

## Course syllabus

Department of Civil Engineering, Indian Institute of Technology Madras

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### CE5012 - Structural Fire Engineering

**Credit Distribution:** C:9 L:3 T:0 P:0 E:0 O:6 TH:0

**Course Type:** Theory

**Description:** The main objective of this course is to provide an overview of fire safety fundamentals, and to introduce basic principles governing fire analysis and design of structures. The students will be introduced to rational design methodologies for fire resistance design of structures.

**Course Content:** Introduction Fire safety in buildings, role of structural-fire engineering, current building code approaches and performance based approaches. Heat Transfer Fundamentals and Basic definitions. Overview of conduction, convection and radiation. Characterizing Fires Fuels, fire initiation and growth, pre- and post- flashover fires, design fires, time-temperature curves. Heat Transfer Calculations for Structure-Fire Problems, Analysis of conduction, convection and radiation heat transfer applied to structure-fire problems, simplified calculation methods and computer programs for heat transfer analysis. Material Properties at Elevated Temperatures Stress-strain curves for steel and concrete at elevated temperatures, effects on stiffness, strength and ductility and material properties for design. Fire Protection Materials Concrete, spray applied fire resistant materials and intumescent coatings and fiber board. Structural Fire Resistance - Conventional Code Approaches Typical building code regulations (NBC, IS800, IS456, etc.), ASTM E119, standard furnace tests, hourly ratings, UL rating and limitations of conventional approaches. Structural Response to Elevated Temperatures Forces resulting from thermally induced strains, effects of degraded material properties, simple calculation techniques and examples. Design of Structures at Elevated Temperatures Design of steel, concrete and composite structures subjected to fire, Use of design codes such as EC3, IS800, IS456, etc. and computer analysis.

**Text Books:**

- Structural Design for Fire Safety by Andrew Buchanan, Wiley, 2nd Edition, 2017.
- Fire Engineering of Structures: Analysis and Design by Bangash, Al-Obaid and Bangash, Springer, 1st Edition, 2013.

**Reference Books:**

- An Introduction to Fire Dynamics by D. Drysdale, Wiley, 2nd Edition, 2011.
- Fundamentals of Fire Phenomena by J. Quintiere, Wiley, 1st Edition, 2006.
- SFPE Handbook of Fire Protection Engineering, SFPE, Springer, 5th Edition, 2016.

**Prerequisite:** NIL