CE-814 Structural Fire Engineering

Code	Credit Hours	Category
CE-814	3	Elective

Course Description:

This course aims to develop the ability in students to understand structural fire engineering and design effective fire-resistant structures. Students will explore topics such as time-temperature relationships for post-flashover fires, equivalent fire severity/fire resistance, material properties at elevated temperatures, temperature profiles in structural assemblies, and fire resistance of various structural materials. Practical/project/research work involves applying numerical models to analyze the fire resistance of structures and designing buildings for fire safety. This comprehensive approach equips students with the necessary skills for advanced structural fire engineering.

Text Book:

- Buchanan, A.H. (2002). "Structural design for fire safety", John Wiley and Sons Ltd, Chichester, England.

Reference Books:

- Y. C. Fung and Pin Tong, (2001): Classical and Computational Solid Mechanics, World Scientific Publishing Company, Singapore.
- George E. Mase (1970): Schaum's Outlines: Continuum Mechanics, Mc-Graw-Hill, New York.
- Pisidhi Karsudhi (1990): Foundations of Solid Mechanics, Kluwer Academic Publishers.
- T. J. Lardner and R. R. Archer (1994): Mechanics of Solids: An Introduction, McGraw-Hill International Editions, Singapore.
- Purkiss, J.A. (2007). "Fire safety engineering design of structures" Butterworth-Heinemann-Elsevier, Oxford, UK.
- Franssen, J; Kodur V; Zaharia, R. (2009), "Designing Steel Structures for Fire Safety" PP. 162. Taylor and Francis.
- "Structural fire protection", ASCE (1992), Committee on fire protection and structural division, American Society of Civil Engineers, New York.
- "Structural Fire protection engineering (SFPE)". Handbook of fire protection engineering,(2008) P.J. DiNenno, editor, National fire protection association, Quincy, MA.
- ACI 216.1 (2007). "Code requirements for determining fire resistance of concrete and masonry construction assemblies". ACI 216.1-07 / TMS-0216-07, American Concrete Institute, Farmington Hills, MI, 1-3.

Prerequisites:

BE (Civil, Architecture, Construction Engineering & Management)

Assessment System

Component	Percentage Range
Quizzes	10-15%
Assignments	10-15%
Mid Terms	20-30%
ESE	40-50%
Project and/or Case-Study (optional)	10-15%

Teaching Plan:

Week No	Topic	Learning Outcomes
1	Introduction to Fire Safety in Buildings	• Understand fire safety objectives • Describe fire development processes • Identify key fire safety regulations and standards
2	Fire Behaviour and Fire Detection	• Explain fire behaviour • Discuss methods of fire detection • Analyze factors affecting fire growth and spread
3	Passive and Active Fire Control	• Differentiate between passive and active fire control measures • Discuss their importance in building design • Evaluate effectiveness of fire suppression systems
4	Fire Resistance of Materials and Assemblies	• Define fire resistance • Calculate fire resistance of different materials • Assess fire performance of building materials
5	Fire Spread and Building Construction	• Analyze fire spread within buildings • Evaluate building construction methods for fire safety • Design building layouts to minimize fire spread
6	Fire Safety Concepts and Risk Assessment	• Apply risk assessment methods • Develop fire safety concepts • Implement fire safety management strategies
7	Combustion and Fire Dynamics	• Explain combustion processes • Analyze fire dynamics in buildings • Predict fire development scenarios
8	Design Fires and Fire	• Describe methods for predicting design fires

Week No	Topic	Learning Outcomes
	Modelling	
9	**Mid Term Exam/ OHT, (As per NUST Exam Policy)**	
10	Structural Design in Fire Conditions	• Apply structural design principles under fire conditions • Calculate loads for fire design • Design structural members for fire resistance
11	Material Properties at Elevated Temperatures	• Analyze mechanical properties of materials at high temperatures • Evaluate material behaviour in fire • Specify fire protection requirements for structural elements
12-13	Fire Resistance of Steel Structures	• Design steel members for fire resistance • Assess performance of fire protection systems • Specify fire rating criteria for steel structures
14	Fire Resistance of Concrete Structures	• Design concrete members for fire resistance • Evaluate spalling and other effects in concrete • Implement fireproofing strategies for concrete structures
15	Composite Structures in Fire	• Evaluate fire resistance of composite structures • Design composite elements for fire safety • Analyze bonding characteristics in composite materials
16	Timber Structures and Fire Performance	• Assess fire performance of timber structures • Design timber members for fire resistance • Specify fire protection requirements for timber buildings
17	Advanced Calculation Methods in Fire Engineering	• Apply advanced calculation methods for fire engineering • Use structural analysis tools for fire conditions • Integrate fire safety into structural design optimization
18	**End-Semester Examination (ESE)**	• Evaluate comprehensive understanding of fire safety in structural engineering • Synthesize knowledge from course topics

Additional Sessions:

- **Week 9**: Case Study Presentations
- **Week 16**: Term Project Presentations

Softwares

- SAFIR
- Ozone 4.1