unit guide

EXPLOSION AND FIRE

SFO-2-155

2006

LEVEL 2

become what you want to be

UNIT SFO-2-155, EXPLOSION & FIRE

Basic data

Level:	2	***Subject area:***	SAS1
Credit value	2	***Semester***	
Class contact hours	36	***Student managed study hours***	114
Pre-requisites	None		
Unit leader	Dr C.H Steele	*Room:E240*	*Tel:0207815798* *E-mail:* *Steelech@sbu.ac.uk*
Other teachers	Prof. P.F Nolan	*Room: E236*	*Tel:02078157901* *E-mail:n/a*

Assessment

Element	*Description*	*Weighting*
Course work	4 laboratory practicals	50%
Examination	2 hour unseen examination	50%

Short introduction to the unit

This unit introduces you to a new facet of forensic science, that of explosion, fire and toxic release. The course of study is relevant to both accident investigation and criminal investigation. For example the origin of explosion and fire may point towards criminal intent or may simply be caused by accidental events or negligence. The unit is quantitative by nature. The requirements and effects of explosions, fires and toxic release can be predicted precisely through scientific computation. You must understand these basic techniques if you are going to understand the forensic analysis of such physiochemical phenomena. The unit however is not taught in isolation from the "human" side of the equation. How and why ultimately must relate to or interact with social, political, legislative, economic and societal considerations.

To be of use in an investigation of this nature you must be conversant with the chemistry and physics of fire, explosion and toxic release. You must understand the effects of blast waves, and determine the cause and growth rate of a fire. You must also be able to predict what the possible consequences of a release of a toxic chemical vapour or gas release may have on the surrounding population and what action should be taken.

The unit draws upon the considerable number of research programmes conducted by the Explosion and Fire research group headed by professor Nolan. Over 50 Ph.D programmes have been completed in this area and South Bank is internationally recognised as a centre of expertise in this field with links with the Emergency Services, the Health and Safety Executive, DERA and many commercial Safety Consultancies.

We have divided the Unit into 4 elements of study.

[1].. The nature and effect of fire, fires in buildings.

[2].. Forensic analysis of burning behaviour

[3].. Fire scene investigation

[4].. The types of explosion, their origins and their destructive potential

The unit is taught by Professor P.F Nolan and Dr C.H Steele. Guest presentations will be made by relevant representatives of the emergency services and health and safety executive.

Aims

To introduce students to:

1. The analysis of deliberate and accidental fires and explosions.
2. The consequences of explosions and fires on property and people.
3. The technology of explosives.

Learning outcomes

On successful completion of this unit the student will be able to :

1. Perform basic analysis of deliberate and accidental fires and explosions.
2. Understand the consequences of explosions and fires on property and people.
3. Be familiar with experimental techniques for the quantification of fire hazards.
4. Recognize and apply explosives technology

Indicative content

The Nature and Effect of Fire

Introduction to combustion chemistry. Flaming and smoldering combustion. Flame temperature calculation. Incomplete combustion. Modes of heat transfer. Flammability characteristics. Diffusion flames and fire plumes

Behavior of materials under fire load conditions. Fire tests. Burning velocities. Fire spread ratings of materials Smoke and combustion product toxicology. Compartment fires, flashover and back draught.. Alarm and detection systems. Fire protection, active and passive. Fires in buildings.

Oxygen consumption calorimetry. Bomb calorimetry. Pensky Martin flash point apparatus. Heat release rate measurements using a cone calorimeter. NIST smoke chamber. Large scale calorimetry of fires. Oxygen index apparatus. Thermogravimetric analysis.

Forensic Analysis of runaway chemical reactions and explosions

Decomposition reactions and thermal stability. Runaway chemical reactions. Solvents and ignition sources.

Fire Scene Investigation

Observation, excavation and interrogation. Fire damage patterns. The Point of origin of fire. Fire spread indicators. Sequential analysis. Causes of fire (e.g. electrical). Characteristics of arson and incendiary fires. Accelerants and their pour patterns. Consequences of accelerants (e.g. concrete spalling). Detection of accelerants after fire. Fire residue analysis.

Explosives and Blast Damage

Introduction to explosives. Deflagration and detonations. Energy and energy transfer processes. States of matter.

Types of explosions - BLEVE, gas, vapour, dust. Fireballs. Example case histories. Point of ignition and definition of epicentre. Blast wave and overpressure. Impulse. Overpressure contours. Scaling laws. TNT equivalence. Consequences of blast, thermal radiation, flying

fragments (missiles), cratering and ground shock to people and property. Application of simple consequence models.

Teaching Method

The unit will be delivered by mixture of lectures and seminars with tutorials devoted to calculation techniques. This will be complemented with a laboratory programme in explosion and fire studies.

Details of times and locations are given in the published class timetables.

Students are encouraged to make full use of library facilities and the Science reference library during progress of the unit.

Meetings with tutors, tutorial assistance and answers to other questions relating to the work may be obtained through e-mail to: steelech@sbu.ac.uk.

Weekly teaching and learning programme

The programme of classes below is intended only as a guide and is subject to modification according to rate of progress and unforeseen factors.

WEEK No.	Prof P.F Nolan *1 hour lecture* *(1 hour tutorial/ odd weeks)*	Dr C.H Steele *1 hour lecture* *(1 hour tutorial/ even weeks)*
1	Introduction	Introduction. The laboratory practicals and use of the lab manual
2	Part 3. Combustion chemistry	The fire triangle, a technical view
3	Part 3. Combustion Chemistry	Compartmentation
4	Part 3. Explosions	Fire curve & Fire growth
5	Part 3. Explosions	Fire Tests.. behaviour of materials in fire using cone calorimetry
6	Part 3. Explosions	Fire Tests.. NBS smoke chamber. Pensky martin flashpoint. Oxygen Index.
7	Part 3. Explosions	Effects of fire on building structure
8	Part 3. Explosions	Life safety and building design: Fire Protection
9	Part 4. Fire Investigation	Fire Alarm & Detection
10	Part 4. Fire Investigation	Fire scenarios
11	Part 4. Fire Investigation	Chemical explosions and fires: thermal stability and the decomposition pressure test. Runaway chemical reactions
12	Part 4. Fire Investigation	REVISION

Assessment

Examinations:

The examination will be of 2 hours duration. Students will attempt 3 questions out of a total of six. All questions will carry equal marks. The examination paper will be sectioned.

Section A: Fires in buildings

Section B: Explosions

Coursework:

You are required to complete the laboratory manual.

Students should be reminded that the University has a policy on late submission of coursework and on claiming for mitigating circumstances. REMEMBER you must fill in the appropriate forms relevant to your circumstances. Failure to do so will invalidate any claim to mitigating circumstances at a later date.

	% of Unit Marks
LAB MANUAL SUBMISSION	50%
2-hour written examination	50%
TOTAL	100%

Recommended reading

Core reading

R. Noon; Engineering analysis of fires and explosions CRC press (1995).

P.W Cooper and S.R Kuvowski; Introduction to the technology of explosives. VCH (1996).

R. Bangash; Impact and explosion analysis and design. Blackwell (1993).

Backgroung Reading

Bodurtha. F.T: Industrial Explosion Prevention and Protection. Mc Graw-Hill

Lees F.P. Loss Prevention in the Process Industries. 2nd edition. 1996. Butterworth.

Optional reading

Chemistry and Chemical Reactivity: Kotz and Treichel. Fourth edition. Harcourt Brace.

On-line materials

To be advised by individual unit lecturers.