rules; Water Act, 1974; Air Act, 1981; Environment (Protection) Act, 1986; CPCB and SPCB guidelines; Basel Convention; Sustainable waste management practices; Industrial case studies.	20%	9

Practical	**Weightage**	**Contact Hours**
1. Determination of pH, Electrical Conductivity, Total Solids, TDS and TSS	15%	4
2. Determination of Dissolved Oxygen (DO), Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD)	15%	4
3. Determination of Total Hardness, Alkalinity and Chlorides	10%	3
4. Ambient Air Quality Monitoring (PM, Gaseous Pollutants)	15%	4
5. Stack Emission Monitoring and Noise Monitoring	15%	4
6. Solid Waste Characterization and Waste Segregation Study	10%	3
7. Hazardous Waste Identification, Compatibility, Labeling and Storage Practices	10%	4
8. Industrial Environmental Monitoring and Environmental Audit	10%	4

Case Study		

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation, Case studies

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: Explain the sources, characteristics and impacts of environmental pollution and environmental quality parameters. CO2: Apply pollution monitoring techniques and pollution control technologies for air and water pollution. CO3: Analyze solid and hazardous waste management practices and recommend suitable treatment and disposal methods. CO4: Evaluate environmental legislation, environmental management systems and regulatory requirements applicable to industries. CO5: Recommend sustainable environmental management strategies including cleaner production, waste minimization and resource recovery for industrial applications.	Cognitive	Understand Apply Analyze Evaluate Create

Learning Resources	
1.	**Reference Books** 1. C. S. Rao, Environmental Pollution Control Engineering, New Age International. 2. Metcalf & Eddy, Wastewater Engineering: Treatment and Resource Recovery, McGraw-Hill. 3. M. N. Rao & H. V. N. Rao, Air Pollution, McGraw-Hill. 4. Charles A. Wentz, Hazardous Waste Management, McGraw-Hill. 5. R. Rajagopalan, Environmental Studies: From Crisis to Cure, Oxford University Press.
2.	**Journals & Periodicals** 1. Environmental Pollution 2. Journal of Environmental Management 3. Science of the Total Environment 4. Environmental Monitoring and Assessment
3.	**Codes, Standards & Online Resources** 1. Ministry of Environment, Forest and Climate Change (MoEFCC) –

	https://moef.gov.in 2. Hazardous and Other Wastes (Management & Transboundary Movement) Rules, 2016 – https://moef.gov.in 3. Bureau of Indian Standards (BIS) – https://www.bis.gov.in 4. ISO 14001: Environmental Management Systems – https://www.iso.org/iso-14001-environmental-management.html

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

COURSE CODE:	**COURSE NAME:**			**SEMESTER:**			
BTFS605A	**Smoke Control Systems**			VI			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	**3**	3	0	0	**3**

Course Pre-requisites	Introduction to Fire Dynamics
Course Category	Professional Elective

Course focus	Fire Protection Engineering, Smoke Management and Life Safety
Rationale	Smoke is the primary cause of fatalities during building fires due to reduced visibility, toxic gas exposure, and heat. Smoke Control Systems are designed to manage smoke movement, maintain tenable conditions for occupant evacuation, facilitate firefighting operations, and minimize property damage. This course provides knowledge of smoke generation, smoke movement, smoke management strategies, design principles, performance-based fire engineering, and applicable codes and standards for smoke control systems in buildings.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain the principles of smoke generation, movement, and tenability during fires. 2. Analyze smoke movement using fire dynamics and performance-based engineering concepts. 3. Apply various smoke management techniques for different building occupancies. 4. Evaluate smoke control system design, HVAC integration, and smoke exhaust strategies. 5. Interpret codes, standards, testing procedures, and performance requirements for smoke control systems.

Course Content (Theory)	Weightage	Contact hours
Unit I: Smoke Generation & Fire Dynamics: Fundamentals of combustion; Smoke generation; Smoke constituents; Toxic and corrosive gases; Smoke layer formation; Buoyancy; Smoke plume; Fire growth; Fire dynamics; Smoke hazards; Impact of smoke on life safety and firefighting operations.	20%	9
Unit II: Smoke Movement & Tenability: Smoke movement in buildings; Stack effect; Wind effect; HVAC influence; Smoke migration; Tenability criteria; Visibility; Smoke temperature; Toxicity; Carbon monoxide exposure; Fractional Effective Dose (FED); ASET and RSET concepts; Smoke modelling fundamentals.	20%	9
Unit III: Smoke Management Systems: Smoke compartmentation; Smoke barriers; Smoke curtains; Pressurization systems; Natural smoke ventilation; Mechanical smoke exhaust systems; Smoke dilution; Atrium smoke management; Staircase and lift lobby pressurization; Smoke vents; System selection based on occupancy.	20%	9

Unit IV: Smoke Control System Design: Smoke exhaust calculations; Airflow calculations; Pressure differential calculations; Fan selection; Duct design; Damper systems; Smoke extraction systems; HVAC integration; Fire alarm interface; Control philosophy; Inspection, testing and maintenance of smoke control systems.	20%	9
Unit V: Performance-Based Design & Codes: Performance-based fire engineering; CFD-based smoke modelling; Computational analysis; ASET-RSET assessment; Evacuation analysis; Commissioning and validation; NBC 2016 Part 4; NFPA 92; ASHRAE guidelines; IS standards; Smoke control case studies.	20%	9 hours

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: Explain the principles of smoke generation, movement, and tenability during building fires. CO2: Analyze smoke movement and tenability using fire dynamics and performance-based engineering principles. CO3: Apply appropriate smoke management techniques for different building occupancies and fire scenarios. CO4: Evaluate the design and integration of smoke control systems with HVAC and fire protection systems. CO5: Interpret codes, standards, and performance-based design requirements for smoke control systems.	Cognitive	Understand Analyze Apply Evaluate Evaluate

Learning Resources

1.	**Reference Books:** 1. John H. Klote & James A. Milke, *Principles of Smoke Management*, ASHRAE. 2. SFPE, *SFPE Handbook of Fire Protection Engineering*, Springer. 3. Dougal Drysdale, *An Introduction to Fire Dynamics*, Wiley. 4. John G. Quintiere, *Fundamentals of Fire Phenomena*, Wiley. 5. Morgan J. Hurley (Ed.), *SFPE Handbook of Fire Protection Engineering*, 6th Edition, Springer.
2.	**Journals & Periodicals** 1. Fire Safety Journal 2. Fire Technology 3. Journal of Fire Sciences

	4. Fire Engineering
3.	**Codes, Standards & Online Resources** 1. National Building Code of India 2016 – Part 4: Fire and Life Safety - https://www.bis.gov.in/national-building-code/ 2. NFPA 92 – Standard for Smoke Control Systems - https://www.nfpa.org/codes-and-standards 3. ASHRAE Handbook – HVAC Applications (Smoke Management) - https://www.ashrae.org 4. Society of Fire Protection Engineers (SFPE) - https://www.sfpe.org 5. Bureau of Indian Standards (BIS) - https://www.bis.gov.in

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	**COURSE NAME:**			**SEMESTER:**			
BTFS605B	**Behaviour Based Safety**			VI			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	**3**	3	0	0	**3**
Course Pre-requisites	Safety Management I & II						
Course Category	Professional Elective						
Course focus	Behavioural Safety, Human Performance and Safety Culture						
Rationale	Behaviour Based Safety (BBS) is a proactive approach to improving workplace safety by identifying, analyzing, and influencing employee behaviours that contribute to occupational accidents and incidents. The						

	course develops competencies in behavioural observation, safety culture, human factors, human error reduction, ergonomics, and organizational safety leadership. It enables students to design and implement behaviour-based interventions that enhance workplace safety performance, employee engagement, and organizational excellence.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain the principles of Behaviour Based Safety and its role in developing a positive safety culture. 2. Analyze human behaviour, human factors, and critical behaviours influencing workplace safety. 3. Apply Behaviour Based Safety tools and behavioural observation techniques for organizational safety improvement. 4. Evaluate human errors, human reliability, and behavioural interventions to reduce workplace risks. 5. Apply ergonomic principles and human-centered design concepts to improve workplace health, safety, and productivity.

Course Content (Theory)	Weightage	Contact hours
Unit I: Behaviour Based Safety Fundamentals: Evolution and principles of Behaviour Based Safety (BBS); Safety culture and safety climate; Human behaviour; Psychology of safe behaviour; Attitude, perception, motivation, personality, memory and learning; Antecedent–Behavior–Consequence (ABC) model; Behavioural reinforcement; Unsafe acts and unsafe conditions; Heinrich's Domino Theory; Bird's Loss Causation Model; Human Performance concepts.	20%	9
Unit II: Human Behaviour & Safety Culture: Human factors influencing accidents; Behavioural analysis; Critical behaviour identification; Risk perception; Decision making; Behavioural observation process (BOP); Observation checklists; Feedback techniques; Positive reinforcement; Employee engagement; Safety culture maturity models; Safety communication; Behavioural performance indicators.	20%	9
Unit III: BBS Implementation & Leadership: BBS implementation process; Steering committee; Behavioural observations; Safety coaching; Safety leadership; Employee participation; Behavioural interventions; Goal setting; Safety performance measurement; Key Performance Indicators (KPIs); Human and Organizational Performance (HOP); Continuous improvement; Case studies.	20%	9

Unit IV: Human Factors & Human Reliability: Human factors engineering; Human error; Types and causes of human error; Human Reliability Analysis (HRA); HEART; THERP; SPAR-H; SHERPA; Task Analysis; Fatigue; Stress; Situational awareness; Human-machine interaction; Human error prevention strategies.	20%	9
Unit V: Ergonomics & Human-Centered Design: Principles of ergonomics; Physical, cognitive and organizational ergonomics; Anthropometry; Manual material handling; Workstation design; Musculoskeletal disorders; Ergonomic risk assessment tools (RULA, REBA, NIOSH Lifting Equation); Human-centered workplace design; Office ergonomics; Industrial applications.	20%	9

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1: Explain the principles of Behaviour Based Safety and their role in developing a positive safety culture.	Cognitive	Understand
CO2: Analyze human behaviour, safety culture, and behavioural factors influencing workplace safety.		Analyze
CO3: Apply Behaviour Based Safety tools, behavioural observation techniques, and leadership principles to improve organizational safety performance.		Apply
CO4: Evaluate human errors and apply human reliability methods to minimize workplace risks and improve system performance.		Evaluate
CO5: Apply ergonomic principles and human-centered design concepts to improve workplace health, safety, and productivity.		Apply

Learning Resources

1.	**Reference Books** 1. E. Scott Geller, The Psychology of Safety Handbook, CRC Press. 2. B.S. Dhillon, Safety and Human Error in Engineering Systems, CRC Press. 3. CCPS, Guidelines for Preventing Human Error in Process Safety, Wiley. 4. James Reason, Human Error, Cambridge University Press. 5. John Ridley & John Channing, Safety at Work, Butterworth-Heinemann.

2.	**Journals & Periodicals** 1. Safety Science 2. Journal of Safety Research 3. Human Factors 4. Ergonomics
3.	**Codes, Standards & Online Resources** 1. ISO 45001:2018 – Occupational Health and Safety Management Systems - https://www.iso.org/iso-45001-occupational-health-and-safety.html 2. OSHA – Safety and Health Management Systems - https://www.osha.gov/safety-management 3. CCPS – Center for Chemical Process Safety - https://www.aiche.org/ccps 4. Human Factors and Ergonomics Society (HFES) - https://www.hfes.org 5. NIOSH – Ergonomics and Workplace Safety - https://www.cdc.gov/niosh

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	**COURSE NAME:**			**SEMESTER:**			
BTFS605C	**Climate Change & Sustainability**			VI			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	**3**	3	0	0	**3**
Course Pre-requisites	Environmental Pollution & Control Measures						
Course Category	Professional Elective						
Course focus	Climate Change Mitigation, Sustainability and Environmental Governance						

Rationale	Climate change is one of the most significant global environmental challenges affecting ecosystems, industries, infrastructure, and human health. Sustainable development requires balancing environmental protection, economic growth, and social well-being while reducing greenhouse gas emissions and improving climate resilience. This course provides knowledge of climate science, energy systems, climate adaptation and mitigation, sustainability principles, environmental governance, and global climate frameworks to enable students to contribute towards sustainable industrial development and climate-resilient societies.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain the scientific basis of climate change, greenhouse gases, and global climate systems. 2. Analyze climate change impacts, vulnerability, mitigation, and adaptation strategies. 3. Evaluate conventional and renewable energy systems from sustainability and environmental perspectives. 4. Apply sustainability principles, carbon management, and resource efficiency concepts for sustainable development. 5. Interpret international climate agreements, environmental policies, ESG principles, and sustainable development frameworks.

Course Content (Theory)	Weightage	Contact hours
Unit I: Climate Science & Global Warming: Climate system; Weather and climate; Earth's energy balance; Greenhouse effect; Greenhouse gases (CO_2, CH_4, N_2O, HFCs, SF_6); Global warming; Radiative forcing; Climate variability; Anthropogenic and natural causes of climate change; IPCC findings; Observed and projected climate trends.	20%	9
Unit II: Climate Change Impacts & Adaptation: Climate change impacts on ecosystems, water resources, agriculture, biodiversity, human health and industries; Sea level rise; Glacier retreat; Urban heat island; Extreme weather events; Climate vulnerability; Climate risk assessment; Adaptation and resilience strategies; Nature-based solutions; Disaster Risk Reduction (DRR).	20%	9
Unit III: Energy Systems & Decarbonization: Conventional energy resources; Renewable energy technologies; Solar, wind, biomass, geothermal, tidal and hydrogen energy; Energy efficiency; Energy conservation; Carbon emissions; Low-carbon technologies;	20%	9

Decarbonization pathways; Circular economy; Sustainable energy transitions.		
Unit IV: Sustainability & Carbon Management: Principles of sustainability; Triple Bottom Line; Sustainable Development Goals (SDGs); ESG principles; Carbon footprint; Green buildings; Life Cycle Assessment (LCA); Carbon accounting; Carbon credits; Carbon trading; Net Zero emissions; Cleaner production; Sustainable industrial practices.	20%	9
Unit V: Climate Governance & Sustainable Development: UNFCCC; IPCC; Kyoto Protocol; Paris Agreement; COP Conferences; Nationally Determined Contributions (NDCs); Climate finance; Environmental policies; National Action Plan on Climate Change (NAPCC); Environmental governance; Corporate sustainability reporting; Future climate scenarios and industrial case studies.	20%	9

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:	Cognitive	
CO1: Explain climate science, greenhouse gas emissions, and global climate change processes.		Understand
CO2: Analyze climate change impacts, vulnerability, and adaptation strategies for sustainable development.		Analyze
CO3: Evaluate renewable energy systems and decarbonization strategies for reducing greenhouse gas emissions.		Evaluate
CO4: Apply sustainability principles, carbon management techniques, and ESG concepts in industrial and environmental decision-making.		Apply
CO5: Interpret international climate agreements, national policies, and sustainable development frameworks for climate governance.		Evaluate

Learning Resources	
1.	**Reference Books** 1. IPCC, Sixth Assessment Report (AR6): Climate Change, Cambridge University Press.

	2. Mark Maslin, Climate Change: A Very Short Introduction, Oxford University Press. 3. Daniel M. Bodansky, International Climate Change Law, Oxford University Press. 4. Michael L. McKinney & Robert M. Schoch, Environmental Science: Systems and Solutions, Jones & Bartlett. 5. M. K. Tolba, Our Fragile World: Challenges and Opportunities for Sustainable Development, UNESCO.
2.	**Journals & Periodicals** 1. Climate Policy 2. Nature Climate Change 3. Climatic Change 4. Journal of Cleaner Production
3.	**Codes, Standards & Online Resources** 1. Intergovernmental Panel on Climate Change (IPCC) - https://www.ipcc.ch 2. United Nations Framework Convention on Climate Change (UNFCCC) - https://unfccc.int 3. United Nations Sustainable Development Goals (SDGs) - https://sdgs.un.org/goals 4. Ministry of Environment, Forest and Climate Change (MoEFCC) - https://moef.gov.in 5. International Energy Agency (IEA) - https://www.iea.org

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	**COURSE NAME:**	**SEMESTER:**
BTFS606	**Fire Drill Practical**	VI

Teaching Scheme (Hours)	**Teaching Credit**

Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
0	4	0	**4**	0	2	0	**2**

Course Pre-requisites	Fire Drill Practical III
Course Category	Program Core – Laboratory / Skill-based
Course focus	Development of practical firefighting skills, rescue techniques, operation of fire protection equipment, emergency response, teamwork, leadership, and compliance with standard fire service practices through hands-on training and simulated emergency drills.
Rationale	Fire drills and practical training are essential for developing the operational competencies required by fire and safety professionals. This course provides systematic hands-on training in firefighting, rescue operations, fire protection systems, emergency response, and industrial fire safety through progressive practical sessions. The curriculum develops technical proficiency in operating firefighting equipment, conducting rescue operations, responding to emergencies, and managing fire incidents while emphasizing discipline, teamwork, communication, leadership, safety practices, and adherence to national and international fire service standards. The course bridges theoretical concepts with field applications, preparing students for careers in industrial fire services, municipal fire brigades, airport fire services, emergency response organizations, and disaster management.
Course Revision/ Approval Date:	
Course Objectives	The course aims to: 1. Develop competency in firefighting drills, rescue techniques, and emergency response operations using standard firefighting procedures. 2. Demonstrate safe operation, inspection, maintenance, and application of firefighting equipment, appliances, and fire protection systems. 3. Apply standard operating procedures for fire suppression, rescue, evacuation, and emergency response in residential, commercial, and industrial environments. 4. Develop teamwork, leadership, communication, discipline, and decision-making skills during firefighting and rescue operations. 5. Perform firefighting, rescue, and emergency management activities in accordance with national and international fire service standards and professional ethics.

Course Content (Theory)	Weightage	Contact hours
1. **Fixed Fire Suppression Systems:** Water-based systems; Foam systems; Clean agent systems	15%	8
2. **Fire Detection & Alarm Systems:** Fire detection; Fire alarm systems	10%	7
3. **Breathing Apparatus & Fire Entry:** SCBA entry; Fire proximity suits; Fire entry suits	15%	8
4. **Confined Space Rescue:** Confined space and vertical rescue	15%	8
5. **Extension Ladder Drill:** Extension ladder handling and operation	10%	7
6. **Hook Ladder Drill**	10%	7
7. **High Reach Ladder Drill:** Turn-table ladder; High reach platform	10%	7
8. **Industrial Fire & Emergency Drill:** Industrial firefighting and coordinated emergency response	15%	8

Instructional Method and Pedagogy:
Demonstration, Hands-on Practice, Drill Simulation, Group Exercise, Field Visit

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1 Demonstrate drill commands, discipline, teamwork, and safe operation of basic firefighting equipment during fire service activities.	Psychomotor	Apply
CO2 Perform firefighting, rescue, evacuation, and casualty handling operations using appropriate equipment and standard operating procedures.	Psychomotor	Apply
CO3 Operate and inspect portable and fixed fire protection systems, firefighting appliances, ladders, pumps, and rescue equipment during emergency response.	Psychomotor	Apply
CO4 Analyze emergency situations and execute appropriate firefighting, rescue, and incident response techniques while ensuring personal and team safety.	Cognitive	Analyze
CO5 Demonstrate professional competency, leadership, communication, discipline, and ethical practices while participating in fire drills, mock exercises, and emergency management activities.	Affective	Apply

Learning Resources

1.	**Reference Books** 1. Fire Service Manual – Volume I: Fire Service Drill, Ministry of Home Affairs, Government of India. 2. Fire Service Manual – Volume II: Fire Service Equipment, Ministry of Home Affairs, Government of India. 3. IFSTA, Essentials of Fire Fighting, 7th Edition, Fire Protection Publications. 4. Arthur E. Cote (Ed.), NFPA Fire Protection Handbook, Latest Edition. 5. V. K. Jain, Fire Safety in Buildings, New Age International Publishers.
2.	**Journals & Periodicals** 1. Fire Technology 2. Fire Safety Journal 3. Journal of Fire Sciences 4. Fire Engineering Magazine
3.	**Codes, Standards & Online Resources** 1. National Building Code of India 2016 – Part 4: Fire and Life Safety - https://www.bis.gov.in/national-building-code/ 2. National Fire Protection Association (NFPA) – Codes & Standards - https://www.nfpa.org/codes-and-standards 3. International Fire Service Training Association (IFSTA) - https://www.ifsta.org 4. Society of Fire Protection Engineers (SFPE) - https://www.sfpe.org

Evaluation Scheme	**Total Marks**	
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

COURSE CODE:	**COURSE NAME:**	**SEMESTER:**
BTOE07	**Industrial Safety**	VI

Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	**3**	3	0	0	**3**

Course Pre-requisites	Nil
Course Category	Open Elective
Course focus	Employability
Rationale	Industrial Safety is essential for creating safe, healthy, and productive workplaces across manufacturing, construction, process industries, utilities, laboratories, and service sectors. The course introduces students to workplace hazards, hazard identification, risk assessment, accident prevention, emergency preparedness, incident investigation, safety performance, and legal requirements. It develops safety awareness and equips students with the knowledge required to recognize hazards, minimize occupational risks, and contribute to a positive safety culture irrespective of their engineering discipline.
Course Revision/ Approval Date:	03/03/2023
Course Objectives	The course aims to: 1. Explain the fundamentals of industrial safety, occupational health, and safety legislation. 2. Identify workplace hazards and apply basic hazard identification and risk assessment techniques. 3. Apply safe work practices and hazard control measures for common industrial activities. 4. Explain incident reporting, accident investigation, and emergency preparedness principles. 5. Evaluate safety performance through inspections, audits, and continuous improvement practices.

Course Content (Theory)	**Weightage**	**Contact hours**
Unit I: Introduction to Industrial Safety: Evolution of industrial safety; Occupational Safety and Health (OSH); Industrial accidents and occupational diseases; Hazard, risk, incident, accident and near miss; Safety culture; Roles and responsibilities of employers and employees; ILO, OSHA, DGFASLI and National Safety Council (India); Occupational Safety, Health and Working Conditions Code, 2020; Basic safety legislation.	20%	9
Unit II: Workplace Hazards & Risk Assessment: Classification of workplace hazards; Physical, chemical, biological, ergonomic and psychosocial hazards; Electrical hazards; Fire hazards; Slips, trips and falls; Manual material handling; Hazard Identification; Basic Risk	20%	9

Assessment; 5-Step Risk Assessment; 3×3 and 5×5 Risk Matrix; Hierarchy of Controls.		
Unit III: Hazard Control & Safe Work Practices: Safe work practices; Permit to Work (PTW) concept; Lockout/Tagout (LOTO); Machine guarding; Personal Protective Equipment (PPE); Housekeeping (5S); Material handling safety; Work at height; Confined space awareness; Electrical safety; Fire prevention; Safety signage; Behaviour-based safety concepts.	20%	9
Unit IV: Incident Investigation & Emergency Preparedness: Incident and accident reporting; Iceberg theory; Accident causation models; Incident investigation procedure; Root Cause Analysis (RCA); Corrective and preventive actions (CAPA); Emergency preparedness; Emergency response plans; Fire evacuation; First aid basics; Mock drills; Lessons learned from industrial accidents.	20%	9
Unit V: Safety Performance & Safety Management: Safety inspections; Safety audits; Safety observations; Safety performance indicators; Leading and lagging indicators; Safety training; Toolbox talks; Safety communication; Behavioural safety; Continuous improvement; ISO 45001 overview; Industrial case studies and best practices.	20%	9

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: Explain the fundamentals of industrial safety, occupational health, and workplace safety regulations. CO2: Identify workplace hazards and apply basic hazard identification and risk assessment techniques. CO3: Apply safe work practices and hazard control measures for common industrial activities. CO4: Explain incident reporting, accident investigation, and emergency preparedness procedures. CO5: Evaluate safety performance using inspections, audits, and safety management principles for continuous improvement.	Cognitive	Understand Apply Apply Understand Evaluate

Learning Resources	
1.	**Reference Books** 1. Phil Hughes & Ed Ferrett, Introduction to Health and Safety at Work, Routledge. 2. C. Ray Asfahl & David W. Rieske, Industrial Safety and Health Management, Pearson. 3. L. M. Deshmukh, Industrial Safety Management, Tata McGraw-Hill. 4. Benjamin O. Alli, Fundamental Principles of Occupational Health and Safety, ILO. 5. K. U. Mistry, Fundamentals of Industrial Safety, Siddharth Prakashan.
2.	**Journals & Periodicals** 1. Safety Science 2. Journal of Safety Research 3. Process Safety Progress 4. Industrial Safety Chronicle (NSC India)
3.	**Codes, Standards & Online Resources** 1. Occupational Safety, Health and Working Conditions Code, 2020 – https://labour.gov.in 2. Directorate General Factory Advice Service & Labour Institutes (DGFASLI) – https://dgfasli.gov.in 3. National Safety Council (India) – https://nsc.org.in 4. Occupational Safety and Health Administration (OSHA) – https://www.osha.gov 5. ISO 45001:2018 Occupational Health and Safety Management Systems – https://www.iso.org/iso-45001-occupational-health-and-safety.html

Evaluation Scheme	Total Marks	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	COURSE NAME:			SEMESTER:			
BTOE08	Fire Science			VI			
Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
3	0	0	**3**	3	0	0	**3**

Course Pre-requisites	
Course Category	Open Elective
Course focus	Employability
Rationale	Fire Science provides fundamental knowledge of fire behaviour, combustion processes, fire dynamics, explosion phenomena, compartment fires, and fire protection principles. The course enables students to understand the scientific principles governing fire development, fire hazards, smoke movement, and fire prevention strategies. It develops the ability to analyze fire scenarios, evaluate fire risks, and understand the application of active and passive fire protection systems in buildings and industries, making it suitable for students from all engineering disciplines.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain the principles of fire science and their application in fire safety engineering. 2. Apply combustion chemistry and fire dynamics principles to understand fire behaviour. 3. Analyze fire growth, explosion phenomena, and compartment fire behaviour. 4. Evaluate fire hazards and the influence of ventilation, smoke movement, and fire load on fire development. 5. Explain the principles and applications of active and passive fire protection systems.

Course Content (Theory)	Weightage	Contact hours
Unit I: Introduction to Fire Science: Fundamentals of fire science; Importance of fire science in engineering; History of major fire disasters; Fire triangle and fire tetrahedron; Fire chemistry; Heat transfer principles; Introduction to thermodynamics; Fluid mechanics; Heat and	20%	9

mass transfer; Fire safety terminology; Fire risk concepts.		
Unit II: Combustion Science & Fire Behaviour: Combustion chemistry; Complete and incomplete combustion; Oxidation and chain reactions; Heat of combustion; Calorific value; Stoichiometry; Fuel-air ratio; Ignition temperature; Flash point; Fire point; Auto-ignition temperature; Flammability limits (LFL/UFL); Classification of fires; Fire growth stages; Fire extinguishment principles.	25%	9
Unit III: Fire Dynamics & Explosion Phenomena: Fire dynamics; Diffusion and premixed flames; Smouldering combustion; Spontaneous ignition; Flame spread; Pool fires; Jet fires; Flash fires; Fireballs; Explosion fundamentals; BLEVE; Vapour Cloud Explosion (VCE); Dust explosions; Explosion protection principles; Industrial fire and explosion case studies.	20%	9
Unit IV: Compartment Fires & Smoke Movement: Compartment fire development; Fire growth phases; Flashover; Backdraft; Smoke generation; Smoke movement; Fire plume; Ceiling jet; Stack effect; Ventilation effects; Fire load calculations; Fire severity; Tenability; Introduction to smoke management concepts.	20%	9
Unit V: Fire Protection Principles: Fire prevention principles; Active fire protection systems; Portable fire extinguishers; Fire hydrants; Automatic sprinkler systems; Water spray systems; Foam systems; Fire detection and alarm systems; Passive fire protection; Fire resistance; Means of egress; Fire compartmentation; Fire doors; NBC 2016 overview; Introduction to NFPA standards.	20%	9

Instructional Method and Pedagogy:
PPT, Tutorial, Video Presentation

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: Explain the principles of fire science, combustion, and fire behaviour. CO2: Apply combustion chemistry and fire dynamics principles to analyze fire scenarios. CO3: Analyze fire growth, explosion phenomena, and fire hazards in industrial and built environments.	Cognitive	Understand Apply Analyze

CO4: Evaluate compartment fire behaviour, smoke movement, ventilation effects, and fire load for different occupancies. CO5: Explain the principles and applications of active and passive fire protection systems for life and property protection.		Evaluate Understand

Learning Resources	
1.	**Reference Books** 1. Dougal Drysdale, An Introduction to Fire Dynamics, 4th Edition, Wiley. 2. John G. Quintiere, Fundamentals of Fire Phenomena, Wiley. 3. Arthur E. Cote, NFPA Fire Protection Handbook, NFPA. 4. Morgan J. Hurley (Ed.), SFPE Handbook of Fire Protection Engineering, Springer. 5. A. M. Purandare, Handbook on Industrial Fire Safety, P&A Publications.
2.	**Journals & Periodicals** 5. Fire Safety Journal 6. Fire Technology 7. Journal of Fire Sciences 8. Fire Engineering Magazine
3.	**Codes, Standards & Online Resources** 11. National Building Code of India 2016 – Part 4: Fire and Life Safety - https://www.bis.gov.in/national-building-code/ 12. National Fire Protection Association (NFPA) Codes & Standards - https://www.nfpa.org/codes-and-standards 13. Society of Fire Protection Engineers (SFPE) - https://www.sfpe.org 14. Bureau of Indian Standards (BIS) - https://www.bis.gov.in

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	COURSE NAME:	SEMESTER:
BTFS608	Fire System Design	VI

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
2	2	0	**4**	2	1	0	**3**

Course Pre-requisites	*Fire protection systems*
Course Category	Core
Course focus	Employability
Rationale	The course "Fire System Design" is intended to provide students with practical and analytical knowledge for designing various fixed fire protection systems used in buildings, industries, tank farms, warehouses, commercial complexes, and hazardous occupancies. The course focuses on the interpretation and application of Indian Standards (IS), National Building Code (NBC), OISD Standards, and NFPA standards for designing sprinkler systems, medium and high velocity water spray systems, internal and external hydrant systems, fire pumps, water storage systems, and alarm integration. The course enables students to perform hydraulic calculations, hazard classification, system layout preparation, pump and tank capacity calculations, and code-based system selection for different occupancies and industrial hazards. Students will also gain hands-on exposure to .
Course Revision/ Approval Date:	14/05/2026
Course Objectives	1. Understand and interpret IS Codes, NBC, NFPA and OISD standards related to fire protection system design. 2. Design sprinkler systems for different hazard classifications using hydraulic calculations and code requirements. 3. Design medium velocity water spray (MVWS) and high velocity water spray (HVWS) systems for industrial applications. 4. Design internal hydrant, yard hydrant, hose reel, riser and fire water network systems. 5. Calculate fire water demand, pump capacity, tank sizing and pressure requirements. 6. Prepare basic fire protection layouts and design documentation for buildings and industrial facilities. 7. Evaluate fire protection system adequacy based on occupancy, fire load and hazard analysis.

Course Content (Theory)	Weightage	Contact hours

Unit 1: Introduction to Fire System Design: Design philosophy of active fire protection systems, overview of NBC Part 4, IS Codes, NFPA and OISD standards. Hazard classification and occupancy classification. Design basis report, fire load assessment, design density and area concepts. Introduction to hydraulic calculations and design parameters.	20%	9
Unit 2:Sprinkler System Design: Types of sprinkler systems, sprinkler characteristics and selection criteria. Hazard classification as per IS 15105 and NFPA 13. Pipe schedule and hydraulic calculation methods. Sprinkler spacing, remote area concept, water demand calculations, system zoning, alarm valves, installation requirements and design examples for commercial and industrial occupancies.	25%	9
Unit 3: Internal Hydrant & Yard Hydrant System Design: Design of wet riser, down comer and yard hydrant systems. Fire water demand calculations, hydrant spacing, hose reel requirements, underground and overhead fire water storage. Pump sizing and pressure calculations. Design of ring main systems, sectional valves, fire brigade inlets and accessories. Relevant provisions of IS 3844, NBC and OISD standards.	20%	9
Unit 4: Medium Velocity & High Velocity Water Spray System Design: Design principles and applications of MVWS and HVWS systems. Protection of transformers, cable galleries, conveyors and process equipment. Water spray nozzle types, spray density, discharge calculations, deluge valves and detection integration. Design criteria as per IS 15325, TAC, NFPA 15 and OISD standards.	20%	9
Unit 5: Fire Pumps, Water Storage & Design Documentation: Selection and sizing of fire pumps as per IS 15301 and NFPA 20. Jockey pumps, standby pumps and diesel engine-driven pumps. Fire water storage calculations. Preparation of fire protection drawings, P&ID basics, equipment schedules, BOQ preparation and review of practical case studies.	20%	9

Practical / Design Exercises

1. Hazard classification of different occupancies.
2. Sprinkler spacing and hydraulic calculation exercises.
3. Design of sprinkler system for commercial building.
4. Design of internal hydrant system for institutional building.
5. Design of yard hydrant network for industrial occupancy.
6. Pump head and fire water demand calculations.
7. MVWS/HVWS system design for transformer protection.
8. Preparation of fire protection layout using AutoCAD.
9. Preparation of design basis report and equipment schedule.
10. Case study analysis of industrial fire protection systems.

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain

1. Understand and interpret IS Codes, NBC, NFPA and OISD standards related to fire protection system design. 2. Design sprinkler systems for different hazard classifications using hydraulic calculations and code requirements. 3. Design medium velocity water spray (MVWS) and high velocity water spray (HVWS) systems for industrial applications. 4. Design internal hydrant, yard hydrant, hose reel, riser and fire water network systems. 5. Calculate fire water demand, pump capacity, tank sizing and pressure requirements. 6. Prepare basic fire protection layouts and design documentation for buildings and industrial facilities. 7. Evaluate fire protection system adequacy based on occupancy,	Cognitive	Understand Apply Analyze Evaluate Understand

Learning Resources

1.

Codes, Standards & Online Resources

Suggested Codes & Standards

Indian Standards (IS)

- IS 15105 – Automatic Sprinkler Systems – Code of Practice
- IS 3844 – Installation and Maintenance of Internal Fire Hydrants
- IS 13039 – External Hydrant Systems
- IS 15325 – Installation of Water Spray Systems
- IS 15301 – Installation of Fire Pumps
- IS 2189 – Fire Detection and Alarm Systems
- IS 2190 – Selection, Installation and Maintenance of Fire Extinguishers

NBC

- NBC 2016 Part 4 – Fire and Life Safety

NFPA Standards

- NFPA 13 – Installation of Sprinkler Systems
- NFPA 14 – Standpipe and Hose Systems
- NFPA 15 – Water Spray Fixed Systems
- NFPA 20 – Fire Pumps
- NFPA 24 – Private Fire Service Mains

OISD Standards

- OISD STD 117

Semester VII

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
											Theory Marks				Practical Marks	**Total Marks**
			L	P	T	***Total***	L	P	T	**Total**	MS	CEC	ES	***Total***		
1	BTFS701	Structural Behaviour & Passive Fire Protection	3	-	-	***3***	3	-	-	**3**	20	40	40	***100***	--	**100**
2	BTFS702	Managing Occupational Health	3	2	-	***5***	3	1	-	**4**	20	40	40	***100***	50	**150**
3	BTFS703	Safety Inspections & Audits	1	2	1	***4***	1	1	1	**3**	20	40	40	***100***	50	**150**
4	BTFS704	Environmental Impact Assessment	3	-	-	***3***	3	-	-	**3**	20	40	40	***100***	--	**100**
5	BTFS705	Fire & Safety in Major Accident Hazard Units	4	-	-	***4***	4	-	-	**4**	20	40	40	***100***	--	**100**
6	BTFS706 A B1 C	Professional Elective – II A - Fire Investigation B1 - Process Safety C - Wastewater Engineering	3	-	-	***3***	3	-	-	**3**	20	40	40	***100***	--	**100**
7	BTFS709	Minor Project	-	4	-	***4***	-	2	-	**2**	--	--	--	**--**	100	**100**
8	BTFS708	Industrial Internship	-	-	-	**-**	-	2	-	**2**	--	--	--	**--**	100	**100**
		Total				***29***				**24**						**1050**

Note: L = Lecture, **P =** Practice, **T=** Tutorial, **MS -** Mid Semester, **CEC -** Continuous Evaluation Component**, ES -** End Semester

COURSE CODE:		COURSE NAME:			SEMESTER:		
BTFS701		Structural Behaviour & Passive Fire Protection			VII		
Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
3	0	0	**3**	3	0	0	**3**

Course Pre-requisites	**Building fire prevention & protection**
Course Category	Professional Core
Course focus	Employability
Rationale	The rationale behind understanding structural behaviour and implementing passive fire protection measures is to ensure the safety and integrity of buildings and structures. Both aspects play crucial roles in protecting occupants and property from the effects of fire. 1. Structural Behaviour: Structural behaviour refers to the response of a building or structure to various loads and forces, including gravity, wind, seismic activity, and other environmental factors. Understanding structural behaviour is essential for designing and constructing buildings that can withstand these loads and maintain their stability. The key rationales are Safety, Load distribution, Performance under Extreme Events, Optimal Design. 2. Passive Fire Protection: Passive fire protection refers to measures that are designed to prevent or slow down the spread of fire within a building. It includes the use of fire-resistant materials, compartmentalization, fire barriers, and other strategies that do not rely on active systems like fire sprinklers or extinguishers. The key elements are Life Safety, Property Protection, Firefighter Safety, Code Compliance, Insurance Requirements.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain structural systems and fire behaviour of structural elements exposed to elevated temperatures. 2. Evaluate fire resistance, fire severity and structural performance using standard fire resistance methods. 3. Analyze fire behaviour and fire resistance characteristics of construction materials. 4. Apply compartmentation principles and fire resistance requirements for building fire safety.

	5. Evaluate fire stopping systems, fire and smoke dampers, and service penetrations for maintaining compartment integrity.

Course Content (Theory)	Weightage	Contact hours
Unit I: Structural Fire Behaviour: Structural systems; Load-bearing and non-load-bearing elements; Functions and design principles; Behaviour of structural elements at elevated temperatures; Structural response during fire; Fire resistance requirements for buildings; NBC 2016 Part 4 provisions.	20%	9
Unit II: Fire Resistance Assessment: Active and passive fire protection; Fire resistance concepts; Standard time–temperature curves; Fire resistance criteria; Fire severity and influencing factors; Fire severity calculations (Lie Method, Eurocode); Behaviour of columns and beams at elevated temperatures; Structural fire resistance assessment methods.	20%	9
Unit III: Fire Behaviour of Construction Materials: Fire behaviour of concrete, steel, masonry, timber, glass, polymers and cladding materials; Concrete spalling; Charring of timber; Loss of strength in steel; Fire protection methods for structural members; Fire performance testing of construction materials.	20%	9
Unit IV: Compartmentation & Fire Separation: Principles of compartmentation; Fire compartment sizing; Occupancy separation; Protection of exits; Hazardous area separation; Fire resistance rating of walls; Fire-rated doors, windows and glazing systems; Fire resistance test methods; NBC provisions.	20%	9
Unit V: Fire Stopping & Building Services: Building service penetrations; Curtain wall fire barriers; Fire stop materials and systems; Fire sealing for penetrations and joints; Fire dampers; Smoke dampers; Fire/smoke dampers in HVAC systems; Performance characteristics; Inspection and maintenance requirements.	20%	9
Instructional Method and Pedagogy: PPT, Chalkboard, Animated Videos, Tutorial		

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: Analyze the behaviour of structural elements subjected to fire exposure. CO2: Evaluate fire resistance, fire severity and structural performance using standard methods.	Cognitive	Analyze Evaluate

CO3: Analyze fire behaviour and fire resistance characteristics of construction materials. CO4: Apply compartmentation principles and fire resistance requirements for building fire safety. CO5: Evaluate fire stopping systems, service penetrations and fire/smoke dampers for maintaining compartment integrity.		Analyze Apply Evaluate

Learning Resources	
1.	**Reference Books:** 1. Andrew H. Buchanan & Anthony K. Abu, Structural Design for Fire Safety, 2nd Edition, Wiley. 2. V. K. Jain, Fire Safety in Buildings, New Age International. 3. NFPA, Fire Protection Handbook, Latest Edition. 4. National Building Code of India 2016, Part 4 – Fire and Life Safety, BIS. 5. Drysdale, D., An Introduction to Fire Dynamics, 4th Edition, Wiley. 6. SFPE, SFPE Handbook of Fire Protection Engineering, 6th Edition.
2.	**Journals & Periodicals** 1. Fire Safety Journal 2. Fire Technology 3. Journal of Fire Sciences 4. Engineering Structures 5. Case Studies in Fire Safety
3.	**Codes, Standards & Online Resources** 1. National Building Code of India (NBC 2016), Part 4 – Fire and Life Safety - https://www.bis.gov.in/national-building-code/ 2. Bureau of Indian Standards (BIS) - https://www.bis.gov.in 3. National Fire Protection Association (NFPA) – Codes & Standards - https://www.nfpa.org/codes-and-standards 4. Society of Fire Protection Engineers (SFPE) - https://www.sfpe.org 5. Fire Dynamics Simulator (FDS) – NIST - https://pages.nist.gov/fds-smv 6. National Institute of Standards and Technology (NIST) – Fire Research Division - https://www.nist.gov/fire 7. International Code Council (ICC) - https://www.iccsafe.org 8. International Association for Fire Safety Science (IAFSS) - https://www.iafss.org

Evaluation Scheme	Total Marks	
Theory: Mid semester Marks	**20 marks**	
Theory: End Semester Marks	**40 marks**	
	Attendance	05 marks

Theory: Continuous Evaluation Component Marks	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	**COURSE NAME:**			**SEMESTER:**			
BTFS702	**Managing Occupational Health**			VII			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	2	0	**5**	3	1	0	**4**
Course Pre-requisites	Industrial Hygiene & Toxicology						
Course Category	Professional Core						
Course focus	Employability						
Rationale	Worker Health and Well-being, Compliance with Legal Requirements, Enhanced Productivity and Performance, Reduction of Work-related Injuries and Illnesses, Cost Savings, Compliance with Social Responsibility, Sustainable Workforce. In summary, managing occupational health is crucial for protecting workers' health and well- being, complying with legal requirements, enhancing productivity, reducing workplace injuries and illnesses, achieving cost savings, fulfilling social responsibility, and maintaining a sustainable workforce. It is an integral part of responsible business practices and contributes to creating safe, healthy, and thriving workplaces.						
Course Revision/ Approval Date:	**5th March 2024**						
Course Objectives	The course aims to: 1. Explain occupational health principles, workplace health management systems and occupational health regulations. 2. Explain the assessment and control of occupational noise and vibration hazards. 3. Analyze heat stress, radiation hazards and appropriate control measures. 4. Apply ergonomics and human factor principles to prevent work-related						

	musculoskeletal disorders. 5. Evaluate biological hazards and occupational disease prevention strategies.

Course Content (Theory)	Weightage	Contact hours
Unit I: Occupational Health Fundamentals: Occupational health, safety, welfare, occupational illness, occupational diseases, accidents, dangerous occurrences and near-miss events; Direct and indirect costs of occupational injuries and illnesses; Safety culture; Occupational health management systems; Role of Government, ILO and WHO; Occupational Safety, Health and Working Conditions (OSHWC) Code, 2020; Occupational health provisions under applicable Indian regulations.	20%	9
Unit II: Noise & Vibration Hazards: Human ear anatomy; Noise-induced hearing loss; Noise measurement instruments; Calibration; Equivalent continuous noise level (LAeq), daily and weekly noise exposure; Noise control techniques; Hearing protection devices; Whole Body Vibration (WBV); Hand-Arm Vibration (HAV); Vibration measurement instruments; Exposure assessment; Vibration control measures.	20%	9
Unit III: Heat & Radiation Hazards: Sources of heat stress; Heat transfer mechanisms; Heat stress and heat strain; Thermal comfort; WBGT Index; Hydration and work-rest cycles; Ionizing and non-ionizing radiation; Radiation dose concepts; Radiation measurement instruments; Biological effects of radiation; Radiation protection and control measures.	20%	9
Unit IV: Ergonomics & Human Factors: Principles of ergonomics; Human factors engineering; Manual material handling; Lifting techniques; Postural assessment; Work-related Musculoskeletal Disorders (WMSDs); Revised NIOSH Lifting Equation; Ergonomic risk assessment tools; Administrative, engineering and PPE controls.	20%	9
Unit V: Biological Hazards: Biological agents; Classification of microorganisms; Occupational infectious diseases; Allergic sensitizers; Histoplasmosis; Bagassosis; Byssinosis; Woodworker's lung; Occupational cancers; Biological monitoring; Containment systems; Biosafety practices; Infection prevention and control measures.	20%	9
Practical	**Weightage**	**Contact Hours**
1. Measurement of blood pressure, pulse rate, body temperature and oxygen saturation using occupational health monitoring instruments.	20%	6
2. Audiometry; Noise exposure assessment; Colour blindness and	20%	6

visual acuity tests.		
3. Blood glucose estimation; Spirometry; ECG interpretation for occupational health screening.	20%	6
4. Vibration measurement using vibrometer; Workplace vibration assessment.	20%	6
5. Occupational health assessment report; Interpretation of physiological monitoring data; Case study on occupational disease prevention.	20%	6

Instructional Method and Pedagogy: PPT, Chalkboard, Animated Videos, Tutorial

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: Explain occupational health concepts, workplace health management systems and regulatory frameworks. CO2: Explain occupational noise and vibration hazards, exposure assessment and control measures. CO3: Analyze heat stress and radiation hazards and recommend suitable control measures. CO4: Apply ergonomics principles to evaluate and control work-related musculoskeletal disorders. CO5: Evaluate biological hazards and recommend occupational disease prevention and control strategies.	Cognitive	Understand Understand Analyze Apply Evaluate

Learning Resources

1.	**Reference Books:** 1. R Charles D. Reese, Occupational Health and Safety Management – A Practical Approach, CRC Press. 2. R. K. Jain, Industrial Safety, Health and Environment Management Systems, Khanna Publishers. 3. R. K. Mishra, Occupational Health Management, AITBS Publishers. 4. Jeremy Stranks, The Health and Safety Handbook, Kogan Page. 5. Frank R. Spellman, Handbook of Occupational Safety and Health, CRC Press. 6. ILO, Encyclopaedia of Occupational Health and Safety.
2.	**Journals & Periodicals** 1. Occupational and Environmental Medicine 2. Journal of Occupational Health 3. American Journal of Industrial Medicine 4. International Journal of Occupational Safety and Ergonomics

	5. Safety and Health at Work
3.	**Codes, Standards & Online Resources** 1. Occupational Safety, Health and Working Conditions (OSHWC) Code, 2020 - https://labour.gov.in 2. International Labour Organization (ILO) – Occupational Safety & Health - https://www.ilo.org/safework 3. World Health Organization (WHO) – Occupational Health - https://www.who.int/health-topics/occupational-health 4. Occupational Safety and Health Administration (OSHA) - https://www.osha.gov 5. National Institute for Occupational Safety and Health (NIOSH) - https://www.cdc.gov/niosh 6. ISO 45001:2018 Occupational Health and Safety Management Systems - https://www.iso.org/iso-45001-occupational-health-and-safety.html 7. American Conference of Governmental Industrial Hygienists (ACGIH) - https://www.acgih.org 8. International Ergonomics Association (IEA) - https://iea.cc 9. Indian Council of Medical Research (ICMR) - https://www.icmr.gov.in

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE:	COURSE NAME:	SEMESTER:
BTFS703	**Safety Inspections and Audits**	VII

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
1	2	1	**4**	1	1	1	**3**

Course Pre-requisites	Hazard Identification, Risk Management & Control Techniques
Course Category	Professional Core
Course focus	Employability
Rationale	Safety inspections and audits involve systematic assessments of workplaces, processes, procedures, and safety management systems. Here are the key rationales for conducting safety inspections and audits: Hazard Identification and Risk Assessment, Compliance with Legal and Regulatory Requirements, Continuous Improvement, Prevention of Accidents and Incidents, Employee Engagement and Participation, Management Accountability, Reputation and Stakeholder Confidence. In summary, safety inspections and audits are conducted to identify hazards, assess risks, ensure compliance, drive continuous improvement, prevent accidents, engage employees, hold management accountable, and enhance organizational reputation. These processes contribute to the creation of a safe and healthy work environment, protect employees' well-being, and promote the long-term success and sustainability of the organization.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain the principles, scope, planning and legal requirements of safety inspections and audits. 2. Apply occupational safety audit methodologies and inspection techniques to identify workplace hazards and evaluate compliance. 3. Evaluate fire safety systems, emergency preparedness and statutory compliance through structured fire audits. 4. Prepare audit reports, risk assessments, corrective action plans and follow-up reports for continual improvement.

Course Content (Theory)	Weightage	Contact hours
Unit I: Audit Fundamentals: Introduction to safety inspections and audits; Objectives, scope and types of audits; Audit planning; Audit protocol; Audit team selection; Resource allocation; Legal and ethical considerations; Audit frequency; Pre-audit activities; Company policy review; Applicable statutory requirements.	25%	4

Unit II: Occupational Safety Audit: Occupational Safety and Health (OSH) audit methodology; IS 14489 guidelines; Roles and responsibilities of auditor, auditee and client; Audit process; Workplace inspection; Housekeeping; Incident records; Employee interviews; Medical surveillance records; Safety committee evaluation; Training records; Compliance assessment.	25%	4
Unit III: Fire Safety Audit: Fire audit objectives; NBC 2016 Part 4 requirements; Means of egress; Fire detection and alarm systems; Portable and fixed fire protection systems; Emergency lighting; Public address systems; Smoke management; Fire vehicle accessibility; Hazardous occupancies; SCBA inspection and maintenance; Fire emergency preparedness.	25%	4
Unit IV: Audit Reporting & Follow-up: Closing meeting; Risk assessment; Audit findings; Non-conformities; Corrective and preventive actions (CAPA); Audit report preparation; Report documentation; Compliance verification; Follow-up audits; Continual improvement; Audit record retention.	25%	3

Practical	**Weightage**	**Contact Hours**
1. Preparation of audit checklist and questionnaires based on IS 14489, ISO 45001 and statutory requirements.	20%	6
2. Occupational Safety Audit of laboratories, workshops or industrial facilities including audit planning, inspection, documentation and report preparation.	40%	12
3. Fire Safety Audit of institutional or industrial buildings based on NBC 2016 including inspection, compliance assessment and final audit report.	40%	12

Tutorial Activity	**Contact Hours**	**Contact Hours**
1. Case studies on industrial accidents and audit findings	20%	3
2. Preparation of audit checklists and questionnaires	20%	3
3. Risk ranking and non-conformity classification	20%	3
4. Audit report writing and presentation	20%	3
5. Discussion on legal compliance and corrective action plans	20%	3

Instructional Method and Pedagogy: PPT, Chalkboard, Animated Videos, Tutorial

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: Explain the principles, planning and legal requirements of safety inspections and audits. CO2: Apply occupational safety audit methodologies to identify hazards and evaluate compliance. CO3: Evaluate fire safety systems and emergency preparedness through structured fire audits. CO4: Prepare audit reports, corrective action plans and follow-up documentation for continual improvement.	Cognitive	Understand Apply Evaluate Create

Learning Resources	
1.	**Reference Books:** 1. Simon Watson Pain, Safety, Health and Environmental Auditing: A Practical Guide, 2nd Edition, CRC Press. 2. E. Scott Dunlap, Loss Control Auditing, CRC Press. 3. CCPS, Guidelines for Auditing Process Safety Management Systems. 4. IFSTA, Fire Inspection and Code Enforcement, Latest Edition. 5. ISO 19011:2018, Guidelines for Auditing Management Systems. 6. Charles D. Reese, Occupational Health and Safety Management, CRC Press.
2.	**Journals & Periodicals** 1. Safety Science 2. Journal of Safety Research 3. Process Safety Progress 4. Fire Safety Journal 5. Journal of Loss Prevention in the Process Industries
3.	**Codes, Standards & Online Resources** 1. IS 14489:1998 – Code of Practice on Occupational Safety and Health Audit - https://www.services.bis.gov.in 2. ISO 19011:2018 – Guidelines for Auditing Management Systems - https://www.iso.org/standard/70017.html 3. ISO 45001:2018 Occupational Health and Safety Management Systems - https://www.iso.org/iso-45001-occupational-health-and-safety.html 4. National Building Code of India (NBC 2016) – Part 4 Fire and Life Safety - https://www.bis.gov.in/national-building-code/ 5. Occupational Safety, Health and Working Conditions Code, 2020 - https://labour.gov.in 6. National Fire Protection Association (NFPA) - https://www.nfpa.org/codes-and-standards 7. Occupational Safety and Health Administration (OSHA) - https://www.osha.gov

Evaluation Scheme	Total Marks
Theory: Mid semester Marks	**20 marks**

Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**
Practical Marks	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	Total	**50 Marks**

COURSE CODE:		**COURSE NAME:**		**SEMESTER:**			
BTFS704		**Environmental Impact Assessment**		VII			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	**3**	3	0	0	**3**

Course Pre-requisites	Environmental Pollution & Control Measures
Course Category	Professional Core
Course focus	Employability
Rationale	The EIAs aim to identify and mitigate adverse environmental effects, promote sustainable development, and facilitate informed decision-making. Here are the key rationales for conducting Environmental Impact Assessments: Sustainable Development, Environmental Protection, Decision-Making Tool, Stakeholder Engagement, Legal and Regulatory Compliance, Risk Management, Public Awareness and Education. In summary, the rationale behind conducting Environmental Impact Assessments is to promote sustainable development, protect the environment, support informed decision-making, engage stakeholders, ensure legal compliance, manage risks, and raise public awareness. EIAs serve as a critical tool for integrating environmental considerations into

	planning processes, minimizing adverse environmental impacts, and promoting a more sustainable and resilient future.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain the principles, objectives, methodologies and legal framework of Environmental Impact Assessment (EIA). 2. Analyze environmental hazards, environmental risks and risk management techniques associated with development projects. 3. Evaluate environmental impacts and prepare Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) reports. 4. Apply remote sensing, GIS, environmental modelling and environmental clearance procedures in EIA studies.

Course Content (Theory)	Weightage	Contact hours
Unit I: EIA Fundamentals & Methodologies: Environment and environmental impacts; Environmental Impact Assessment (EIA); Objectives and principles of EIA; EIA as a planning and decision-making tool; Screening and scoping; Rapid and Comprehensive EIA; EIA methodologies (Ad hoc, Checklist, Matrix, Network and Overlay methods); Selection criteria for EIA methodologies; Predictive models; Sustainable development; Life Cycle Assessment (LCA); Introduction to Strategic Environmental Assessment (SEA).	20%	11
Unit II: Environmental Risk Assessment: Hazard identification; Environmental Risk Assessment (ERA); Hazard identification techniques; Exposure assessment; Dose-response assessment; Risk characterization; Environmental risk management; Environmental health risk; Risk communication; Opportunities and challenges in Environmental Risk Assessment and Management (ERAM).	20%	11
Unit III: Impact Assessment & Environmental Management Plan: Baseline environmental data collection; Physical, biological and socio-economic environment; Impact identification and prediction; Environmental modelling; Public consultation and public hearing; Resettlement and Rehabilitation (R&R); Environmental Management Plan (EMP); Environmental Monitoring Plan; EIA report preparation; Review process.	20%	11
Unit IV: GIS, Environmental Clearance & Case Studies: Remote Sensing (RS); Geographic Information System (GIS); GPS applications in EIA; Environmental modelling software; EIA case studies; Environmental Impact Assessment Notification, 2006 and amendments;	20%	12

Environmental Clearance (EC) process; Siting guidelines for industries; Environmental Statement (Form V); Environmental compliance, monitoring and post-project auditing.		

Instructional Method and Pedagogy: PPT, Chalkboard, Animated Videos, Tutorial

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: Explain the principles, methodologies and legal framework of Environmental Impact Assessment. CO2: Analyze environmental hazards, environmental risks and risk management techniques. CO3: Evaluate environmental impacts and prepare Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) reports. CO4: Apply remote sensing, GIS, environmental modelling and environmental clearance procedures in EIA studies.	Cognitive	Understand Analyze Evaluate Apply

Learning Resources	
1.	**Reference Books:** 1. L. W. Canter, Environmental Impact Assessment, McGraw-Hill. 2. Peter Morris & Riki Therivel, Methods of Environmental Impact Assessment, Routledge. 3. Y. Anjaneyulu & V. Manickam, Environmental Impact Assessment, BS Publications. 4. Judith Petts, Handbook of Environmental Impact Assessment, Blackwell Science. 5. C. A. Wentz, Environmental Impact Assessment, McGraw-Hill. 6. S. K. Dhameja, Environmental Engineering and Management, S. K. Kataria & Sons.
2.	**Journals & Periodicals** 1. Environmental Impact Assessment Review 2. Journal of Environmental Management 3. Environmental Monitoring and Assessment 4. Environmental Science and Pollution Research 5. Journal of Cleaner Production
3.	**Codes, Standards & Online Resources** 1. Environmental Impact Assessment (EIA) Notification, 2006 (MoEFCC) - https://moef.gov.in 2. Ministry of Environment, Forest and Climate Change (MoEFCC) -

	https://moef.gov.in 3. State Environment Impact Assessment Authority (SEIAA) - https://environmentclearance.nic.in 4. Parivesh Portal (Environmental Clearance System) - https://parivesh.nic.in 5. National Green Tribunal (NGT) - https://greentribunal.gov.in 6. National Remote Sensing Centre (NRSC–ISRO) - https://www.nrsc.gov.in 7. Indian Institute of Remote Sensing (IIRS–ISRO) - https://www.iirs.gov.in 8. United Nations Environment Programme (UNEP) - https://www.unep.org 9. International Association for Impact Assessment (IAIA) - https://www.iaia.org

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	**COURSE NAME:**			**SEMESTER:**			
BTFS705	**Fire & Safety in Major Accident Hazard Units**			VII			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
4	0	0	**4**	4	0	0	**4**

Course Pre-requisites	Legislations Related to Fire & EHS, Safety Management II
Course Category	Professional Core
Course focus	Employability, Skill Development and Industry Readiness
Rationale	Major Accident Hazard Units (MAHUs) handle hazardous chemicals and processes that can lead to catastrophic events such as fires, explosions and toxic releases. Effective fire and safety management in MAHUs is essential to prevent major accidents, protect human life, safeguard the environment, ensure business continuity and comply with statutory requirements. This course provides knowledge of hazard identification, fire prevention,

	emergency planning, consequence analysis and regulatory frameworks applicable to MAHUs. It also covers fire and safety practices in chemical, fertilizer, aviation, maritime and nuclear industries, enabling students to develop competencies in risk reduction, emergency preparedness and regulatory compliance.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain the concepts of Major Accident Hazard (MAH) units, hazardous chemicals and applicable statutory regulations. 2. Analyze fire, explosion and toxic release hazards in chemical and fertilizer industries and recommend appropriate control measures. 3. Evaluate fire safety systems, operational hazards and emergency preparedness in aviation, maritime and nuclear industries. 4. Apply emergency planning, consequence analysis and major hazard control systems for MAH units. 5. Evaluate statutory responsibilities, documentation, safety reports and regulatory compliance for effective MAH management.

Course Content (Theory)	**Weightage**	**Contact hours**
Unit I: Major Accident Hazard Fundamentals: Major Accident Hazard (MAH); Major industrial hazards; Fire, explosion and toxic release scenarios; Hazardous chemicals and threshold quantities; Identification and classification of MAH units; Duties of occupier; MSIHC Rules, 1989 (as amended); Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996; ILO Convention C174; On-site and Off-site Emergency Plans; Introduction to COMAH principles.	20%	12
Unit II: Chemical & Fertilizer Industry Safety: Chemical and fertilizer manufacturing processes; Hazardous raw materials and products; Storage of LPG, chlorine, anhydrous ammonia and ammonium nitrate; Hazard Identification and Vulnerability Assessment (HIVA); Fire and explosion hazards; Fire prevention and protection systems; Safety in design and operation; Chemical emergencies; Toxic release scenarios; Process safety measures.	20%	12
Unit III: Fire Safety in High-Risk Industries: Fire safety in aviation industry; Airport hazards; Aircraft hangars; Refuelling and defuelling operations; Aircraft Rescue and Fire Fighting (ARFF); Crash Fire Tenders (CFT); Maritime environment; Shipbreaking industry hazards; Cargo vessel fire safety; Nuclear industry; Radiation protection; Radioactive waste management; Emergency preparedness; Fire protection systems in Nuclear Power Plants (NPPs).	20%	12
Unit IV: Emergency Planning & Consequence Analysis: Objectives	20%	12

of emergency planning; Emergency Control Centre; Alarm and communication systems; On-site and Off-site Emergency Plans; Mock drills; Consequence analysis; Gas dispersion; Vapour cloud explosion; BLEVE; Thermal radiation; Blast overpressure; Toxic dispersion; Public information; Emergency response coordination.		
Unit V: MAH Compliance & Safety Management: Roles and responsibilities of occupier, management, workers and regulatory authorities; Role of Safety Officer, Fire Officer and Incident Commander; Safety documentation; Safety Report; Notification of major accidents; Information dissemination; Regulatory inspections; Safety audits; Compliance monitoring; Lessons learned from major industrial accidents.	20%	12

Instructional Method and Pedagogy: PPT, Chalkboard, Videos, Case Studies

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: Explain major accident hazards, hazardous chemicals and statutory requirements applicable to MAH units. CO2: Analyze fire, explosion and toxic release hazards in chemical and fertilizer industries and recommend appropriate safety measures. CO3: Evaluate fire safety systems and emergency preparedness in aviation, maritime and nuclear industries. CO4: Apply emergency planning and consequence analysis techniques to minimize the impact of major industrial accidents. CO5: Evaluate statutory compliance, safety documentation and management responsibilities for effective MAH control.	Cognitive	Understand Analyze Evaluate Apply Evaluate

Learning Resources

1.	**Reference Books:** 1. Trevor Kletz, What Went Wrong? Case Histories of Process Plant Disasters, Elsevier. 2. CCPS, Guidelines for Chemical Process Quantitative Risk Analysis, AIChE. 3. CCPS, Guidelines for Hazard Evaluation Procedures, AIChE. 4. Frank P. Lees, Lees' Loss Prevention in the Process Industries, 4th Edition, Elsevier. 5. Daniel A. Crowl & Joseph F. Louvar, Chemical Process Safety: Fundamentals with Applications, Pearson. 6. Mannan, Lees' Process Safety Essentials, Elsevier.

2.	**Journals & Periodicals** 1. Process Safety Progress 2. Journal of Loss Prevention in the Process Industries 3. Safety Science 4. Fire Safety Journal 5. Process Safety and Environmental Protection
3.	**Codes, Standards & Online Resources** 1. Manufacture, Storage and Import of Hazardous Chemicals (MSIHC) Rules, 1989 - https://moef.gov.in 2. Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996 - https://moef.gov.in 3. Factories Act, 1948 / Occupational Safety, Health and Working Conditions Code, 2020 - https://labour.gov.in 4. National Disaster Management Authority (Chemical Disaster Guidelines) - https://ndma.gov.in 5. CCPS – Center for Chemical Process Safety - https://www.aiche.org/ccps 6. International Labour Organization (ILO) – Convention C174 - https://www.ilo.org 7. National Fire Protection Association (NFPA) - https://www.nfpa.org/codes-and-standards 8. United Nations Environment Programme (UNEP) – Chemical Safety - https://www.unep.org

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	**COURSE NAME:**	**SEMESTER:**
BTFS706A	**Fire Investigation**	VII

Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	**3**	3	0	0	**3**

Course Pre-requisites	Smoke Control System
Course Category	Professional Elective
Course focus	Employability
Rationale	Fire investigation is a systematic scientific process used to determine the origin, cause, and circumstances of fire incidents. Accurate fire investigation is essential for identifying ignition sources, determining fire spread mechanisms, establishing legal accountability, supporting insurance claims, preventing recurrence of similar incidents, and improving fire safety practices. This course provides students with knowledge of fire scene examination, evidence collection and preservation, fire cause analysis, arson investigation, wildfire investigation, fire modelling, and forensic laboratory techniques. It also emphasizes the application of scientific principles, legal procedures, and modern investigation tools for fire scene reconstruction and reporting. The course prepares students with the technical competencies required for careers in fire investigation, forensic analysis, insurance investigations, law enforcement support, and fire safety management.
Course Revision/ Approval Date:	**5th March 2024**
Course Objectives	The course aims to: 1. Explain the principles, procedures, legal framework and documentation involved in fire investigation. 2. Apply systematic fire scene examination, evidence collection and safety practices during fire investigations. 3. Analyze fire causes, ignition sources and fire patterns in structural and vehicle fires. 4. Evaluate arson, wildfire incidents and behavioural indicators using scientific investigation techniques. 5. Apply fire modelling and forensic laboratory techniques for fire scene reconstruction and reporting.

Course Content (Theory)	**Weightage**	**Contact hours**
Unit I: Fire Investigation Fundamentals: History and objectives of fire investigation; Economic, legal and insurance aspects; Scientific method of fire investigation; Roles and responsibilities of fire investigators; Investigation planning; Interviews and witness statements; Documentation; Notebook procedures; Scene photography; Digital documentation; Chain of custody; Rules of evidence; Report writing; Case file preparation.	20%	9 hours

Unit II: Fire Scene Examination & Evidence Collection: Health and safety during fire investigation; Risk assessment; Scene security and cordoning; Fire scene examination; Determination of area of origin and point of origin; Fire patterns; Fire spread analysis; Effects of suppression activities; Fire scene excavation; Evidence identification; Evidence collection, preservation and packaging; Laboratory examination of fire debris.	20%	9 hours
Unit III: Fire Cause Determination: Fire cause classification; Electrical fire investigation; Appliance-related fires; Smoking materials; Open flames; Hot work; Spontaneous heating and spontaneous ignition; Vehicle fire investigation; Electrical, mechanical and fuel-related ignition sources; Fire cause determination methodology.	20%	9 hours
Unit IV: Arson & Wildfire Investigation: Incendiary fires; Accelerants and ignitable liquids; Arson investigation procedures; Fire setter behaviour; Juvenile fire setters; Fire investigation interviewing techniques; Wildfire behaviour; Wildfire origin and cause investigation; Burn indicators; Scene search methods; Wildfire case studies.	20%	9 hours
Unit V: Fire Modelling & Forensic Analysis: Fire modelling concepts; Zone models; Field (CFD) models; Fire Dynamics Simulator (FDS); Smokeview; Fire scenario reconstruction; Model validation; Forensic laboratory analysis; Volatile accelerants; Chemical incendiaries; Forensic sampling; Preservation and transportation of evidence; Role of forensic experts; Fire investigation reporting.	20%	9 hours

Instructional Method and Pedagogy:
PPT, Video Presentation, Case Studies, Site Visits

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:	Cognitive	
CO1: Explain fire investigation principles, legal requirements and documentation procedures.		Understand
CO2: Apply systematic fire scene examination, evidence collection and safe investigation practices.		Apply
CO3: Analyze ignition sources, fire patterns and fire causes in structural and vehicle fires.		Analyze
CO4: Evaluate arson and wildfire incidents using scientific investigation techniques and behavioural indicators.		Evaluate
CO5: Apply fire modelling and forensic laboratory techniques for fire scene reconstruction and reporting.		Apply

Learning Resources

1.	**Reference Books:** 1. John J. Lentini, Scientific Protocols for Fire Investigation, 3rd Edition, CRC Press. 2. Douglas J. Carpenter & John D. DeHaan, Kirk's Fire Investigation, 8th Edition, Pearson. 3. Niamh Nic Daeid, Fire Investigation, CRC Press. 4. NFPA 921, Guide for Fire and Explosion Investigations, Latest Edition. 5. Russell K. Chandler, Fire Investigation, Delmar Cengage Learning. 6. Drysdale, D., An Introduction to Fire Dynamics, Wiley.
2.	**Journals & Periodicals** 1. Fire Technology 2. Fire Safety Journal 3. Journal of Forensic Sciences 4. Forensic Science International 5. Journal of Fire Sciences
3.	**Codes, Standards & Online Resources** 1. NFPA 921 – Guide for Fire and Explosion Investigations - https://www.nfpa.org/codes-and-standards 2. NFPA 1033 – Professional Qualifications for Fire Investigator - https://www.nfpa.org/codes-and-standards 3. National Institute of Standards and Technology (NIST) – Fire Research Division - https://www.nist.gov/fire 4. Fire Dynamics Simulator (FDS) & Smokeview - https://pages.nist.gov/fds-smv 5. International Association of Arson Investigators (IAAI) - https://www.firearson.com 6. National Association of Fire Investigators (NAFI) - https://www.nafi.org 7. Bureau of Indian Standards (BIS) - https://www.bis.gov.in

Evaluation Scheme	**Total Marks**	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

Avg.	***3***	***2.8***	***2.8***	***2.8***	***2***	***2***	***1.8***	***1.8***	***2***	***2.2***	***2.4***	***2.2***

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE:	COURSE NAME:	SEMESTER:
BTFS706B1	**Process Safety**	VII

Teaching Scheme (Hours)				Teaching Credit			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	**3**	3	0	0	**3**

Course Pre-requisites	Safety Engineering
Course Category	Professional Elective
Course focus	Employability
Rationale	Process Safety focuses on preventing catastrophic incidents involving fires, explosions and toxic releases in industries handling hazardous chemicals and processes. Unlike occupational safety, process safety emphasizes the integrity of process systems, engineering controls, asset reliability and risk management throughout the lifecycle of a facility. This course introduces internationally accepted process safety management frameworks, including the CCPS Risk-Based Process Safety (RBPS) model, regulatory requirements, hazard identification and risk assessment techniques, and process safety performance indicators. It prepares students to identify process hazards, evaluate risks and implement effective management systems for safe and sustainable operation of high-hazard industries.
Course Revision/ Approval Date:	**29th May 2025**
Course Objectives	The course aims to: 1. Explain the principles, evolution and importance of process safety management in high-hazard industries. 2. Explain national and international process safety regulations, standards and management systems. 3. Apply the CCPS Risk-Based Process Safety (RBPS) framework for managing process safety. 4. Analyze process hazards using qualitative and quantitative risk assessment techniques. 5. Evaluate process safety performance and recommend continual improvement strategies.

Course Content (Theory)	Weightage	Contact hours
Unit I: Process Safety Fundamentals: History and evolution of Process Safety Management (PSM); Major industrial accidents (Bhopal, Flixborough, Texas City, Buncefield); Process Safety versus Occupational Safety; Safety culture; Process safety lifecycle; Introduction to OSHA PSM (29 CFR 1910.119); API	20%	6

RP 750; CCPS Risk-Based Process Safety (RBPS); API RP 754 Process Safety Performance Indicators.		
Unit II: Regulatory Frameworks & Standards: Indian regulatory framework; MSIHC Rules, 1989 (as amended); Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996; Occupational Safety, Health and Working Conditions Code, 2020; Relevant BIS standards; International regulations including OSHA PSM, EPA Risk Management Program (RMP), ISO 45001, IEC 61511 and IEC 61508.	20%	10
Unit III: Risk-Based Process Safety (RBPS): CCPS Risk-Based Process Safety framework; Four pillars and twenty elements; Process Safety Culture; Compliance with Standards; Workforce Involvement; Process Knowledge Management; Hazard Identification and Risk Analysis; Human Factors; Operating Procedures; Safe Work Practices; Asset Integrity; Contractor Management; Management of Change; Operational Readiness; Emergency Management; Incident Investigation; Learning from Experience.	20%	10
Unit IV: Process Hazard Analysis & Risk Assessment: Hazard identification; Hazard categorization; HAZOP; What-If Analysis; Checklist Analysis; FMEA; Fault Tree Analysis (FTA); Event Tree Analysis (ETA); Bow-Tie Analysis; Layer of Protection Analysis (LOPA); Safety Integrity Level (SIL); Quantitative Risk Assessment (QRA); HAZOP case study.	20%	10
Unit V: Process Safety Performance & Continuous Improvement: Process Safety Performance Indicators (API RP 754); Leading and lagging indicators; Root Cause Analysis (RCA); Auditing process safety management systems; Management review; Digitalization in process safety; Industrial Internet of Things (IIoT); Artificial Intelligence applications; Predictive analytics; Sustainability and ESG in process safety; Continuous improvement.	20%	9

Instructional Method and Pedagogy: PPT, Chalkboard, Animated Videos, Tutorial, Case studies

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: Explain the principles, history and importance of process safety management. CO2: Explain national and international process safety regulations and standards. CO3: Apply the CCPS Risk-Based Process Safety framework to manage process safety.	Cognitive	Understand Understand

CO4: Analyze process hazards using qualitative and quantitative risk assessment techniques. CO5: Evaluate process safety performance and recommend continual improvement strategies.		Apply Analyze Evaluate

Learning Resources	
1.	**Reference Books:** 1. CCPS, Introduction to Process Safety for Undergraduates and Engineers, AIChE. 2. CCPS, Guidelines for Risk-Based Process Safety, AIChE. 3. CCPS, Guidelines for Hazard Evaluation Procedures, AIChE. 4. Trevor Kletz, What Went Wrong? Case Histories of Process Plant Disasters, Elsevier. 5. Daniel A. Crowl & Joseph F. Louvar, Chemical Process Safety: Fundamentals with Applications, Pearson. 6. Frank P. Lees, Lees' Loss Prevention in the Process Industries, Elsevier.
2.	**Journals & Periodicals** 1. Process Safety Progress 2. Process Safety and Environmental Protection 3. Journal of Loss Prevention in the Process Industries 4. Safety Science 5. Reliability Engineering & System Safety
3.	**Codes, Standards & Online Resources** 1. CCPS – Center for Chemical Process Safety - https://www.aiche.org/ccps 2. OSHA Process Safety Management Standard (29 CFR 1910.119) - https://www.osha.gov/process-safety-management 3. EPA Risk Management Program (RMP) - https://www.epa.gov/rmp 4. API Recommended Practice 754 – Process Safety Performance Indicators - https://www.api.org 5. IEC 61511 – Functional Safety for the Process Industry Sector - https://webstore.iec.ch 6. ISO 45001:2018 Occupational Health and Safety Management Systems - https://www.iso.org/iso-45001-occupational-health-and-safety.html 7. AIChE Academy – Process Safety Resources - https://www.aiche.org/academy 8. Manufacture, Storage and Import of Hazardous Chemicals (MSIHC) Rules - https://moef.gov.in 9. Chemical Accidents (Emergency Planning, Preparedness and Response) Rules - https://moef.gov.in 10. Bureau of Indian Standards (BIS) - https://www.bis.gov.in

Evaluation Scheme	Total Marks	
Theory: Mid semester Marks	**20 marks**	
Theory: End Semester Marks	**40 marks**	
	Attendance	05 marks

Theory: Continuous Evaluation Component Marks	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

COURSE CODE:	**COURSE NAME:**			**SEMESTER:**			
BTFS706C	**Wastewater Engineering**			VII			
Teaching Scheme (Hours)				**Teaching Credit**			
Lecture	**Practical**	**Tutorial**	**Total Hours**	**Lecture**	**Practical**	**Tutorial**	**Total Credit**
3	0	0	**3**	3	0	0	**3**
Course Pre-requisites	Environment Pollution and control measures						
Course Category	Professional Elective						
Course focus	Employability						
Rationale	Industrial and municipal wastewater management plays a vital role in protecting public health, conserving water resources, ensuring environmental sustainability, and complying with statutory regulations. Industries are increasingly required to implement efficient wastewater treatment systems, resource recovery techniques, and Zero Liquid Discharge (ZLD) practices to minimize environmental impacts. This course provides students with fundamental knowledge of wastewater characteristics, monitoring, treatment technologies, treatment plant design, industrial effluent management, discharge standards, and environmental legislation. The course equips students with the skills required for designing, operating, monitoring, and managing wastewater treatment systems in industrial and municipal sectors.							
Course Revision/ Approval Date:	**5th March 2024**						
Course Objectives	The course aims to: 1. Explain water resources, wastewater generation, characteristics and environmental impacts. 2. Explain wastewater monitoring techniques and water quality assessment methods. 3. Analyze wastewater collection systems and physical, chemical and biological treatment technologies. 4. Apply design principles for wastewater treatment plants and advanced treatment systems.						

	5. Evaluate industrial wastewater management practices, discharge standards and environmental regulations.

Course Content (Theory)	Weightage	Contact hours
Unit I: Water Resources & Wastewater Fundamentals: Hydrological cycle; Surface and groundwater resources; Water resource management; Rainwater harvesting; National and global freshwater availability; Water demand and consumption patterns; Wastewater generation; Domestic and industrial wastewater; Wastewater characteristics; Water pollutants and environmental impacts; Cost estimation of wastewater treatment systems.	20%	9 hours
Unit II: Wastewater Monitoring & Characterization: Objectives of wastewater monitoring; Sampling methods; Grab, composite and continuous sampling; Water quality parameters; pH; DO; BOD; COD; TOC; TDS; TSS; Turbidity; Conductivity; Hardness; Oil and grease; Nutrients; Heavy metals; Microbiological parameters; Wastewater characterization and interpretation.	20%	9 hours
Unit III: Wastewater Collection & Treatment Technologies: Wastewater collection systems; Sewerage systems; Pumping stations; Wastewater conveyance; Physical treatment processes; Chemical treatment processes; Biological treatment processes; Industrial wastewater treatment; Equalization; Neutralization; Advanced oxidation processes (AOPs); Membrane technologies; Industrial Effluent Treatment Plants (ETPs); Common Effluent Treatment Plants (CETPs).	20%	9 hours
Unit IV: Wastewater Treatment Plant Design: Design flow estimation; Hydraulic and organic loading; Design of screening chambers; Grit chambers; Equalization tanks; Sedimentation tanks; Aeration systems; Biological reactors; Secondary clarifiers; Sludge treatment and disposal; Tertiary treatment; Advanced wastewater treatment; Water reuse; Zero Liquid Discharge (ZLD); Energy-efficient wastewater treatment systems.	20%	9 hours
Unit V: Industrial Effluent Management & Regulations: Wastewater reuse and recycling; Industrial effluent minimization; Cleaner production; Wastewater remediation techniques; The Water (Prevention and Control of Pollution) Act, 1974; Water Rules, 1975; Environment (Protection) Rules, 1986; CPCB discharge standards; Industrial effluent standards; Environmental compliance; Wastewater auditing; Sustainable wastewater management.	20%	9 hours
Instructional Method and Pedagogy: PPT, Chalkboard, Animated Videos, Tutorial		

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: CO1: Explain water resources, wastewater generation and wastewater characteristics. CO2: Explain wastewater monitoring techniques and water quality assessment methods. CO3: Analyze wastewater collection systems and treatment technologies for industrial and municipal applications. CO4: Apply design principles for wastewater treatment plants and advanced treatment systems. CO5: Evaluate industrial wastewater management practices, discharge standards and environmental regulations.	Cognitive	Understand Understand Analyze Apply Evaluate

Learning Resources	
1.	Reference Books: 1. Metcalf & Eddy, Wastewater Engineering: Treatment and Resource Recovery, 5th Edition, McGraw-Hill. 2. A. D. Patwardhan, Industrial Wastewater Treatment, PHI Learning. 3. M. N. Rao & A. K. Dutta, Wastewater Treatment, Oxford & IBH. 4. Mackenzie L. Davis, Water and Wastewater Engineering, McGraw-Hill. 5. Vesilind, Peirce & Weiner, Environmental Engineering, Butterworth-Heinemann. 6. Tchobanoglous, Burton & Stensel, Wastewater Engineering: Treatment and Reuse, McGraw-Hill.
2.	**Journals & Periodicals** 1. Water Research 2. Journal of Environmental Management 3. Water Environment Research 4. Journal of Water Process Engineering 5. Environmental Technology
3.	**Codes, Standards & Online Resources** 1. Ministry of Environment, Forest and Climate Change (MoEFCC) - https://moef.gov.in 2. The Water (Prevention and Control of Pollution) Act, 1974 - https://legislative.gov.in 3. Environment (Protection) Rules, 1986 - https://moef.gov.in 4. Central Public Health and Environmental Engineering Organisation (CPHEEO) Manual - https://mohua.gov.in 5. Bureau of Indian Standards (BIS) - https://www.bis.gov.in 6. Central Water Commission (CWC) - https://cwc.gov.in 7. National Mission for Clean Ganga (NMCG) - https://nmcg.nic.in 8. United States Environmental Protection Agency (US EPA) – Wastewater -

	https://www.epa.gov/npdes 9. Water Environment Federation (WEF) - https://www.wef.org

Evaluation Scheme	Total Marks	
Theory: Mid semester Marks		**20 marks**
Theory: End Semester Marks		**40 marks**
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment / Case study	15 marks
	Article review	10 marks
	Total	**40 Marks**

Semester VIII

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
											Theory Marks				Practical Marks	**Total Marks**
			L	P	T	***Total***	L	P	T	**Total**	MS	CEC	ES	***Total***		
1	BTFS801	Major Project	-	16	-	***16***	-	8	-	**8**	--	--	--	**--**	100	**100**
		Total				***16***				**8**						**100**

Note: L = Lecture, **P =** Practice, **T=** Tutorial, **MS -** Mid Semester, **CEC -** Continuous Evaluation Component**, ES -** End Semester