



# **MKH1313**

## **Industrial Hygiene**

### **PROF ARSHAD AHMAD**

# Course Content

## 1. Introduction

- Topic 1: Overview of Industrial Hygiene
- Topic 2: Toxicology
- Topic 3: Standard of Exposure

## 2. Understanding Hazards

- Topic 4: Chemicals
- Topic 5: Biological
- Topic 6: Physical
- Topic 7: Psychological & Ergonomics

## 3. Measurement and Sampling

- Topic 8: Basic Gas & Vapour Behaviour
- Topic 9: Air Sampling Instrumentation
- Topic 10:

## 4. Control Measure

- Topic 10 : Ventilation System
- Topic 11: Administrative control & PPE

## 5. Risk Assessment

- Topic 12: CHRA

# Grading

- **Group Projects** : **30**
- **Mid-Term Exam** : **20**
- **Final Exam** : **50**

**\*Reflection journals (3 throughout semester)  
and e-portfolio: Bonus marks - 5**

# **Topic 1 - Overview of Industrial Hygiene**



# What is Industrial Hygiene?

- Industrial hygiene is the science of anticipating, recognizing, evaluating, and controlling workplace conditions that may cause workers' injury or illness.

# Industrial Hygiene

- **Anticipation**
  - The prospective recognition of hazardous conditions based on chemistry, physics, engineering and toxicology
- **Recognition**
  - Both the detection and identification of hazards or their adverse effects through chemistry, physics and epidemiology
- **Evaluation**
  - The quantitative measurement of exposure to environmental hazards and the qualitative interpretation of those hazards
- **Control**
  - Conception, education, design, and implementation of beneficial interventions carried out that reduce, minimize, or eliminate hazardous conditions.

# Industrial Hygienist

- **Approach**
  - Industrial hygienists use environmental monitoring and analytical methods to detect the extent of worker exposure and employ engineering, work practice controls (admin), and other methods to control potential health hazards i.e PPE.
- **Responsible for**
  - Selecting and using instrumentation to monitor workplace during the identification and control phases of industrial hygiene projects.
  - Recommend relevant control techniques
  - Maintain control measure (e.g. ECE in OSHA 1994 is maintained by hygiene technician)

# **Some Occupational hazards**

- **Chemical agents**
  - Gases, vapours and particulate aerosols
- **Physical (energy) agents**
  - Noise, ionizing / non-ionizing radiation, heat and cold stress
- **Biological agents**
  - Infectious agents, allergens
- **Psychological stressors**
- **Ergonomic**



# **Example of industrial Hygiene Activity**

- **Monitoring toxic airborne concentration**
- **Reducing toxic airborne by using ventilation**
- **Selecting PPE to prevent worker exposure**
- **Developing procedure for handling hazardous material – SOP, MSDS**
- **Monitoring and reducing noise, heat, radiation.**
- **Any other activity to ensure workers are not expose to harmful levels**

# History: Earliest Recordings

- **Lead poisoning among miners by Hippocrates, 4<sup>th</sup> century BC**
- **Zinc and sulfur hazards by Pliny the Elder, 3<sup>rd</sup> century BC**
- **Georgius Agricola published a 12 volume set in 1556, De Re Metallica**



Figure 1-1 (A and B): The hazards associated with airborne contaminants were already recognized four hundred years ago. These woodcuts from Agricola's *De Re Metallica* (1556) show some of the methods used to provide ventilation in hazardous atmospheres.

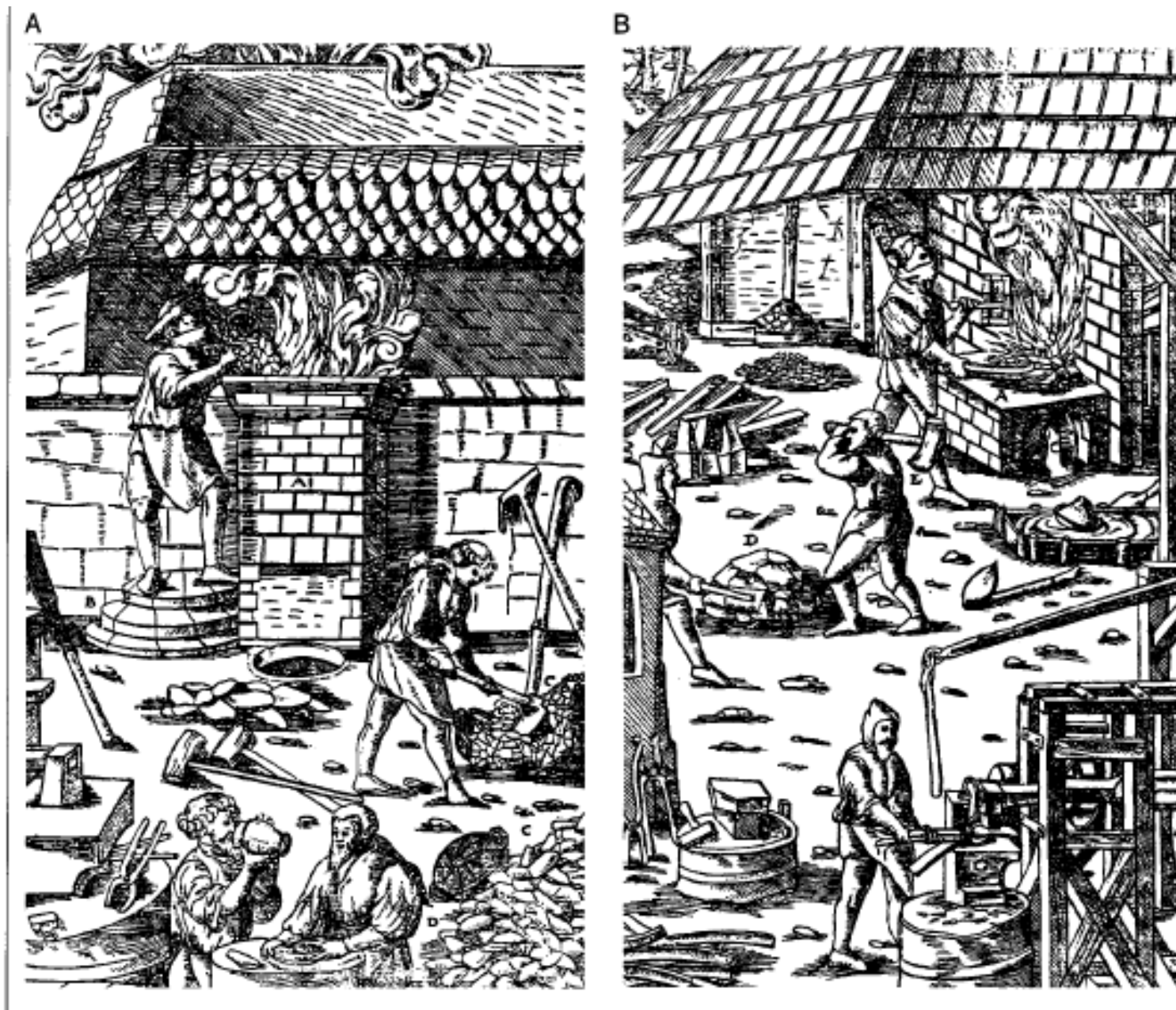


Figure 1-2 (A and B): These woodcuts (also from *De Re Metallica*) illustrate examples of protective equipment used by mine and smelter workers. Workers protected themselves from inhalation hazards of mines and smelting operations by using what would be considered - by present-day standards - a crude respirator (A and B), sometimes made from a goat's bladder. One of the workers in (B) appears to be using a hand-held shield against the heat.

# **Metallica Quotes**

- **“If the dust has corrosive qualities, it eats away at the lungs, and implants consumption in the body”**
- **Later determined to be silicosis, tuberculosis, and lung cancer**

# **Metallica Quotes**

- **“there is found in the mines black pompholyz, which eats wounds and ulcers to the bone; this also corrodes iron . . . There is a certain kind of cadmia which eats away at the feet of workmen when they have become wet, and similarly their hands, and injures their lungs and eyes.”**
- **Later recognized as manifestations of toxicity of arsenic and cadmium**

# Paracelsus

- **Published work describing mercury poisoning of miners in 1567**
- **His famous quote, “All substances are poisons; there is none which is not a poison. The right dose differentiates a poison and a remedy.”**
- **This provided the basis for the concept of the dose-response relationship.**

# **Dose-Response Relationship**

- **The toxicity of a substance depends not only on its toxic properties, but also on the amount of exposure, or the dose**
- **Paracelsus differentiated between**
  - **Chronic (low-level, long-term) poisoning**
  - **Acute (high-level, short-term) poisoning**



# **Bernardino Ramazzini (1633-1714)**

- **Wrote a book, “De Morbis Artificum” (Diseases of Workers), starting the field of occupational medicine**
- **Urged physicians to ask the question, “Of what trade are you?”**
- **He described diseases associated with various lower-class trades, such as corpse carriers and laundresses.**

# Protection Starts to Arrive


- **English Factory Act, 1833, allows injured workers to receive compensation**
- **English Factory Inspectorate, 1878**
- **US Workers Compensation started in 1908-1915 in several states (state programs, not federal)**
- **Occupational Safety & Health Act enacted in 1970 creating OSH Administration**
  - **Created regulations, inspections, recordkeeping, enforcement, etc.**

# Professional Organizations (USA)

- American Industrial Hygiene Association (AIHA), [www.aiha.org](http://www.aiha.org)
- American Conference of Governmental Industrial Hygienists (ACGIH), [www.acgih.org](http://www.acgih.org), organization for government employees
- American Board of Industrial Hygiene (ABIH), [www.abih.org](http://www.abih.org), independent organization that administers certification programs for industrial hygiene professionals
  - IHIT, Industrial Hygienist in Training
  - CIH, Certified Industrial Hygienist
  - Requires maintenance of certification – REGULAR TRAINING

# IH Program: Minimum Elements

1. Identification of health hazards
2. Evaluation of health hazards
3. Control of health hazards
4. Recordkeeping
5. Employee training
6. Periodic program review



Commonly regarded as the three phase of industrial hygiene

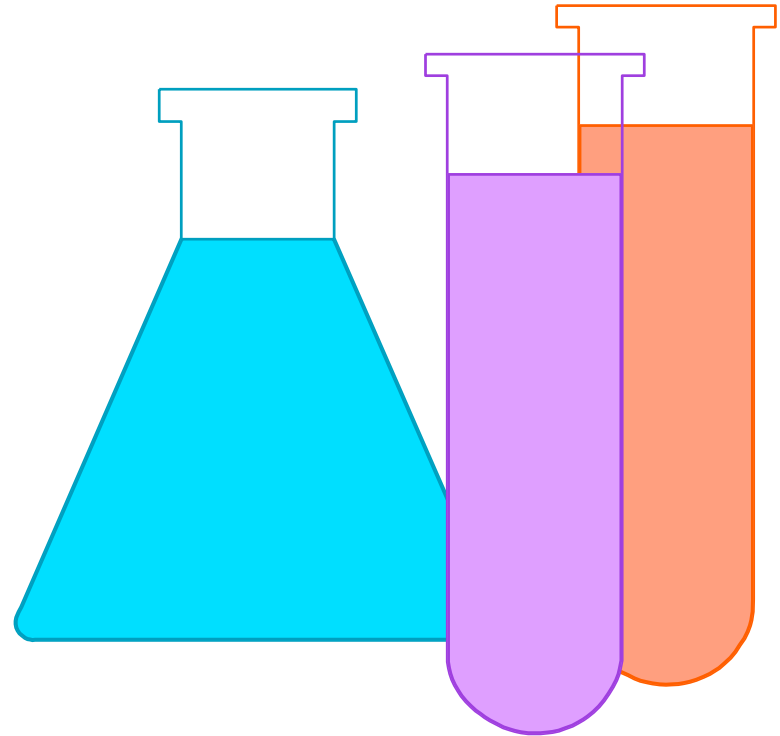
# 1. Identification of Health Hazard

- **Determination of the presence or possibility of workplace exposures.**
- **Identification Process**
  - Through study of process, operation conditions and operating procedures
  - **MSDS**
  - Frequently involves risk assessment (i.e. study on potential for hazards to result in an accident)

# Health Hazard 1 - CHEMICAL

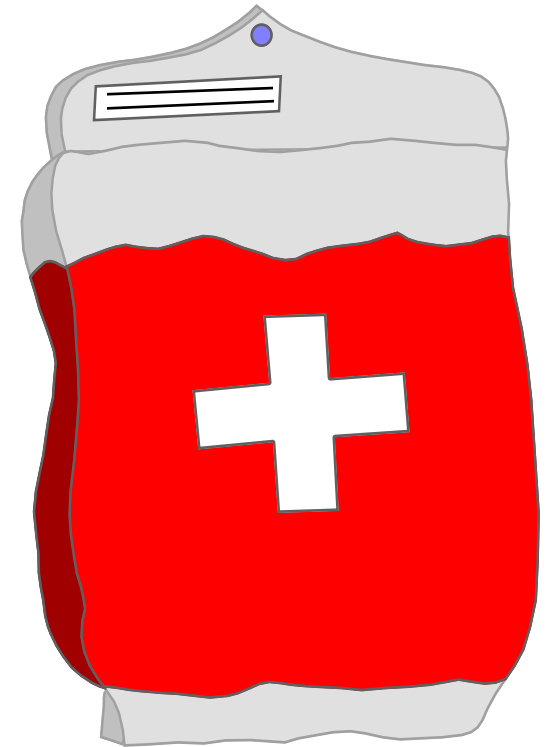
## EXAMPLES INCLUDE:

- Paints/Solvents
- Welding Fumes
- Wood Dust
- Carbon Monoxide
- Exhaust Fumes



# Health Hazard 2 - BIOLOGICAL

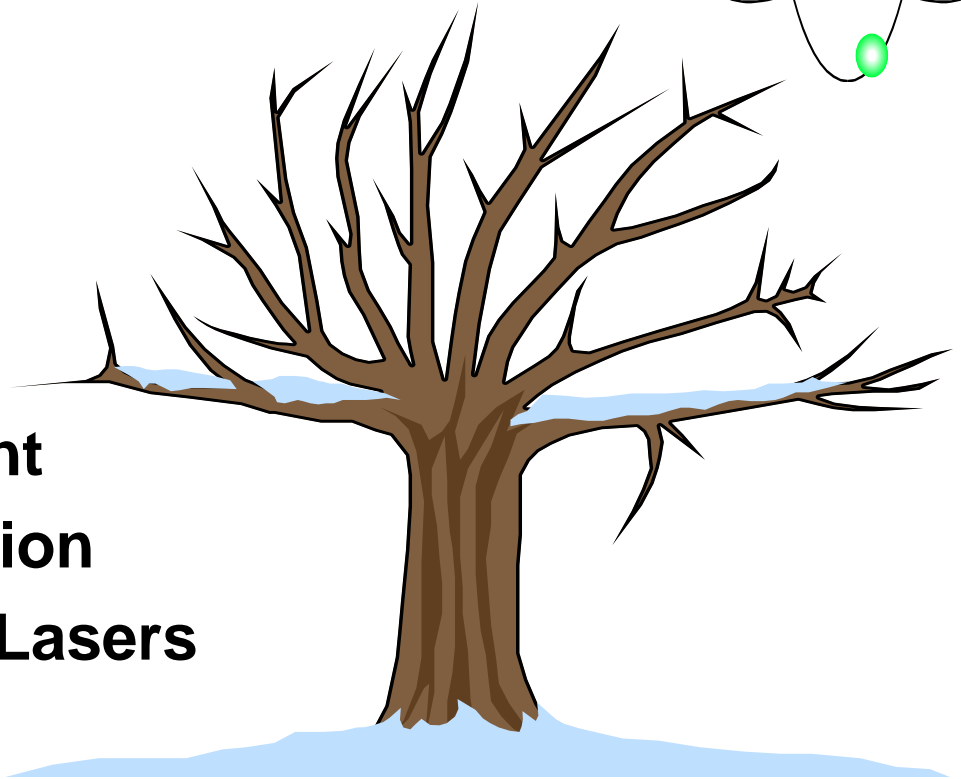
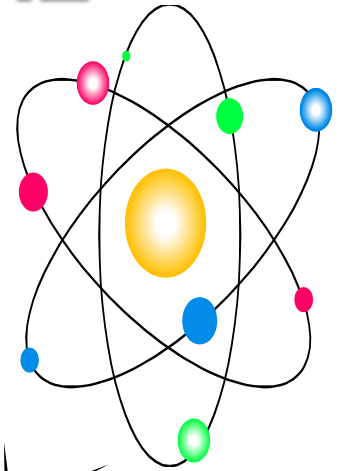
- **Infectious Blood/Body Fluids**
- **Bird Droppings**
- **Mold & Mildew**
- **Tuberculosis/Hepatitis**
- **Hypersensitivity Pneumonitis**



# Health Hazard 3 - PHYSICAL

## Examples Include:

- **Noise**
- **Energy**
  - Extreme Heat
  - Extreme Cold
  - Light
- **Radiation**
  - Ultra-Violet (UV) Light
  - Infra-Red (IR) Radiation
  - Microwaves, Radar, Lasers
  - X-Rays





# **Health Hazard 4 - Ergonomic & Psychological hazards**

- **Workstation design, repetitive motion, improper lifting/reaching, poor visual conditions**
- **Psychological stressors**
  - **Sexual harassment, peer pressure, stress at works**

## **2. Evaluation of Hazards**

- **Determination the magnitude of the exposure to toxicants and other physical hazards (e.g. dust);**
  - **Sampling for exposure data to determine workers exposure conditions**
  - **Placement of monitoring equipment (concentration may vary depends on locations) individual vs. workplace**
  - **Interpretation of data and calculation of dose (level and duration of exposure)**
  - **Compare with acceptable OSH standards (TLV, PEL, IDLH)**
  - **Also study the effectiveness of existing control measures**
- **Keep records**

# Evaluation: Level of Exposure

- **Sudden exposure to high concentration (e.g. due to large leak)**
  - immediate acute effect (unconsciousness, burning eyes, fits of coughing)
- **Repeated exposure to low concentration (unseen small leak)**
  - Chronic effects (long-term permanent or serious impairments effect)
  - To detect, requires periodic sampling
  - If problem is evident, immediate implementation of controls (ECE)
  - Temporary solution such as PPE could be used before permanent controls installed

# Exposure Assessment

- **Route of exposure: Inhalation, ingestion, dermal, injection**
- **Magnitude of exposure: Concentration in media (ppm, mg/m<sup>3</sup>, f/cm<sup>3</sup>)**
- **Duration of exposure: Minutes, hours, days, lifetime**
- **Frequency of exposure: Daily, weekly, seasonally**

# **Risk Assessment**

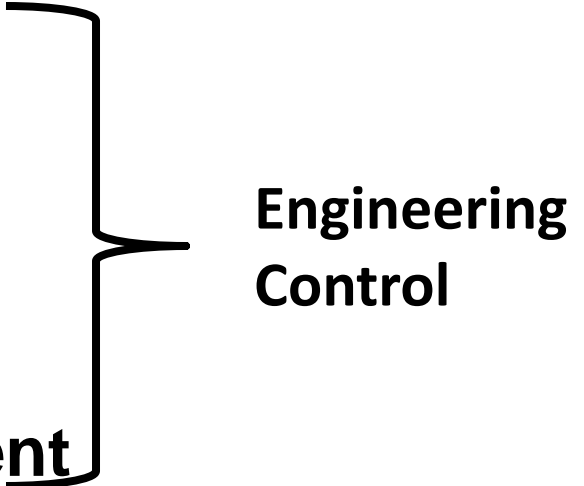
- **Chemical Health Risk Assessment**
- **Biological Risk Assessment**

# **3. Control of Hazards (Prioritized)**

- **1 Engineering**
  - Substitute a less hazardous material, local exhaust ventilation
- **2 Administrative**
  - Worker rotation, training
- **3 Personal Protective Equipment**
  - Respirators, gloves, eye protection, ear protection, etc.

# 3. Control

## Control Measure (in order of effectiveness)

- Elimination
  - Substitution
  - Enclosure
  - Isolation
  - Modification
  - Engineering Control Equipment
  - Safe work system and procedure (Administrative Control)
  - Personal Protective Equipment (PPE)
  - Others (Administrative Control)
- 
- Engineering Control

# **Education of an Industrial Hygienist**

- **Usually requires advanced education in engineering and the biological sciences**
- **A combination of education and experience is necessary in order to take the American Board of Industrial Hygiene (ABIH) exam for certification in industrial hygiene (CIH)**



# Professional Organizations

- **American Industrial Hygiene Association (AIHA)**
  - Founded 1939
  - Nonprofit professional society for IH professionals
  - Exists to promote the field
  - 12,500 members in 2000
- **American Conference of Governmental Industrial Hygienists (ACGIH)**
  - Founded 1938, Approximately 5,000 members
  - Full members government and academic IHS only
  - Increased role for associate members
  - Publish threshold limit values (TLVs) and Biological Exposure Indices (BEIs)
- **Malaysian Industrial Hygiene Association (MIHA)**

# **Industrial Hygiene Related Competency**

- **OYK Noise**
- **CHRA Assessor**
- **Indoor Air Quality Assessor**
- **Authorised Gas Tester (AGT) / Entry Supervisor (ES) for confined space**

# **OYK NOISE FACTORIES & MACHINERY (NOISE EXPOSURE) REGULATIONS 1989**

- **Option 1: Certified Industrial Hygienist**
- **Option 2: Minimum Diploma in Occupational / Industrial Hygiene**
- **Option 3: Minimum Diploma in Acoustic Engineering**
- **Option 4: (a) *Minimum SPM / MCE* , (b) *Menghadiri kursus Monitoring of Noise Exposure* (c) *Minimum 1 tahun pengalaman kerja dalam bidang Monitoring of Noise Exposure***
- ***Sekiranya permohonan memenuhi syarat-syarat yang dikehendaki, pemohon akan diberikan Kelulusan Sementara selama 3 bulan untuk menjalankan pemantauan.***
- ***Pemohon dikehendaki untuk menghantar laporan pemantauan tersebut dan sekiranya memuaskan, pemohon akan dipanggil untuk sesi temuduga.***
- ***Setelah lulus temuduga, pemohon***

# **HT 1 – CHEMICAL MONITORING**

## **(USECHH REGULATION 2000 AND GUIDELINES FOR THE REGISTRATION OF ASSESSOR, HYGIENE TECHNICIAN & OCCUPATIONAL HEALTH DOCTOR, 2<sup>nd</sup> EDITION 2006)**

- **Option 1: (a) Certified Industrial Hygienist , (b) Lulus peperiksaan Hygiene Technician 1 (Part II)**
- **Option 2: (a) Minimum Postgraduate Diploma in Occupational / Industrial Hygiene , (b) Lulus peperiksaan Hygiene Technician 1**
- **Option 3: (a) Diploma in Engineering, or Natural & Applied Science (b) Menghadiri kursus Hygiene Technician 1 (c) Lulus peperiksaan Hygiene Technician 1 (d) Minimum 1 tahun pengalaman kerja dalam bidang Keselamatan & Kesihatan Pekerjaan**
- **Option 4: (a) STPM (Principal in any Science subject) / Polytechnic Engineering certificate (b) Menghadiri kursus Hygiene Technician 1 (c) Lulus peperiksaan Hygiene Technician 1 (d) Minimum 1 tahun pengalaman kerja dalam bidang Keselamatan & Kesihatan Pekerjaan**
- **Sekiranya permohonan memenuhi syarat-syarat yang dikehendaki, pemohon akan dipanggil untuk sesi temuduga.**
- **Setelah lulus temuduga, pemohon akan didaftarkan sebagai HT 1.**
- **Tempoh kelulusan = 3 tahun**

**HT 2 – ENGINEERING CONTROL  
(USECHH REGULATION 2000 AND GUIDELINES FOR THE  
REGISTRATION OF ASSESSOR, HYGIENE TECHNICIAN &  
OCCUPATIONAL HEALTH DOCTOR, 2<sup>nd</sup> EDITION 2006)**

- **Option 1: (a) Certified Industrial Hygienist (b) Lulus peperiksaan Hygiene Technician 2 (Part II)**
- **Option 2: (a) Minimum Postgraduate Diploma in Occupational / Industrial Hygiene (b) Lulus peperiksaan Hygiene Technician 2**
- **Option 3: (a) Diploma in Engineering, or Natural & Applied Science (b) Menghadiri kursus Hygiene Technician 2 (c) Lulus peperiksaan Hygiene Technician 2 (d) Minimum 1 tahun pengalaman kerja dalam bidang Keselamatan & Kesihatan Pekerjaan**
- **Sekiranya permohonan memenuhi syarat-syarat yang dikehendaki, pemohon akan dipanggil untuk sesi temuduga.**
- **Setelah lulus temuduga, pemohon akan didaftarkan sebagai HT 2.**
- **Tempoh kelulusan = 3 tahun**

# **CHRA ASSESSOR**

## **(USECHH REGULATION 2000 AND GUIDELINES FOR THE REGISTRATION OF ASSESSOR, HYGIENE TECHNICIAN & OCCUPATIONAL HEALTH DOCTOR, 2<sup>nd</sup> EDITION 2006)**

- **Option 1: (a) Certified Industrial Hygienist , (b) Lulus peperiksaan CHRA (Part II)**
- **Option 2: (a) Degree / Postgraduate Diploma in Occupational Safety & Health, Occupational Safety, Occupational Health or Industrial / Occupational Hygiene , (b) Menghadiri kursus CHRA (c) Lulus peperiksaan CHRA (Part II) , (d) Minimum 1 tahun pengalaman kerja dalam bidang Keselamatan & Kesihatan Pekerjaan**
- **Option 3: (a) Degree in Medicine, Engineering, Physics, Chemistry, Biochemistry, Ergonomics or Natural & Applied Science (b) Menghadiri kursus CHRA , (c) Lulus peperiksaan CHRA , (d) Minimum 3 tahun pengalaman kerja dalam bidang Keselamatan & Kesihatan Pekerjaan**
- **Option 4: (a) Degree of Science (Environmental & Occupational Health) from UPM – issued since January 2006 , (b) Lulus peperiksaan CHRA , (c) Minimum 1 tahun pengalaman kerja dalam bidang Keselamatan & Kesihatan Pekerjaan**
- **Option 5: (a) Diploma in Medicine, Engineering, Physics, Chemistry, Biochemistry, Ergonomics, Natural & Applied Science or nursing (b) Menghadiri kursus CHRA , (c) Lulus peperiksaan CHRA (d) Minimum 3 tahun pengalaman kerja dalam bidang Keselamatan & Kesihatan Pekerjaan**
- **Sekiranya permohonan memenuhi syarat-syarat yang dikehendaki, pemohon akan dipanggil untuk sesi temuduga.**
- **Setelah lulus temuduga, pemohon akan didaftarkan sebagai Pengapit. . Tempoh**

# **IAQ ASSESSOR**

## **(CODE OF PRACTICE ON INDOOR AIR QUALITY 2005)**

- **Option 1: Certified Occupational Hygienist**
- **Option 2: (a) Degree / Postgraduate Diploma in Occupational Safety & Health, Occupational Safety, Occupational Health or Industrial / Occupational Hygiene (b) Full member of MIHA**
- **Option 3: (a) Competency Assessor (b) Menghadiri kursus IAQ Assessment**
- **Option 4: (a) Competency HT1 (b) Menghadiri kursus IAQ Assessment**
- **Option 5: (a) Minimum Diploma in Pure / Applied Science (b) Menghadiri kursus IAQ Assessment (c) Minimum 1 tahun pengalaman kerja dalam Measurement of Airborne Chemical**
  
- ***Sekiranya permohonan memenuhi syarat-syarat yang dikehendaki, pemohon akan diberikan Kelulusan Sementara selama 3 bulan untuk menjalankan penaksiran dan pemantauan.***
- ***Pemohon dikehendaki untuk menghantar laporan penaksiran dan pemantauan tersebut dan dipanggil untuk sesi pembentangan laporan.***
- ***Setelah lulus sesi pembentangan laporan***

**AUTHORISED GAS TESTER (AGT) / ENTRY SUPERVISOR (ES)  
(GARISPANDUAN LATIHAN PEKERJA, PENDAFTARAN PUSAT  
PENGAJAR DAN PENGENDALIAN KURSUS KESELAMATAN DAN  
KESIHATAN PEKERJA DI RUANG TERKURUNG 2001)**

- **(a) Minimum SPM atau setaraf dengannya dan kredit dalam subjek Sains atau sekurang-kurangnya gred C dalam subjek Sains**
- **(b) Menghadiri kursus AE-SP dan AGT-ES**
- **(c) Lulus peperiksaan AE-SP dan AGT-ES**
- **(d) Minimum 5 tahun pengalaman kerja dalam bidang ruang terkurung**
  - *Sekiranya permohonan memenuhi syarat-syarat yang dikehendaki, pemohon akan didaftarkan sebagai AGT/ES/kedua-duanya (mengikut permohonan).*
  - *Tempoh kelulusan = 2 tahun*



# Class Schedule

	<b>Topics</b>	<b>Assessment</b>
<b>Week 1-3</b>	<b>Introduction</b>	<b>Project 1</b>
<b>Week 4-5</b>	<b>Understanding Hazards</b>	<b>Project 2</b>
<b>Week 6-9</b>	<b>Engineering Controls, Measurement &amp; Sampling</b>	<b>Mid-Term Exam</b>
<b>Week 9-11</b>	<b>Administrative Control &amp; PPE</b>	<b>Project 3</b>
<b>Week 12-14</b>	<b>Risk Assessment, Review</b>	<b>Final Exam</b>