



***This course is approved and subsidized by governmental agency, qualified for 13 PDUs by PEB (Professional Engineer Board), PIC (40% cash payout) funding support. UTC had conducted a similar course for Republic of Singapore Air Force (RSAF).***

### **COURSE OVERVIEW**

Failures often occur on products, facilities, infrastructures in various industrial sectors, not only resulting in huge economic loss but also fatalities in some cases. It's critical and imperative to determine the failure cause(s), failure mechanism(s) and provide counter measures to prevent similar failure(s) recurrence in future. Effective failure analysis can not only enhance reliability and safety of products and infrastructures, but also improve the product quality and reduce operational cost and down time of facilities so that improve productivity.

This course is designed to provide an overview and solid foundation in understanding and performing industrial failure analysis by sharing relevant knowledge (not only just from textbooks but also from working practice) and discussing actual case studies (including cases submitted by delegates).

### **COURSE INSTRUCTOR**

Dr George YU, is registered Chartered Engineer (UK) and API 510 Pressure Vessel Inspector (USA), Executive Committee Member of The Institute of Materials (East Asia) and Technical assessor/expert by Singapore Accreditation Council. He has more than 30 years of relevant industrial work and research experience. As lead author, he published a number of technical papers in referred international journals and conferences. As Principal Investigator, he successfully completed more than 1000 projects on failure analysis, accident investigation, product development, facility assessment/inspection and material evaluation, including damages of amusement rides (roller coaster vehicle & track), major disruptions in mass rapid transport system (power supply, rails), accidents of cranes, aerospace engine damages, automotive steering system failure, lift rope breakage, landing gear system failure, turbine & hovercraft accidents, failures in gas and steam turbines, notebook computer burning, failures in jack-up rigs, extra-hydrogen release in huge batteries of Submarine (>300 Kg), transformer fire, failures of PCB, PCBA, LCD, passive components and IC, heat exchanger burst, submarine power cable damages, microprocessor malfunction, transformer firing, electrical busduct explosion, premature failure of tungsten carbide tools, explosion of power distribution system, large ship-lifting system cracking, failures in building and structures etc. His investigation and recommendations on two major roller coaster incidents (the operation down for >1 year) resulted in significant improvements on safety & reliability of the system. As expert witness, Dr YU attended a series of court hearings and legal litigations including Committee of Inquiry (COI) on two major MRT disruptions in 2011 and fatal crane incident at National Arts Gallery. Dr YU had correctly determined the root cause of the worst massive MRT disruption on 7 July, 2015 and his views had been published on Top of Views in [\*\*\*The Straits Times \(A4, 30 July 2015\).\*\*\*](#)

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## **COURSE CONTENT**

### ***Part 1, Overview of industrial failure analysis***

Introduction  
General procedures  
Effective failure analysis  
Report preparation and assessment  
How to select failure analysis service providers

### ***Part 2, Non-destructive examination***

Visual examination  
Ultrasonic testing  
Dye/liquid penetration  
Magnetic particle examination  
Eddy Current testing  
X-ray examination

### ***Part 3, Advanced analytical instruments and applications***

Microscopy – microscopic and metallurgical examination  
Scanning electron microscopy (SEM)/Energy-dispersive X-ray spectrometry (EDX)  
Chemical element analysis  
X-ray diffraction (XRD)  
Fourier transform infrared spectrometry (FTIR)  
Differential scanning calorimetry (DSC)

### ***Part 4, Failures - characteristics, mechanisms and prevention***

Mechanical failures  
    Fractures - Brittle and ductile fractures  
    Material embrittlements - hydrogen, liquid metals, tempering  
    Fatigue – LCF, HCF, corrosion fatigue  
    Fractography - macro and micro-examination on fracture surfaces  
    Creep  
    Wear: abrasive, fretting, contact fatigue, ferrography  
Chemical failures  
    General corrosion, pitting, intergranular corrosion, crevice corrosion, galvanic corrosion, stress corrosion, selective leaching, erosion corrosion, hydrogen attack  
Electrical failures  
    Current leakage  
    Short circuit  
    Open circuit  
    Arcing  
    P-N junction breakdown

### ***Part 5, Case Studies.***

A number of actual failure cases from different industrial sectors including aerospace, marine, transportation, construction, electronics, oil refinery will be discussed.

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## LEARNING OBJECTIVES

- To understand general failure analysis procedures, methodologies and techniques.
- To understand the significance of properties of materials, their behavior and influences by structural, process and environment.
- To learn analytical techniques used for failure analysis.
- Characteristics, mechanisms of common failures and their failure causes.

## WHO SHOULD ATTEND

This course is ideal for professionals in engineering, maintenance, QA, safety and R&D from various industries such as manufacturing, automotive, aerospace, marine, construction, oil refinery, chemical, and electronics. This course can also help management staff, lawyers and insurance professionals involved in litigations from industrial failures/accidents for better understanding the natures, mechanisms and responsibilities of the failures/accidents.

## COURSE DURATION:

Two days (18 – 19 Oct, 2018)

## COURSE VENUE:

NTU@Onenorth Campus  
11 Slim Barracks Rise (Off North Buona Vista Road)  
Singapore 138664

*Nearby MRT stations: Buona Vista (east west line, circle line), One north (circle line)*

## COURSE FEE

S\$555/delegate after e2i training grant

Course material, refreshments, complimentary lunch arrangement and certificate for accomplishment will be provided.

10% discount is applicable for company with  $\geq 3$  pax, T & C.

e2i subsidy (S\$225pax, limited seats) is available for PMEs of Singaporean or PR with  $\geq 75\%$  attendance. T & C.

Companies can enjoy [400% tax deductions](#) and/or [40% cash payout](#) of course fee under PIC.

## Terms and Conditions

- Limited subsidy seats are available, is subject to a first-come-first-serve basis.
- Companies may replace participants who have signed up for the course, given one week notice before course commencement.
- UTC reserves the right to change or cancel any course, in light of unforeseen circumstances. Full refund is applicable in case of cancelation.
- All details are correct at time of dissemination.

## Registration

Please fill in the attached registration form and email to [enquiry@ut.sg](mailto:enquiry@ut.sg), make the payment properly. The registration is effective only after the payment is received, and confirmation email will be sent to you accordingly.

**For queries, please send to [enquiry@ut.sg](mailto:enquiry@ut.sg) or call/SMS 81380509 or visit website [www.ut.sg/training-courses-failure-analysis.html](http://www.ut.sg/training-courses-failure-analysis.html).**

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## Registration Form

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Please register following delegate(s) for “*Industrial Failure Analysis*” course:

**Delegate 1**

Name: \_\_\_\_\_  
IC No: \_\_\_\_\_  
Designation: \_\_\_\_\_  
HP/Phone: \_\_\_\_\_  
Email: \_\_\_\_\_

**Delegate 2**

Name: \_\_\_\_\_  
IC No: \_\_\_\_\_  
Designation: \_\_\_\_\_  
HP/Phone: \_\_\_\_\_  
Email: \_\_\_\_\_

**Delegate 3**

Name: \_\_\_\_\_  
IC No: \_\_\_\_\_  
Designation: \_\_\_\_\_  
HP/Phone: \_\_\_\_\_  
Email: \_\_\_\_\_

**Delegate 4**

Name: \_\_\_\_\_  
IC No: \_\_\_\_\_  
Designation: \_\_\_\_\_  
HP/Phone: \_\_\_\_\_  
Email: \_\_\_\_\_

Company Name: \_\_\_\_\_

Company Address: \_\_\_\_\_  
\_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Name: \_\_\_\_\_ Company stamp \_\_\_\_\_

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The course fee for **Industrial Failure Analysis** is S\$780/delegate. Limited e2i subsidy seats (S\$225/delegate) is available for PMEs of Singaporean or PR with  $\geq 75\%$  attendance.

10% discount is applicable for company with  $\geq 3$  pax . T & C.

**Registration will be confirmed only after receiving the payment.** Please email your registration form to [enquiry@ut.sg](mailto:enquiry@ut.sg). Registration will be closed 10 days before course commencement.

***Cheque/Bankdraft payment***

Make payable to *Universal Technology Centre LLP*.

Mail to “Universal Technology Centre”,  
10 Anson Road, International Plaza #10-11,  
Singapore 079903.

***Bank transfer***

Account No: 020-901961-6  
Universal Technology Centre LLP

Bank name: DBS Bank Ltd  
12 Marina Boulevard, DBS Asia Central  
Marina Bay Financial Centre Tower 3  
Singapore 018982