Subject Description Form

Subject Code	**BSE4313**
Subject Title	**Fire Fundamentals**
Credit Value	3
Level	4
Pre-requisite Co-requisite Exclusion	Nil Nil BSE4310 Fire Service Engineering
Objectives	• To provide students a detailed theoretical basis of fire physics and reaction kinetics in combustion process and fire dynamics in a building fire. • To further study the thermochemistry, thermal decomposition of fuel, fire development, the burning properties of materials and fire design in Building Technology and fire services systems in building fires
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. To be able to understand different heat transfer mechanisms in building fire b. To be able to understand and appraise thermochemistry, chemical equilibrium, the theory of thermal decomposition of fuel, fire behaviour and the theory of various fire extinguishing mechanisms c. To be able to appraise various fire phenomenon such fire plumes, flame height, air entrainment, effects of combustion conditions on species production. d. To be able to investigate and appraise the current development and research in building fire development, various active fire protection systems in buildings e. To be able to appraise various fire phenomenon in building fires and perform basic fire engineering calculations to estimate the conditions in building fires
Subject Synopsis/ Indicative Syllabus	**Heat transfer mechanisms in fire and fire processes:** conduction of heat in solids, convective heat transfer, radiation heat transfer in fire, fireload, fire triangle, heat transfer, aerodynamics, fire hazards, ceiling jets, plumes. **Thermochemistry in fire:** Thermodynamics, Heat of combustion, chemical reaction and stoichiometry, measurement of heat of combustion, heat of formation and calculation of flame temperature. **Chemical equilibrium in fire:** Chemical equilibrium constant, simultaneous equilibria, the quantification of equilibrium constants, carbon formation in oxygen deficient system **Combustion kinetics :** hydrocarbon oxidation mechanisms, kinetic foundations, rate constant, temperature dependence of elementary reaction rate and activation energy, relative rates of oxidation and degradation of the primary fuel, soot formation in flames **Fire dynamics:** Ignition, premixed burning, fire plumes, flame height, air entrainment, flammability limits, premixed and diffusion flames, effect of combustion conditions on species production , heat losses, burning velocity, flame spread, laminar and turbulent jet flames, flames from natural fires, fire properties of materials. **Compartmental fire:** pre-flashover fire, growth period, flashover, post-flashover, fully-developed fire, fire resistance and fire severity, methods of calculating fire resistance. Radiation.

<table>
<tr>
<td>Teaching/Learning Methodology</td>
<td>
Lectures will be used to introduce topics as listed in the syllabus. Speakers will be invited to give seminar on advanced topics in fire physics and reaction kinetics. Tutorials and seminars will be conducted in formats of film shows, demonstrations and paper discussions. Physical and numerical experiments will be assigned at appropriate stages. Most of the learning materials are contained in the main text and relevant papers.

Visual aids such as films and slides will be shown and discussion on the papers will be held during tutorial. Appropriate demonstration and numerical experiments will be conducted. The syllabus will always be revised and up-dated in conjunction with the development and needs of fire physics and reaction kinetics.

Tutorial Work
Tutorials will be conducted with aids of film shows, demonstrations, discussions on published papers and problem solving based on examination type questions.

Related Project Work
• Heat conduction in building materials
• Study of radiative heat transfer from pool fire
• Heat release rate measurement
• Properties of fire plumes
• Sprinkler head responses
• Numerical experiments using fire models
• Staircase pressurisation systems
</td>
</tr>
<tr>
<td>Assessment Methods in Alignment with Intended Learning Outcomes</td>
<td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="6">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td></td></tr>
<tr><td>1. In-class assessment</td><td>20</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>2. Course work</td><td>20</td><td></td><td></td><td></td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>3. End-of-semester examination</td><td>60</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>Total</td><td>100</td><td colspan="6"></td></tr>
</table>

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

In-class assessment will be used to assess the basic understanding of the lecture material.

Course work will be used to assess the students' ability to investigate and appraise the current development and research in building fires, fire physics and reaction kinetics.

Examination with essay type question and numerical calculations will be used to assess students the overall understanding of the subject.
</td>
</tr>
</table>

Student Study Effort Expected	Class contact:	
	▪ Lecture	30 Hrs.
	▪ Seminars	6 Hrs.
	▪ Assessment	3 Hrs
	Other student study effort:	
	▪ Self learning	81 Hrs.
	Total student study effort	120 Hrs.
Reading List and References	An Introduction to Fire Dynamics (3rd ed.), D. D. Drysdale, John Wiley and Sons, NY, USA (2011) Fire Protection Handbook (20th ed.), NFPA, Quincy, USA (2008) The SFPE Handbook of Fire Protection Engineering (4th ed.), P. J. Di Nenno et al, SFPE, Boston, USA (2008) Fire Spread and Control, Chow W.K., Lecture Notes, Department of Building Services Engineering, The Hong Kong Polytechnic University, HKSAR (1999/2000).	