Subject Description Form

Subject Code	BSE531
Subject Title	Computational Fire Modelling for Building Design
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	To equip the students with the basic theories and techniques in computational fire modelling for fire hazard assessment; and evaluating and improving active control and passive fire design of buildings.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. have a clear understanding of the role of computational fire modeling in fire safety design; b. identify and evaluate the theory of different types of fire models adopted in the performance based design; c. appreciate the merit and limitations of various types of fire models; d. to apply fire models for fire safety design.
Subject Synopsis/ Indicative Syllabus	**Zone modelling techniques:** Empirical results, modelling of rate of heat release, fire plume, ceiling jet; Conservation equations; Zone models in the literature such as the ASET, CFAST/FASTLite, HAVARD5/6, FIRST, BRI2, FIREWIND etc.; Solution of system of stiff ordinary differential equations using the finite differences method, explicit and implicit methods, iteration, convergence, stability; Other methods such as the finite element and boundary element methods. **Field modelling techniques:** Reviews on conduction, convection and radiation; Conservation equations for momentum, enthalpy and mass; Turbulence and turbulent modelling; Finite difference methods, discretization schemes, first and second order; Grid generation; Solution of velocity-pressure linked equations; Boundary conditions and wall functions; Use of computational fluid dynamics packages such as FDS/PyroSim, presentation of results. **Application of fire modelling results:** Simulation of compartment fire, atrium fire, tunnel fire; sprinkler-plume interaction; Design and evaluation of fire engineering systems; Comparison between zone and field modelling results.
Teaching/Learning Methodology	• Lectures and seminars

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a.	b.	c.	d.		
1. Group project	30%	✓	✓	✓	✓		
2. In-class assessment	30%	✓	✓	✓			
3. Assignments	40%	✓		✓	✓		
Total	100%						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The assignments and in-class assessments help students to have a clear understanding of the role of computational fire modeling in fire safety design and the theory behind fire models

The project allow students to practice the learning and apply fire models for fire safety design.

Reading List and References

Quintiere JG. Principles of Fire Behavior. 3rd ed. CRC Press; 2016.

Hurley M.J. et al. (Editor) (2016). *SFPE Handbook of Fire Protection Engineering*, 5th Ed., Quincy, MA, Society of Fire Protection Engineers, Boston, MA, USA.

- Chapter 29 Compartment Fire Modeling
- Chapter 31 Zone Computer Fire Models for Enclosures
- Chapter 32 Modeling Fires Using Computational Fluid Dynamics (CFD)
- Chapter 37 Performance-Based Design
- Chapter 60 Computer Evacuation Models for Buildings

NIST, USA (2017). CFAST – Consolidated Model of Fire Growth and Smoke Transport (Version 7): Technical Reference Guide.

NIST, USA (2014). Report of Experimental Results for the International Fire Model Benchmarking and Validation Exercise #3.