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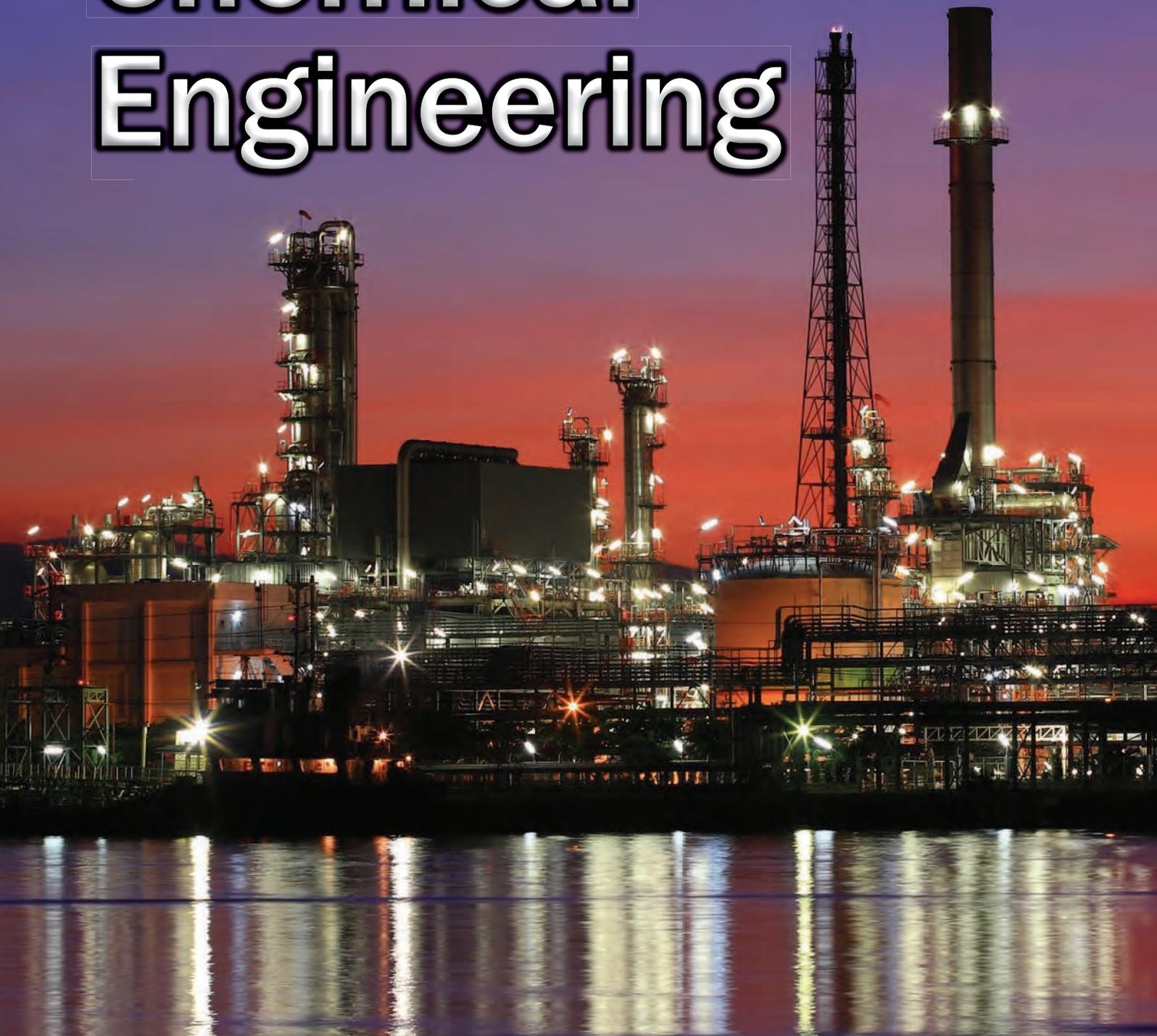
# JURUTERA

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## Chemical Engineering

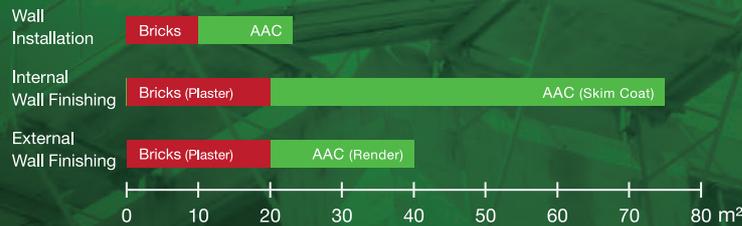


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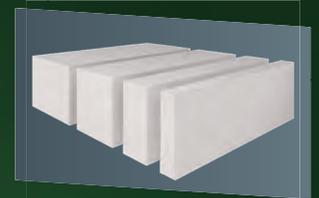
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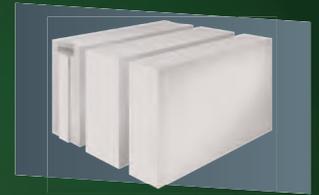


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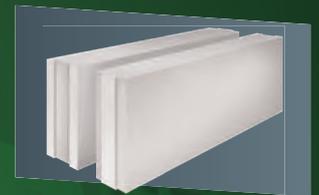
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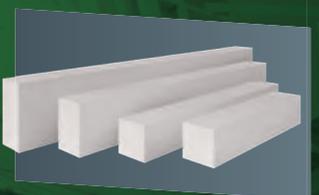
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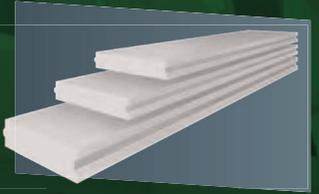
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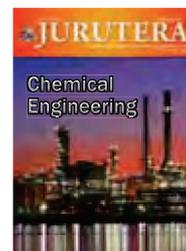
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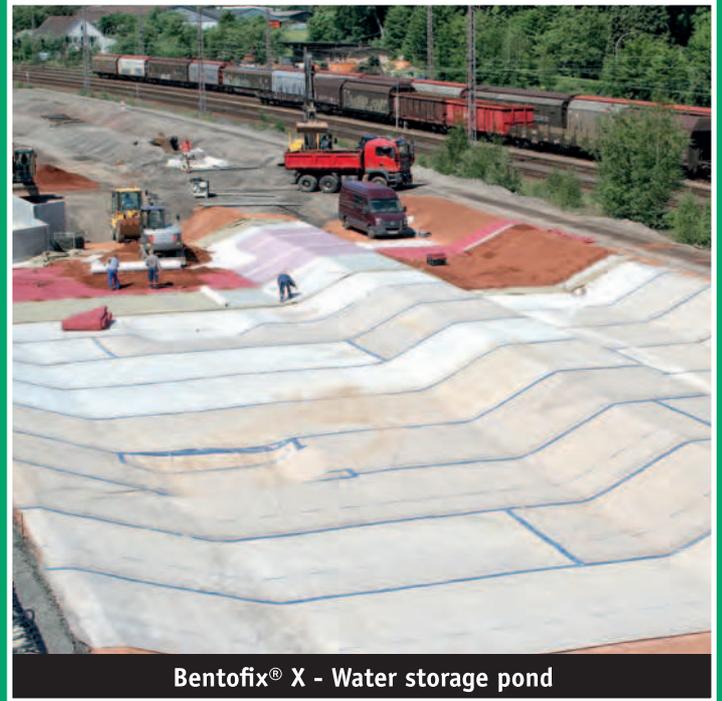
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Facilities Management

*Wishing all members and readers "Happy 50th Malaysia Day". 16 September 1963 marked the joining together of Malaya, North Borneo, Sarawak and Singapore to form Malaysia.*



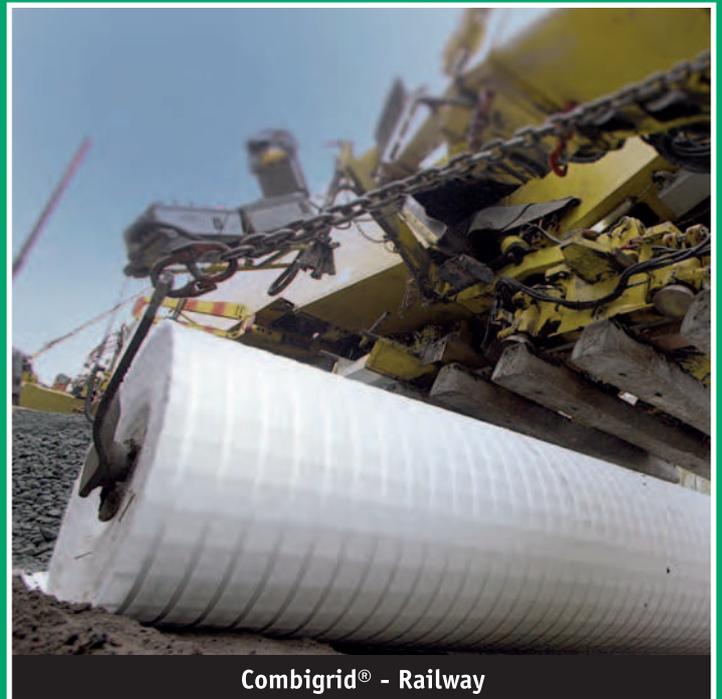
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### Bright Future in Chemical Engineering

by **Ir. Prof. Dr Dominic Foo Chwan Yee**  
Chairman,  
Chemical Engineering Technical Division

**THIS** issue of the IEM Bulletin is dedicated to Chemical Engineering. The last decade has seen an upward and continued growth for the Chemical Engineering profession in the country.

Firstly, there is a significant increase in the number of chemical engineering graduates in the country, as chemical engineering programmes have been introduced in many public and private universities. The number of graduates from foreign universities has also more than doubled in recent years. Despite all this, the number of chemical engineers is insufficient to meet the demands of the ever-growing chemical industry in Malaysia as well as the Asia Pacific region.

Malaysia has transformed itself into a regional hub for oil and gas design and related business. With the two main "oils" of the country (crude oil and palm oil) being identified as the National Key Economic Areas in the Malaysia Economic Transformation Programme (ETP), coupled with the new initiatives such as the RAPID project (Refinery and Petrochemicals Integrated Development), the growing trend of the chemical industry is likely to continue for at least a decade.

To get a better view of the growth of the regional chemical industry, JURUTERA interviewed two prominent chemical engineers – senior academic Ir. Prof. Ali Hashim of University of Malaya and Dr John Thurtell, Engineering Global Support Office Manager at ExxonMobil Business Support Centre Malaysia. The interviews were highly enlightening and shed light on opportunities and issues related to the field.

The Chemical Engineering Technical Division (CETD) of IEM is convinced that there is an urgent and continuous need to produce highly qualified chemical engineers to support the growth of the chemical industry in the region. In line with this objective, CETD hosted various seminars, workshops and activities throughout the year. Perhaps the most successful CETD event is the Malaysian Chem-E-Car Competition, where undergraduate students made use of various alternative fuels (fossil fuel not allowed!) to move a load carrying shoe-box sized car. This year we see another success for the 8th Malaysian Chem-E-Car Competition, with the participation of 34 local and international teams (report on page 38).

Two other relatively new competitions were the Research Paper Competition and Chemical Engineering Design Competition. The former was held in conjunction with the Asia Pacific Confederation of Chemical Engineering (APCChE) congress and the winning students were partially sponsored to present their work at the APCChE congress held at Seoul, Korea in August 2013 (report on page 37). The Chemical Engineering Design Competition was launched last year and had its final presentation in February 2013. It attracted a total of 24 teams from 8 universities, despite this being the inaugural event (report to appear in a future issue of IEM Bulletin, so stay tuned!). In a nutshell, CETD is dedicated to the training of future chemical engineers through interactions with current students via these competitions.

Apart from the above reports of student activities, there are activity reports and feature articles contributed by CETD members and other technical divisions in this September issue. For those who'd like to find out what engineers do in their spare time, check out our activity report on page 32, titled "Why Engineers 'Rock'". You will be surprised at how talented some "hardcore engineers" can be and what varied side interests they have!

Ir. Dr Lee Tin Sin and Ir. Assoc. Prof. Dr Tee Tiam Ting give their views on the growing trend of biodegradable polymer in the feature article on page 14. Ir. Mohamad Anwar Ahmad gives his personal views on the various career aspects of a Chemical Engineering graduate (page 23). The activity report on page 44, contributed by Ir. Noor Iziddin Abdullah of the Project Management Technical Division, was based on a talk on managing renewable energy projects. Another activity report, contributed by Ir. Yee Thien Seng of the Geotechnical Engineering Technical Division, is on the Rankine Lecture given by Professor Malcolm Bolton of the University of Cambridge (page 41).

I hope you enjoy this September issue! ■

# Chemical Engineers Are Not Chemists

Interview with Ir. Professor Mohd Ali Hashim

by Tan Bee Hong



**IR. PROFESSOR** Mohd Ali Hashim is an unassuming man and so soft-spoken that I wonder if his students ever take advantage of him. But make no mistakes. Five minutes with the Professor of Chemical Engineering at University of Malaya and one realises that there is a steely presence behind his patiently quiet demeanour.

He shows Ir. Professor Dr Dominic Foo (Chemical Engineering Technical Division chairman of IEM) and I some facts and figures to back up his replies to our queries during an hour-long interview in his office.

He is smartly dressed with a tie to match, which he admits, at the end of the interview, that he seldom wears, preferring a more casual style.

We wanted to know about how chemical engineering started in this country approximately 40 years ago. Being the most senior chemical engineering professor in this country, Ir. Professor Ali told us about the story. The university's Department of Chemical Engineering was established in 1975 (first in Malaysia, followed by Universiti Teknologi Malaysia in 1983 and Universiti Kebangsaan Malaysia in 1984) with the help of Professor John Kirkaldy, a Scotsman. Before that, an undergraduate course on chemical technology was offered in the Chemistry Department at the Faculty of Science.

At that time, only a selected few were among the intake, less than 10 students a year. "Today, there are about 60 students annually," said Ir. Professor Ali. "When we first started, my students were picked for jobs by corporations, even before they graduated."

However, he adds: "It's not easy to start a chemical engineering department in general, as it involves very expensive lab equipment." Later, he walks us to the lab to show us the impressive equipment set-up.

Despite this, more and more universities have started offering Chemical Engineering studies as the demand for chemical engineers continues to grow. Ir. Professor Dr Foo stated that there are more than 10 Chemical Engineering departments set up in the past 10 years, bringing more than 20 departments that offer Chemical Engineering courses in Malaysia, with approximately 1,600 graduates each year. However, Ir. Professor Ali agrees with Ir. Professor Dr Foo that while graduates are excellent in the "hard" skills part, many are still lacking in soft skills or the ability to communicate and make presentations. One of his ways to overcome this is to get his students to do reports as

presentations which he feels, will prepare them better for the job in the real world.

## WHAT IS CHEMICAL ENGINEERING?

Not to be mistaken for chemistry, chemical engineering is primarily concerned with process engineering though today, the field has expanded to be more than just that.

According to Wikipedia, a chemical engineer is one who works principally in the chemical industry to convert basic raw materials into a variety of products, deals with the design and operation of plants and equipment to do such work. A chemical engineer applies and uses the principles of chemical engineering in any of its various applications and these include:

1. Design, manufacture and operation of plants and machinery in industrial chemical and related processes (chemical process engineers)
2. Development of new or adapted substances for products ranging from foods and beverages to cosmetics to cleaners to pharmaceutical ingredients, among many other products (chemical product engineers) and
3. Development of new technologies such as fuel cells, hydrogen power and nanotechnology, as well as working in fields wholly or partially derived from Chemical Engineering such as materials science, polymer engineering, biochemical and biomolecular engineering.

However it seems that not many in this country actually know what Chemical Engineers are doing for their professional works. Ir. Professor Dr Foo mentioned an interesting finding on a survey that he conducted a few years back with his first year students. For three consecutive years, more than 40% of his student population had enrolled for Chemical Engineering because "I like chemistry"!

There has been a tremendous change of approaches to chemical engineering over the last many years. For a very long time, unit operations and the systemization of transport phenomena have been the core of Chemical Engineering education. The 1960s saw the emergence of process systems engineering. In barely a century, chemical engineers have erected the technological infrastructure of much of modern society. Without their contributions,

industries as diverse as petroleum processing and pharmaceutical manufacturing would not exist as we know them today. Currently, a confluence of intellectual advances, technological challenges, and economic driving forces is shaping a new model of what chemical engineering is. A major force behind this evolution is the upsurge of new products and materials that are entering the market. Whether from the biotechnology industry, the electronics industry, or the high-performance materials industry, these products are critically dependent on structure and design at the molecular level for their usefulness. Another force shaping the future of chemical engineering is society's increasing awareness of health risks and environmental impacts from the manufacture, transportation, use, and ultimate disposal of chemicals. These will be important sources of new challenges to chemical engineers.

When trained in the four-year chemical engineering programme, a graduate can work in waste, food, biochemical industries, apart from the conventional chemical industrial sectors, such as oil and gas, petrochemicals, palm oil-based oleochemicals, etc. The chemical engineering programme trains them basically, for numerous industries, says Ir. Professor Ali.

### JOB PROSPECTS

The chemical industry in the country and Asia Pacific region is developing at an extremely fast rate, creating a huge, insatiable demand for chemical engineers. The oil and gas sector, for instance, he says, is expanding and as new oil fields are discovered, the job market is expanding at an equal rate. Ir. Professor Dr Foo added, Malaysia has emerged to be the design hub for the oil and gas industry in Asia Pacific. There are a lot of new companies (oil and gas, safety and environmental consultants) that started their business in Kuala Lumpur, to support their business in the region, and even worldwide (such as the case for ExxonMobil, see the following page). Ir. Professor Dr Foo noted that there are many new companies sprouting up that are looking for chemical engineers. Those with 4-5 years experience are being snapped up by companies to support their projects in the Middle-East, he says. This explains why more universities are offering chemical engineering programmes, as there are indeed vacant to be filled for this profession. He also believes that the growing trend will continue at least for another 5-10 years.

"Then there is the palm oil-based oleochemical industry which is growing with new products and by-products being created all the time."

Ir. Professor Dr Foo chips in: "And do you know the semi-conductor industry also has a need for chemical engineers?"



*Ir. Professors Ali and Foo at the pilot-scale double-effect evaporator, one of the facilities at the Chemical Engineering Department of University of Malaya*

Seeing the look of surprise on my face, he happily explains: "Yes, think of solvents, waste materials etc. Some 20% to 30% of my students are working in the semi-conductor industry. Chemical engineers have the advantage over chemists when employed as quality controllers as they are trained in the operation process. They also help to deal with the waste treatment in the semi-conductor industry."

Ir. Professor Dr Ali adds: "There is also environmental engineering, previously (the domain of) civil engineers. But today, people realise that chemical engineers have more to offer, particular dealing with industrial effluent. After all, ensuring the treatment process to perform as it should be, is the job of a chemical engineer."

In the last 20-40 years, greater awareness of environmental issues and safety has created the need for chemical engineers to ensure safety in the production process and to promote sustainable development. Ir. Professor Ali says HSE (Health, Safety, Environment) is getting more emphasis in the curriculum of any Chemical Engineering programme offered.

### SUSTAINABLE DEVELOPMENT

According to IChemE (Institution of Chemical Engineers UK), sustainability is the foremost key issue regarding the chemical engineering profession. The three principal areas of focus are sustainable energy, sustainable technology and the 3R (Reduce, Reuse, and Recycle) concept. The world's resources are also becoming depleted. We observe that chemical engineers are the key driver in this aspect. We see significant works being dedicated towards the reduction of raw materials consumption, energy recovery and other aspect of waste minimisation initiative. Ir. Professor Dr Foo says: "A good example can be found in national oil and gas giant Petronas which is now taking serious measure

for water minimisation in various processing sites in the country. What's most encouraging is that they are using pinch technology which we developed locally!"

He added: "Within IEM, we are trying to foster this concept via education. In our recently completed Chemical Engineering Design Competition, we set a scope for zero emission for the students to come out with various schemes for implementing waste reduction for their design project. Besides, we also conduct workshops and seminars regularly to promote resource conservation concept."

Presently, over 80% of the world's energy comes from fossil fuels which emit high levels of GHG (greenhouse gas). Along with depleting reserves, atmospheric pollution from GHGs is a major issue. However, reduction of fossil fuel consumption may not be a sensible solution for a developing country like Malaysia. Instead, chemical engineers should look into the development and application of renewable energy sources.

"In Malaysia, we are blessed with plenty of palm-based biomass, such as empty fruit bunches. You can see significant research are carried out by many academics in the country in order to maximise the potential of this great energy sources." said Ir. Professor Dr Foo.

### PROFESSIONAL BODIES

I then asked about the issue of professional development, as I was told that chemical engineers were not keen to register with the Board of Engineers Malaysia or sign for membership with professional bodies such as IEM and IChemE. Ir. Professor Ali, the first chairman of IChemE Malaysia Branch, says it's useful for new graduates to join bodies such as IChemE and IEM, especially those who want to work overseas. "This is important for all engineers, not just chemical engineers, as a signature acquires greater value with board membership."

Ir. Professor Dr Foo added that, with the signing of the MOU (memorandum of agreement) between IEM and IChemE, "we should soon see some joint efforts in promoting professional development among chemical engineering community in the country". ■



## Plenty of Opportunities for Career Development

Interview with John Thurtell Phd

**JOHN** Thurtell, Engineering Global Support Office (EGSO) Manager of ExxonMobil Business Support Centre Malaysia Sdn Bhd, said demand growth in the chemical industry is anticipated to strengthen over time, linked to the growth of the broader economy.

"Most chemical demand growth is in Asia, driven by manufacturing of consumer products for both worldwide export and to serve the growing Asian middle class. These consumers are expected to purchase more packaged goods, appliances, cars, tyres and clothing, many of which are manufactured from chemical products," he said. "Asia Pacific has accounted for more than two-thirds of global demand growth since 2000, and this trend is expected to continue," said the Canadian who has just arrived in Malaysia approximately half a year back.

In the next decade, global chemical demand is expected to grow by 50%, driven by improving prosperity in developing countries. Large scale investments are ongoing in the region, particularly in Singapore and China where world-class facilities are being built in the refining and

chemical businesses. Thurtell feels this augurs well for the chemical engineering profession as the industry boom will require more engineers with strong professional capabilities in every aspect of the business.

Will the development of the oil & gas sectors in Malaysia & Asia Pacific region affect the chemical engineering profession? In Malaysia, ExxonMobil has been operating for over a century. In fact this year marks the company's 120 years in Malaysia, which is a significant milestone. Thurtell said: "We are a major oil producer and natural gas supplier in Peninsular Malaysia. We produce about a fifth of the nation's crude oil and condensate and supply about half of its natural gas needs which is mainly used for power generation. Beyond upstream operations, our Business Support Centre, which is the second largest within ExxonMobil, also hosts ExxonMobil's IT infrastructure and provides IT support across the globe 24/7."

As an engineering-based company, ExxonMobil hires a lot of engineers to meet the operating needs of its business. "We also employ engineers in our EGSO in Kuala Lumpur.

By virtue of the EGSO functionally reporting to ExxonMobil Research and Engineering (EMRE), our engineers are given the opportunity to provide technical, engineering and application support for ExxonMobil's manufacturing plants around the world," he explained, adding that about 95% of its total workforce is Malaysian which "reflects the tremendous local talent we have in our organisation".

### PROFESSIONAL BODIES

Sadly, many chemical engineers are not registered with the Board of Engineers Malaysia. We asked Thurtell what ExxonMobil is doing to help develop young graduate engineers into professional engineers. He said: "We recognise that engineers play many different roles, depending on their specific job scope. ExxonMobil values the role of certification to ensure compliance with regulatory and process requirements. At ExxonMobil, membership in professional boards is not a prerequisite to employment or an on-the-job requirement as much of our focus is on safe and reliable project management and implementation, as well as operations of our existing facilities. Nevertheless, we are fully supportive of employees who wish to pursue qualifications to improve or maintain their skills and have over the years provided education assistance and reimbursement of the full cost of studies upon successful completion. We also provide internal training programme to strengthen the technical skills of our engineers."

### SUSTAINABLE DEVELOPMENT

Chemical engineers can help to promote sustainable development in the country. Thurtell said ExxonMobil's commitment to operating in an environmentally responsible manner is anchored in its Environment Policy, which fosters appropriate operating practices and training, and requires its facilities to be designed, operated and managed with the goal of preventing environmental incidents.

He added: "Our 'Protect Tomorrow. Today.' initiative guides our management processes to continuously improve environmental performance. Our business operations continue to drive enhancements in environmental performance by incorporating Environmental Business Planning into the annual business planning cycle. In Malaysia, one example where environmental considerations are incorporated into the design basis of our facilities is the use of a hybrid power-generation system on our unmanned satellite platforms. Solar panels produce about half the electricity required, and thermoelectric generators provide the other half. This combination ensures high reliability and low operating costs. Within the global ExxonMobil group, we also focus on various renewable energy initiatives, apart from doing energy optimisation such as co-generation, etc."

Thurtell shared with us more about ExxonMobil's new Engineering Global Support Office in Malaysia and the industry as a whole.

### Q: What is the role of this new office? Why Malaysia?

**Thurtell:** As a whole, Malaysia is a very attractive place to do business because the country has a stable economic and political climate, a talented workforce that is proficient in English, and good infrastructure and connectivity. One of the strongest selling points for us is the exceptional talent pool that is available locally for technical skills and which we can grow and develop into world-class engineers. The government agencies that we worked with were also very supportive of bringing in foreign investment.

The goal of the Engineering Global Support Organisation (EGSO) Office in Kuala Lumpur is to work with EMRE's Central Engineering (US) and Area Engineering Offices around the globe to provide high quality engineering to our manufacturing operations around the world. "However, the interesting part is that, EGSO actually has no projects in Malaysia, since we have no downstream operations in this country. So it only does work for the rest of the world!" Since its opening in July 2011, EGSO has grown quickly and currently has over 50 engineers, predominantly chemical engineers and some mechanical engineers, performing a wide range of technically advanced work for sites in the US, Europe and Asia Pacific. We are trying to create an environment where we enable talented engineers to do great work for our internal customers. The population here that is culturally diverse also helps our newly employed engineers to adapt to different working cultures very easily. "Personally I like this place too, including its weather! Of course I miss the cold... but people here are friendly, helpful and easy to engage with. So I like this place!"

### Q: What are the different positions available to chemical engineers in the Oil & Gas industry? What kind of positions would fresh graduates normally hold and, apart from good academic results, what are the main qualities that MNCs like ExxonMobil look for in fresh graduates?

**Thurtell:** Like many companies, in addition to excellent academic performance, we look for candidates with leadership and communication skills, analytical capability, honesty and integrity. Other qualities include drive, initiative, perseverance and adaptability.

For the EGSO, we hire engineers to provide technical, engineering and application support for ExxonMobil's refineries around the world. Our new employees start as engineers performing a wide range of work, ranging from equipment design to optimisation and controls to development of applications. We develop their core technical competencies and proficiencies (breadth and depth) with initial job assignments before broadening into other technical areas.

Some will move on to more senior positions at ExxonMobil's refineries and chemical plants in Singapore, Thailand, the U.S. or Europe with varied opportunities in engineering, plant manufacturing and even management positions.

**Q:** From technical specialists to project managers and senior executives, what are the different career paths available to an engineer? Is there a point where they need to make a hard decision to choose between technical and management career paths?

**Thurtell:** At ExxonMobil, we have a long-term oriented approach to career development, in which we emphasise continuous learning and professional development. We believe this long-term career-oriented approach provides us with a competitive edge by meeting both business and employee needs.

Generally, engineers in ExxonMobil are developed for a technical or management career path, depending on their interest and capability. Some choose to become senior technical professionals by developing depth and breadth of skills within a given area. They are recognised for their achievements and are also designated subject matter experts (SMEs) in their fields providing an invaluable resource for their customers and peers around the world. Others follow the supervisory or management career path where challenging assignments and projects, with both a local and global scope help build their business judgment, leadership and personal effectiveness skills.

It's not a one-way street, however – some people switch back and forth between these options as they develop their careers. Personally, my career path has moved between technical leadership and management leadership roles multiple times, all within ExxonMobil.

In short, many different career paths are possible, depending on opportunities that arise versus one's interest and capabilities.

**Q:** It is an accepted truth that upstream tends to generate more revenue than the downstream. From a corporate point of view, will Oil & Gas be focusing on just the upstream?

**Thurtell:** Investment decisions in the energy industry are characterised by time horizons measured in decades. At ExxonMobil, we test projects over a wide range of scenarios to ensure that all relevant risks – including financial, commercial, environmental, technical, and others – are properly identified, thoroughly evaluated, and effectively managed.

Our disciplined approach to investing focuses on the efficient use of capital. By combining rigorous standards for project assessment with proven project development expertise, we gain advantage in our investments over the long

term. This discipline is applied across our entire portfolio and includes identification of key growth opportunities and divestment of assets that no longer meet our long-term objectives. In addition, we derive significant value from our globally integrated business model which spans upstream, downstream and chemical, which enables us to maximise the value of every molecule that we produce, leverage the advantages of our organisational structure, and optimise co-located manufacturing.



*Dr John Thurtell and Ir. Prof. Dr Foo at the Engineering Global Support Office of ExxonMobil Business Support Centre Malaysia*

**Q:** When it comes to loyalty versus faster career growth (i.e. by having shorter career stints in multiple companies), what's the point of view on this for MNCs like ExxonMobil?

**Thurtell:** At ExxonMobil, we believe in hiring people for long term careers. We don't think it's desirable to achieve short term gains by switching companies at the expense of long term career progressions. Senior leadership positions in ExxonMobil, both technical and management, are typically filled by people with a deep understanding of our operations, which is obtained through long term careers with the company.

Switching companies limits the ability to progress to the positions from which the senior leadership is formed. Because ExxonMobil is an integrated oil and gas group of companies with global operations in the upstream, downstream and chemical businesses, employees are able to pursue a wide range of job opportunities across the businesses and in various locations. They are also able to take advantage of numerous resources and support, such as workplace flexibility programmes, to help them achieve work life balance. Examples include modified work weeks and part-time regular employment to accommodate pressing, family-related needs for a temporary period of time. ■



# It's Show Time, Young Engineers

by Ir. Choo Kok Beng, FASc

*"The **error of youth** is to believe that intelligence is a substitute for experience, while the **error of age** is to believe experience is a substitute for intelligence."*

– Ernest Hemingway

**THE** error of IEM is to ignore this piece of wisdom from Ernest Hemingway.

Before the older engineers begin to think that they are "over the hill" and before the young think that they are "inexperienced", let me explain.

For as long as I can remember, young engineers in IEM (including the now seasoned, professional engineers who were young once!) have always displayed exceptional leadership qualities with passion and exuberance that are contagious and unmistakable. They have proven to be the *crème de la crème* among other young engineers within the Young Engineers ASEAN Federation of Engineering Organisations (YEAFFEO).

They have redefined IEM's expectations of them and they have done so well that they are now in a class of their own.

It's not just my opinion. The events that the Young Engineers Section has spearheaded speak for themselves – IEM YES National Summit, YEAFFEO, Mt. Kinabalu Malaysian Book of Records attempt and others.

Sadly, all these could come to an end.

Why? Because YES is open only to members who have not passed their professional interview or professional

assessment examination. Once they pass, they will become Corporate Members of IEM. At a little over the age of 30 or even younger, many will feel too overwhelmed and intimidated by more seasoned Corporate Members to stand for positions to serve the IEM.

This flaw in the system is an anti-climax to the incredible success the YES is building. As a result, the once-active YES members who are now Corporate Members will no longer to be active and it is a matter of time that we may lose their once invaluable contributions.

If this problem is not fixed, IEM will lose a pool of the brightest and largest group of engineers who can serve IEM and be its future leaders.

Perhaps age should be the qualifying mark for YES membership instead of grade. Those below the age of 40 should be allowed to remain in YES regardless of their corporate status. By the time they reach the age of 40, they would surely be confident and seasoned enough to join the other Corporate Members in the mainstream activities of IEM.

Less than 10% out of the 66 IEM Council members are below the age of 40. This is a very alarming situation and does not represent a healthy demography considering that a huge percentage of IEM engineers are below age 40.

Let's work towards this to benefit both young and old. The old needs the energy of the young, and the young needs the wisdom of the old.

It's show time, young engineers. ■



Engineering Invention and Innovation Exhibition (EINIX) 2012



Mt. Kinabalu Malaysian Book of Record Attempt



YEAFFEO 2012



IEM YES National Summit 2013



IEM YES Gala Dinner 2013



YEAFFEO 2012

# OUR FIRST OFFICE - WHERE IEM BEGAN



by Dato' Ir. Pang Leong Hoon

IN the initial formative stage in 1958, IEM had no building of its own and the Hon. Secretary, Mr. Lau Foo San had to keep the papers and files in the boot of his car or in his office, Lau & Partners, on the 2nd Floor of Mansion House, High Street, Kuala Lumpur. The building was later renamed Malayan Bank Building.

In 1970, through the good offices of our then President, YAM Raja Tan Sri Ir. Zainal bin Raja Sulaiman, who was also the General Manager of the National Electricity Board (NEB) at the time, IEM was offered temporary use of a section of the former NEB District Office building in Jalan Timur, Petaling Jaya, Selangor. The building has since been demolished and a new multi-storey TNB building stands on the same site.

From our IEM Bulletin (Vol. 1970/1971 No. 7 – February 1971), there was an announcement made on the new office for IEM. An extract from the bulletin is reproduced below:

At its 6th meeting held on 6 November 1959, the IEM Council decided to employ a part-time shorthand typist to help the Hon. Secretary with the correspondence. It was agreed that the person be paid an allowance of "not more than \$5 per hour". As there were no takers, Mr. A.S. Bhatt, a Council Member, was kind enough to provide the required service through his office at the Petaling Jaya Authority. Later, Mr. Thambirajah was recruited as a part-time officer to handle the day-to-day affairs of the Hon. Secretary and served till 1 September 1970. Before this, IEM had appointed Mr. Shan Thurai as clerk-cum-typist from 1 August 1970 to fill the vacancy. Other IEM staff members were recruited from time to time as required.

The IEM office in Jalan Timur (picture right) served as the Secretariat until Bangunan Ingenieur in Jalan Sultan, Petaling Jaya was completed in May 1976. ■



**ANNOUNCEMENTS**

**NEW INSTITUTION OFFICE**

As mentioned elsewhere already in the Bulletin, the Institution has been granted the temporary use of part of the premises of the former N.E.B. District Office building at Jalan Timur, Petaling Jaya.

The Hon. Secretary has announced that the new Office is operational with effect from the 1st October 1970. The Institution Secretariat staff will be in attendance at the office throughout from 9.30 a.m. to 5.15 p.m. on weekdays and from 8.30 a.m. to 1.30 p.m. on Saturdays. The office will be closed on Saturday afternoons and on Sundays and Public Holidays.

A new telephone is being provided for the exclusive use by the Institution Secretariat. The telephone number is Petaling Jaya 53764. A new Post Office Box at Petaling Jaya is being applied, and members will be notified in due course of the new postal arrangements.

The new Institution office has a meeting room which can be utilized by the various I.E.M. Committees for holding their meetings. There is also a small reading room for members who wish to avail themselves of the facilities of the Institution Library.

The Council would like to record its grateful thanks to the Permanent Secretary of the L.L.B., Yang Mulia Dato Tan Sri Zainal, for having at length approved the use of the Board's building by the Institution.

The actual location of the new office is given in the map forwarded to the members, accompanied statistics numbers, but it.



IEM first office

Y.Bhg. Dato' Ir. Pang Leong Hoon was formerly the Director General, Department of Irrigation and Drainage, Malaysia. He was also the Past President of IEM for Sessions 1984/1985 and 1985/1986.



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# Trends of Biodegradable Polymers



by Ir. Dr. Lee Tin Sin and Ir. Assoc. Prof. Dr. Tee Tiam Ting

**POLYMERS** are commonly known as plastics. Polymeric materials are very important for mankind. This is because polymeric materials are lightweight, durable and cheap to produce compared to metal, wood or ceramic. Many people assume that polymers are the materials for modern applications. In fact, humans have been using polymers for thousands of years. For instance, early man first used natural plant gum to stick together pieces of wood to build houses. This gum, known as dammar gum, is obtained from the *Dipterocarpaceae* family of trees in India and East Asia, which is a source of natural polymer.

The first synthetic polymer was invented by Leo Hendrik Baekeland in 1907, a thermosetting-phenol-formaldehyde resin called Bakelite. In just a century, the rapid development of polymer technologies has brought lots of convenience to mankind with the highly effective catalytic polymerization process. When commodity polymers such as polyethylene, polypropylene, polystyrene and polyvinyl chloride became available cheaply, people started to exploit polymers for the production of disposable packaging products. Unfortunately, this has resulted in polymer pollution becoming a serious issue globally as petroleum-derived commodity synthetic polymers required hundreds of years to fully degrade into harmless compounds. For instance, a phone top-up card takes over 100 years to degrade naturally while an apple

core will be naturally transformed into organic fertiliser in just 3 months.

Basically, most biodegradable polymers are produced by a family of polyester as shown in Figure 1. Biodegradable polymer can be divided into two categories, i.e. petroleum- and microorganism-derived types. The former type such as polyvinyl alcohol (PVOH) which is a non-polyester family, uses ethylene to produce vinyl acetate for polymerisation of polyvinyl acetate and is further hydrolysed into PVOH. This polymer is very sensitive to the volatility of crude oil prices and is not environment friendly as the production involves substantial emission of greenhouse gases.

On the other hand, microorganism-derived biodegradable polymers utilise the bio-activity of bacteria to convert plant products such as starch, into the starting chemical for polymerization. Polylactic acid (also known as polylactide – PLA) is the first biodegradable polymer found to be viable for mass production and is produced with the activity of microorganisms to yield lactic acid as the input for polymerization. PLA is currently widely used to produce products such as containers and fibre for making textile, packaging, casing, etc. (refers Table 1). Polyhydroxylalkanoate is also a product of bacteria fermentation. These polymers consume renewable feedstock and the productions create carbon credit.

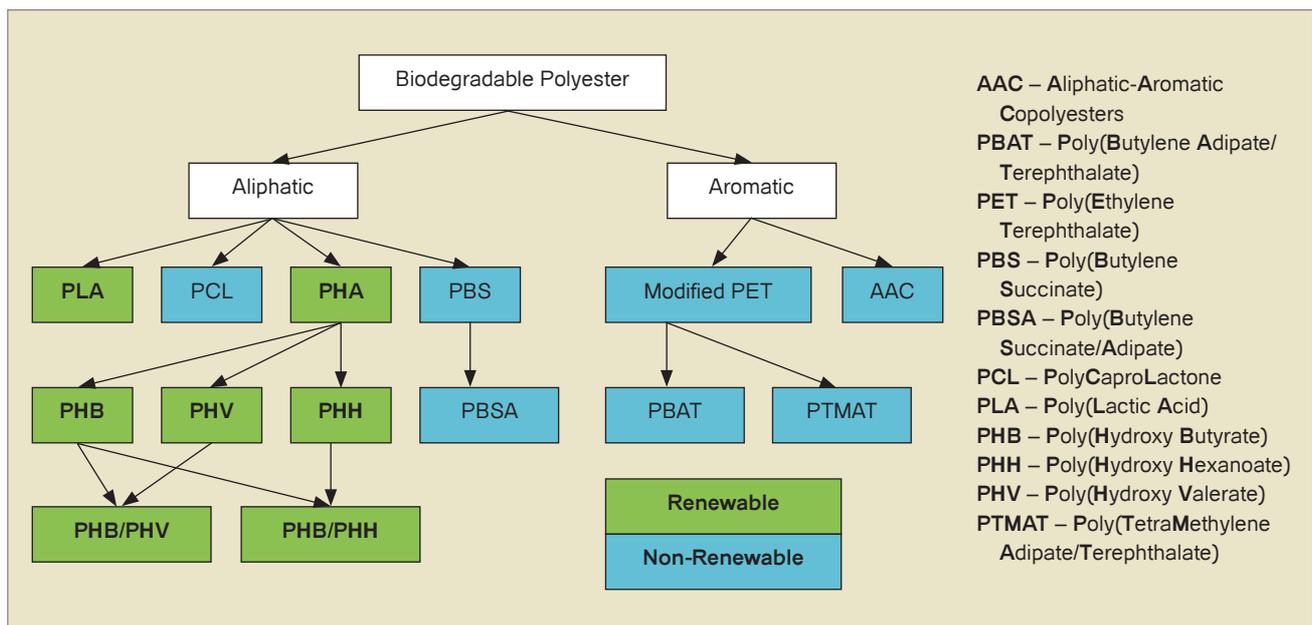


Figure 1: Biodegradable polyester family

In addition, there are also polymer products in the market called oxo-biodegradable plastic. This so-called “biodegradable” plastic has caused controversy among environmentalists as it is actually degraded using a controlled catalyst to kick-start a chain-scissioning reaction to attack the polymer macromolecules. This catalyst is made of series of active organo transition metals. When the oxo-biodegradable polymers are exposed to the ultra-violet and free oxygen attacks, the chain-scissioning reaction occurs extensively and finally reduces the plastics into carbon dioxide (CO<sub>2</sub>). In the market, the oxo-degradation additives are mostly added to polyethylene and polypropylene. This additive is applied in very little amount (<1%) for its high effectiveness. Nevertheless, controversy also arises about

this type of “eco-friendly” plastic because it is still derived from petroleum-based product and its degradation still generates CO<sub>2</sub> which is against the principle of carbon credit products. In short term consideration, it can help to reduce the burden of landfills. However, the use of such oxo-biodegradable can also cause other serious environmental problems, the most serious of which is that it also takes time to be fully degraded into CO<sub>2</sub>. During the early breakdown process, fragmentation of the plastics will pollute the soil and can be accidentally consumed by the soil habitant organisms.

Various types of eco-packaging are available in the market and such eco-plastics products need to undergo a series of test to verify its biodegradability and compostability. In the European Union, the compostable packaging must fulfill the requirement of EN 13432, while other countries have respective standards to be achieved before they are allowed to use the compostable logo on their products (Table 2).

Table 1: Examples of PLA Product Applications

Company	Area of Application	Market Products
CL Chemical Fibers	Spun-bond fabrics	Medical applications, shopping bags, and landscape textiles 
Dyne-A-Pak	Foam meat trays	Dyne-A-Pak Nature™ tray 
Bodin (France)	Foam tray	Tray for meat, fish and cheese 
CDS srl	Food service ware	Cutlery 
Cargo Cosmetics	Casings	Casings for cosmetics 
DS Technical Nonwoven	Exhibition grade carpeting	Ecopunch® carpets 

Table 2: Certification of compostable plastic for respective countries

Certification Body	Standard of Reference	Logo	
Australia Bioplastics Association (Australia) <a href="http://www.bioplastics.org.au">www.bioplastics.org.au</a>	EN 13432: 2000		
Association for Organics Recycling (UK) <a href="http://www.organics-recycling.org.uk">www.organics-recycling.org.uk</a>	EN 13432: 2000		
Polish Packaging Research and Development Centre (Poland) <a href="http://www.cobro.org.pl/en">www.cobro.org.pl/en</a>	EN 13432: 2000		
DIN Certco (Germany) <a href="http://www.dincertco.de/en/">http://www.dincertco.de/en/</a>	EN 13432: 2000		
Keurmerkinstituut (Netherlands) <a href="http://www.keurmerk.nl">www.keurmerk.nl</a>	EN 13432: 2000		
Vincotte (Belgium) <a href="http://www.okcompost.be">www.okcompost.be</a>	EN 13432: 2000		
Biodegradable Products Institute (USA) <a href="http://www.bpiworld.org">www.bpiworld.org</a>	ASTM D 6400-04		
Japan BioPlastics Association (Japan) <a href="http://www.jbpaweb.net">www.jbpaweb.net</a>	Green Plastic Certification System		

(Continued on page 18)

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- Governor of Electricity Generating Authority of Thailand, Thailand
- Dr. Piyasvasti Amranand, Chairman, Energy for Environment Foundation, Thailand
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## WORKSHOP ON PRACTICAL DESIGN, INSTALLATION & TESTING OF DRIVEN PILES, BORED PILES AND MICROPILES

Date & Time : **23th November 2013 (Saturday)** 9.00a.m - 5.30p.m  
Venue : Arcadia 1, Level 3, Hotel Armada, Petaling Jaya  
Participants : Civil Engineers, Geotechnical Engineers, Structural Engineers, Building & Piling Contractors, Consultants, Project Managers, RE, Lecturers, Academics  
Fee : **Normal Price:** RM550/person  
**Promo Price: RM450/person for 2 or more people**  
Speaker : **Ir. Neoh Cheng Aik KMN**



### Course Outline

Overview of pile design, installation & testing. Design principles/concepts & requirements stipulated by code of practice (BS 8004 & EC 7), critical parameters, specification & checklists for pile design & installation. Case histories of design, construction & testing of driven piles, bored piles & micropiles in various common types of geological formations will be illustrated & presented. Planning, execution & interpretation of common types of pile tests for driven piles, bored piles & driven piles will also be included. Workshop notes and more than 300 slides will be given.

## WORKSHOP ON CASE HISTORIES OF BUILDING FOUNDATION DISTRESS/FAILURES

Date & Time : **21st December 2013 (Saturday)** 9.00a.m - 5.30p.m  
Venue : Arcadia 1, Level 3, Hotel Armada, Petaling Jaya  
Participants : Civil Engineers, Geotechnical Engineers, Structural Engineers, Building & Piling Contractors, Consultants, Project Managers, RE, Lecturers, Academics  
Fee : **Normal Price:** RM550/person  
**Promo Price: RM450/person for 2 or more people**  
Speaker : **Ir. Neoh Cheng Aik KMN**

### Course Outline

- Common types of building foundations & the design principles & concepts.
- Detail case histories of various types of building foundation distress/failures, investigation & analysis for causes of distress/failures, remediation proposals & underpinning design with detail scope of design verification/analysis/calculations plus design validation to show compliance with the requirements stipulated by code of practice, etc.
- Comprehensive workshop notes & more than 250 slide presentation.



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This book is compiled with some of the common problems in the design of retaining walls and its solutions, particularly in areas of retaining wall that are relevant in the construction industry. It is an entry level book specially written for practising civil engineers and undergraduates based on basic theories.

Its aim is to provide simple and practical solutions to retaining wall designs and challenges. The solutions are also illustrated with relevant reference charts and tables with a selection of different coefficients and data in solving the problems, providing viable and quick solutions to some of the challenges commonly faced in this area.

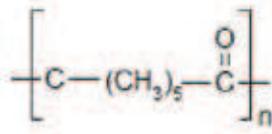
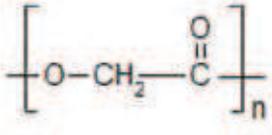
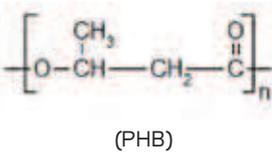
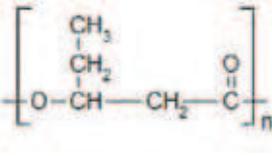
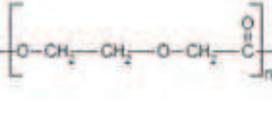
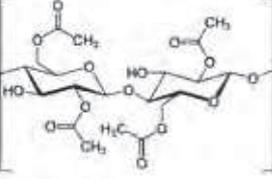


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Table 3: Biopolymer producers and applications

Polymer	Chemical Composition	Producer	Applications	Biodegradability
Polycaprolactone (PCL)		DURECT Corporation-Lactel® Daicel Chemical Industry-Celgreen® Union Carbide Corporation-TONE® Solvay Group-CAPA® Purac-Purasorb® PC 12	Ethicon-Monocryl®-Suture Capronor®-Contraceptive implant Agrotec-Agrothane®-Paint and metal protection film	> 12 months
Polyglycolide or Polyglycolic acid (PGA)		Purac-Purasorb® PG 20 Teleflex Incorporated Kureha Corporation	Dolphin-Petcryl®-Sutures Bondek®-Sutures Dexon™ S-Sutures DemeTech®-Sutures	> 3 months
Polyhydroxyalkanoate- Polyhydroxybutyrate (PHB) and Polyhydroxyvalerate (PHBV)	 (PHB)  (PHV)	Metabolix/ADM-Telles Mirel™ Ningbo Tianan Biologic Material-Enmat™ Copersucar-Biocycle® Biomer-Biomer®	Compost Bags Consumer packaging Agriculture/Horticulture film Rubbermaid®, Calphalon®, Paper Mate®, BioTuf™ EcoGen™	3 -12 months
Polydioxanone (PDO)		Ethicon Samyang	DemeTech® sutures Duracryl® sutures D-Tek® sutures Surgeasy® sutures Ethicon® PDS* II sutures OrthoSorb® pin	< 7 months
Cellulose acetate		Celanese Rhodia	Cigarette filter Textile Spectacle frames Film media Wound dressing-ADAPTIC™ Bioceta® Toothbrush	< 24 months Depend on acetate content

Apart from PVOH and PLA, other commercial biodegradable polymers are only produced on a small scale, either for exploration of commercial potential or mainly for biological applications (refer to Tables 3 and 4). Polycaprolactone (PCL), polyglycolic acid (PGA), and polydioxanone (PDO) are the common biodegradable medium for sutures, pins and drug carrier implants. Normally PGA and PDO are preferable materials over PCL in biomedical application because PCL takes longer time *in vivo* resorbable. A clinical study of PCL-based implantable biodegradable contraceptive indicates that Capronor® containing levonorgestrel remains intact during the first

year of use and is finally degraded and absorbed by the body after two years (Darney, 1989). Both PHB and PHBV belong to polyhydroxyalkanoates (PHA) and are developed using biological fermentation of dextrose. Metabolix and ADM joint venture under Telles produces PHB with the trade name of Mirel™. PHB compost bags need 6-12 months to be naturally degraded. International stationary manufacturer Sanford uses PHB in its famous PaperMate® product range. PHB is not easily degraded under normal condition of usage or even storage under humid environment but when buried under soil and compost, the PHB-made PaperMate® pen decomposes in about a year.

Table 4: PLA in biomedical applications

Polymer	Area of Application	Products
Poly (lactide)	Orthopedic surgery, oral and maxillofacial surgery 	Takiron: Osteotrans™ MX, Fixsorb™ MX (screws, nails, pins) Gunze: Grandfix® Neofix® (screws, nails, pins) Arthrex: Bio-Tenodesis® interference screw, Bio-Corkscrew® suture anchor Conmed Linvatec: SmartScrew® SmartNail® SmartTack® SmartPin® BioScrew® Stryker: Biosteon® Biozip® interference screw, anchor Zimmer: Bio-statak® (suture anchor) prostatic stent, suture anchor, bone cement plug Dermik Laboratories: Sculptra® injectable facial restoration Kensey Nash: EpiGuide®
Poly (D,L-lactide-co-glycolide) Poly (D,L-lactide-co-glycolide) 85/15 Poly (D,L-lactide-co-glycolide) 82/18 Poly (D,L-lactide-co-glycolide) 10/90	Suture Drug delivery Oral, and maxillofacial surgery General surgery Suture, periodontal surgery, general surgery 	USS Sport Medicine: Polysorb™ sutures Instrument Makar: Biologically Quiet™ Interference Screw, Staple 85/15 Biomet: ALLthread™ LactoSorb®, screw, plates, mesh, surgical clip, pins, anchor Ethicon: Vicryl suture, Vicryl Mesh
Poly (L-lactide-co-D,L-lactide) 98/2 Poly (L-lactide-co-D-lactide) 98/4 Poly (L-lactide-co-D,L-lactide) 50/50 Poly (L-lactide-co-D,L-lactide) 70/30 Poly (D-lactide-co-D,L-lactide-co-L-lactide)	Orthopaedic surgery Oral and maxillofacial surgery 	Phusiline® Interference Screw, Sage ConMed: Bio-Mini Revo® Sulzer: Sysorb® Screw (50/50) Geistlich: ResorPin® 70/30 Kensey Nash: Drilac® Surgical dressing
Poly (D,L-lactide-co-caprolactone)	Nerve Regeneration 	Ascension Orthopedics: Neurolac® Polyganics: Vivosorb®

Cellulose acetate is commonly used as cigarette filter, textile, spectacle frames and film media. Since the early 20th Century, cellulose acetate is a very important base material for the film industry. Over the decades the application of cellulose acetate has changed and today, a modified cellulose acetate is suitable to be injection moulded to produce biodegradable plastic articles. Some series of sunglasses marketed by Louis Vuitton are made of cellulose acetate. This material comes in a wide variety of colours and textures. They can be adjusted easily, but tend to get brittle with time.

Knitted cellulose acetate fabric treated with specially formulated petrolatum emulsion helps to protect open wounds and prevents the dressing from adhering to the wound. However, prolonged exposure to moisture, heat or acids will reduce acetyl (CH<sub>3</sub>C) groups that are attached to the cellulose. The degradation process causes the release of acetic acid, which is known as “vinegar syndrome”. This is because when cellulose acetate film is stored under hot and humid conditions, the release of saturated acetic acid emits a smell. This will also further attack the polymer chain and deteriorate the cellulose. A study of cellulose acetate,

reported by Buchanan *et al.* (1993), showed that cellulose acetate can be biodegraded in waste-water treatment assay approximately 70% at 27 days of cellulose diacetate with the rate of degradation also depending on the degree of substitution of acetate. A high degree of substitution of acetate requires longer exposure.

Besides that, most of the mentioned biodegradable polymers belong to the polyester group (Figure 1). This is due to ester containing covalent bond with reactive polar nature. It can be broken down easily by hydrolysis reaction. The biodegradable polyester can be divided into aliphatic and aromatic group with some of the members derived from renewable and non-renewable sources. PLA and PHA are both aliphatic polyester using renewable agricultural sources while PCL and PBS/PBSA are aliphatic polyester produced from non-renewable feedstock. Most of the PCL in the market are used in biomedical application whereas PBS/PBSA, as marketed by Showa Denko under the tradename Bionolle, is supplied to local Japanese government programmes for packing domestic solid waste before collection.

Generally, all aromatic polyesters are produced from petroleum. Some people think that petroleum-based biodegradable polymers are more feasible than bio-based biodegradable polymers. The reason is that bio-based polymers has raised the issue of competition between food supply and plastic production, especially as there is still a shortage of food among many Third World countries. However, do not let this be an obstacle to developing bio-based polymers because a small step in developing renewable technology today can lead to a giant leap in reducing our dependence on fossil resources.

Besides, BASF has introduced an AAC product named Ecoflex®. This material is widely used to produce compostable packaging and films. According to BASF, the annual production capacity of Ecoflex® has expanded to 60,000 MT to capture the demand of biodegradable plastics which is growing at a rate of 20% per year. BASF also blends polyester with PLA for another product called Ecovio®. The high melt strength polyester-PLA can be used directly and processed by conventional blown film lines without the incorporation of additives. Furthermore, Ecovio® has extraordinary puncture-and-tear-resistant as well as weldability characteristics. Another company, Eastman, also produced AAC with the tradename of Eastar Bio® which has a highly linear structure while Ecoflex® contains long-chain branching. A study reported by BASF shows that AAC of the Ecoflex® has comparable biodegradability as cellulose biomass which is able to achieve 90% compostable in 180 days as per CEN EN 13432. Thus, petroleum-based biodegradable polymer can also be as good as natural material in term of degradability.

The conventional polyethylene terephthalate (PET) takes centuries to be naturally degraded. However, PET with appropriate modification such as copolymerization with co-monomer ether, amide or aliphatic monomer will increase biodegradability. Such modified PET materials

include polybutylene adipate/terephthalate (PBAT) and polytetramethylene adipate/terephthalate (PTMAT). Dupont has commercialized Biomax® PTT 1100 with the plastic melting point of 195°C which makes it suitable for use as fast-food disposable packaging and cups for hot food and drinks.

In conclusion, the research and development of biopolymers have been carried out for many years. Nevertheless, many people lack knowledge about the applications of biopolymers. But with NGOs and government agencies promoting the use of biopolymer as environment-friendly materials for a sustainable future, it is expected that the use of biopolymers will grow tremendously in the near future. ■

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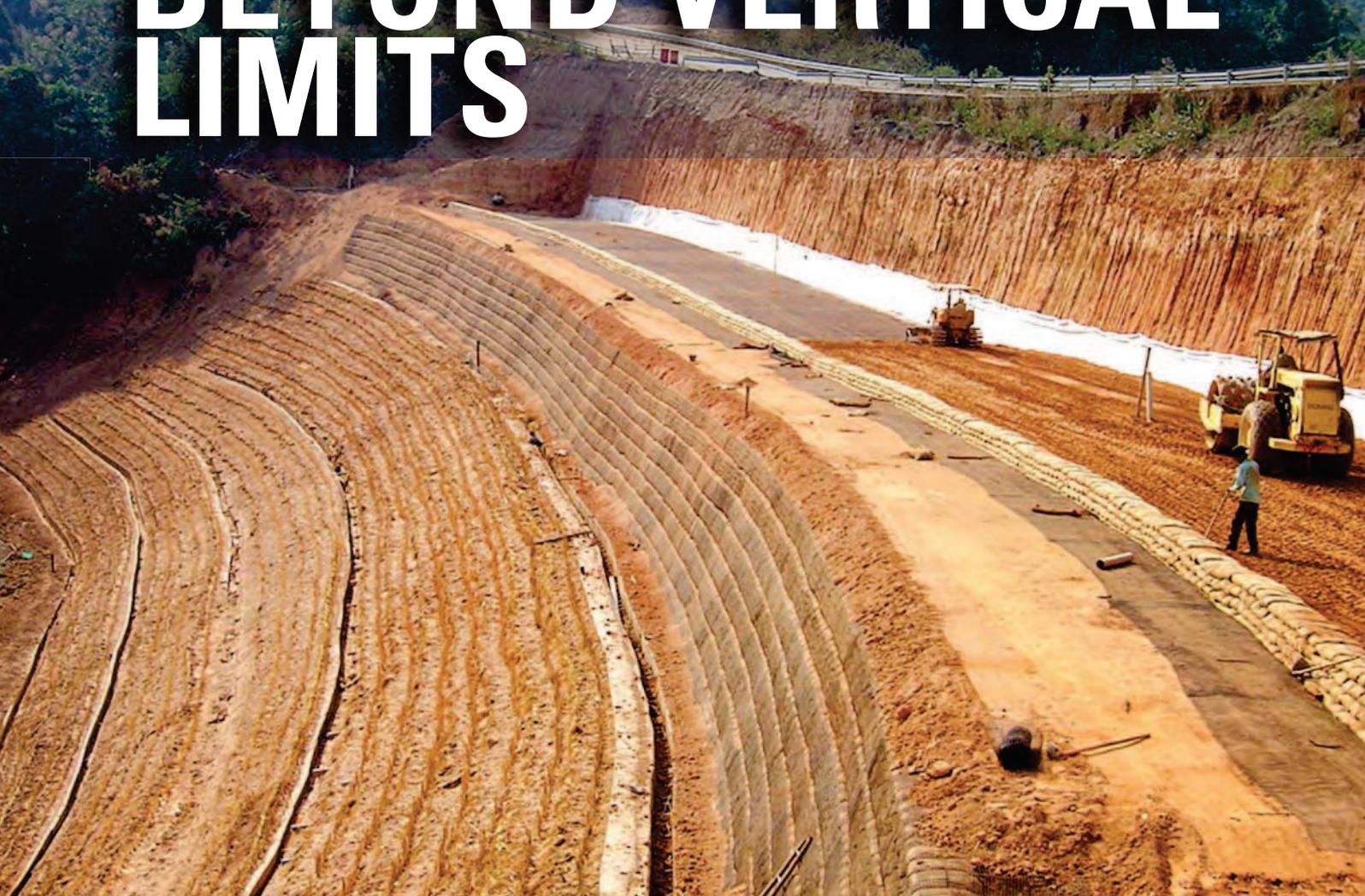
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# Career for Chemical Engineering Graduates – My Personal Perspective



by Ir. Mohamad Anuar Ahmad

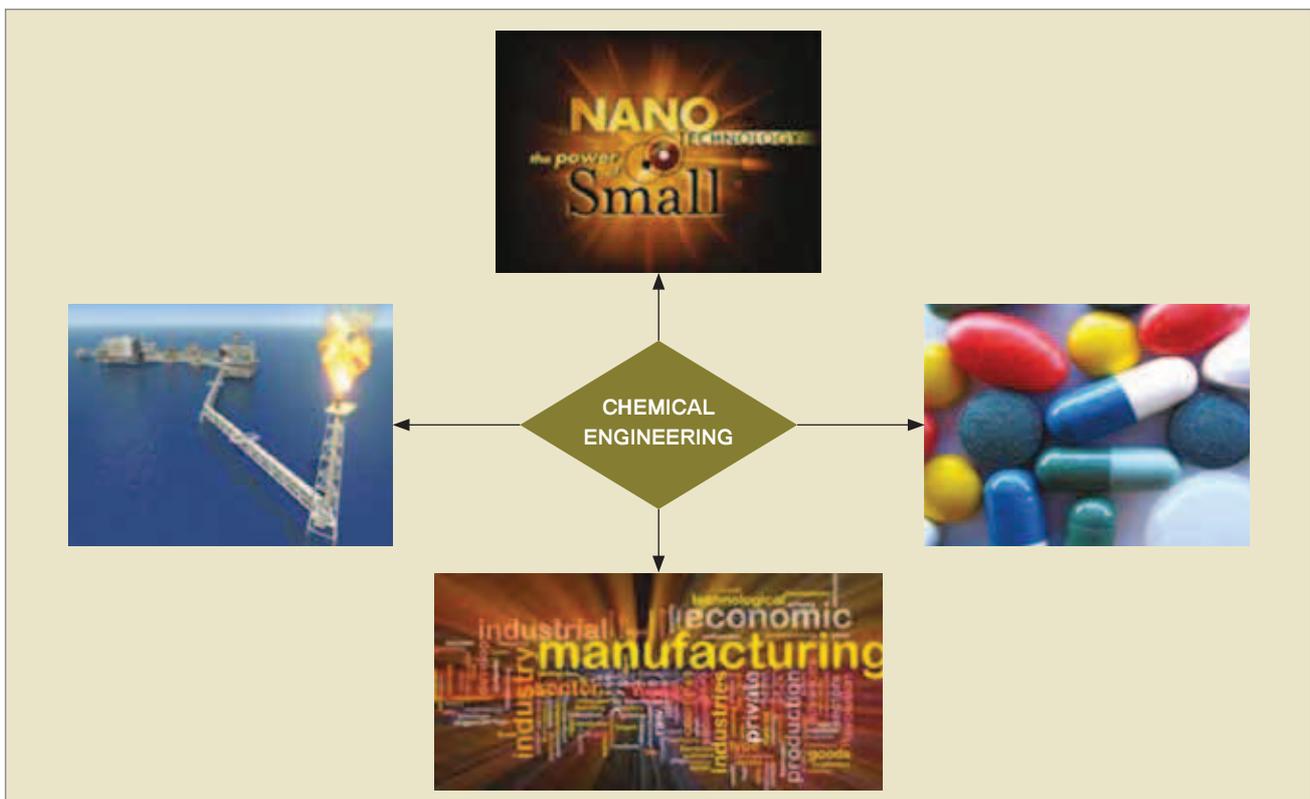
**HOW** many of us know what Chemical Engineering is all about when we fill up the university application form? Some of us may have applied because we have been told to do so, perhaps by our parents and relatives or teachers and seniors, etc. Some of us may have applied because we are interested in chemistry, physics and mathematics.

In my case, I applied for the Chemical Engineering programme because I was interested in the hydrocarbon and petroleum industry. At an education fair, I was attracted to a poster on the petroleum industry. There could be lot more other reasons why we have chosen Chemical Engineering for our further studies.

Some people feel that Chemical Engineering may narrow down our career choice upon graduation. On the contrary, there are lots more opportunities for Chemical Engineering graduates. These include jobs that can be filled by non-chemical engineers as well as those that are specifically meant for chemical engineers. In general, the choice of career is more dependent on one's own preferences and circumstances rather than the supply-demand curve. I have

seen both cases and, to a certain extent, I have experienced them myself too. As a reader, you may ask, "how can it be partially?" Well, believe me, there are many similar cases with different individuals.

When a person graduates from a Chemical Engineering programme in university, he or she will apply for jobs that are more or less related to his or her area of study. As a new graduate, it is quite natural that he or she may apply to join a specific field that matches his or her area of expertise. However, we do not necessarily get what we want. So, a contingency plan must be in place so that we can act according to the circumstances. Even if you do join the industry of your choice, it still does not necessarily mean you will have the chance to be in the specific area of preference. For instance, I started my career in the oil and gas industry but as a graduate process engineer in fabrication yard. I then moved to an operating company and currently, I am with an engineering firm (we call it as "design house").



(Continued on page 25)

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Would you consider this a good or bad move, experience-wise? It really all depends on whether our career is progressing according to our plans and whether we know what we are doing. In my own career path, the areas of work (even when in different companies) are about the same, i.e. process engineering. However, there are cases where chemical engineers end up in project and services, or they deal with project management as a project engineer, performing tasks such as cost estimation, procurement, quality control and other jobs that do not deal with chemical or process engineering.

I have also seen chemical engineers end up as piping engineers, which is the main domain of Mechanical Engineering graduates. I should also mention that a career for chemical engineers in the oil and gas sector can also include working in sub-surface engineering and handling work related to reservoir engineering. In short, a career in chemical engineering in the oil and gas industry can be discussed as an independent topic because it's so wide ranging. As for the contributions that chemical engineers can make to this industry, what has been discussed so far is merely the tip of the iceberg.



Apart from the oil and gas sector, there are many more industries where chemical engineers can plan a career. These include petrochemical, bulk chemical, fertiliser, food and beverage, and many more. Roles for chemical engineers in these industrial sectors range from technical services, operation, planning, safety, etc. These roles may vary, depending on their position. For instance, in the technical service department, chemical engineers will be doing optimisation studies and supporting the operation

team. Operation engineers, on the other hand, are in charge of performance maintenance for the plant to ensure that it operates as planned without problems, that it meets customer satisfaction as well as ensure supply meets demand. As a safety engineer, he or she would ensure that the plant is running at optimum safety standards.

Apart from working in the conventional work sectors such as oil and gas, bulk chemical industry, chemical engineers can also move into various consumer products industries. Among these is the food and beverage industry where chemical engineers can apply the various principles of Particle Technology to the manufacturing process as well as the packaging section. In addition, when production is to be up-scaled, chemical engineers can play an important role to ensure that the specification of the products is met. Just like in other industries, chemical engineers can also play the role of safety engineer to ensure production is maintained at the highest safety standard. Note that even though chemical engineers have to compete with non-chemical engineers (e.g. food technologies) to get hired in this industry, they do offer services that will improve the quality of the food products and the processes.

The pharmaceutical industry also offers good opportunities for chemical engineers. In some countries, Pharmaceutical Engineering programmes are offered to produce engineers in this specialised area. In Malaysia, I have met quite a number of chemical engineers working in pharmaceutical industry. They apply the fundamentals of Chemical Engineering principles such as mass and energy balances, mass and heat transfer, lab analysis, etc. in their daily work. The beauty of being a chemical engineer is that we are exposed to fundamental engineering principles which can be even applied to specialised area such as pharmaceutical engineering.

Another area where chemical engineers can largely contribute to the country is from the environmental perspective. Ranging from waste water treatment plants to air quality monitoring and solid waste management, chemical engineers can ensure that the waste produced from a production facility is properly treated before it is discharged into the environment.

I should also mention that there are many chemical engineers who choose to go into the research and development (R&D) sector, whether it is in the industrial, research or academic institutions. There are many emerging sectors where chemical engineers can contribute significantly, e.g. nano technology, biotechnology, software development, etc. We also find many chemical engineers

# FEATURE

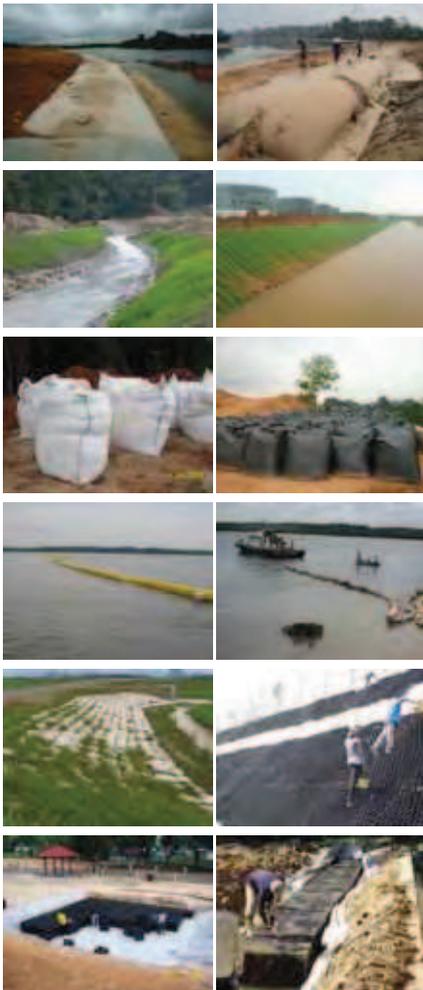


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working in the authority bodies, as regulators and as educators in higher education institutions, etc. There may be some industries that I have missed out in my list here, but as long there is a requirement for non-specialised engineers, chemical engineers are always eligible for the job, especially new graduates and the graduating students in universities.

As for career choices, my advice to fresh graduates and graduating students is to be always realistic when deciding which sector you want to start your professional career. Perhaps a good way of seeking advice is to get involved with professional bodies such as The Institution of Engineers, Malaysia (IEM), or specifically The Chemical Engineering Technical Division (CETD).

There is also The Institution of Chemical Engineers, UK (IChemE) which is now collaborating closely with CETD to enhance the Chemical Engineering profession in the country. By being involved with these professional bodies, we will get to enhance our professional career. ■

Ir. Mohamad Anuar Ahmad is a process engineer with Ranhill Worley Parsons. He holds a B.Sc in Chemical Engineering, University of Malaya (2005).

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(Solution is on page 52 of this issue.)

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LETTER TO THE EDITOR

# GOVERNMENT ON RIGHT TRACK IN TARGETING 40% SCIENCE STUDENTS

13 July 2013



**SCIENCE**, Engineering and Technology are essential for besides others the successful implementation and maintenance of the many infrastructure projects that are needed for the nation to achieve developed status by 2020 and sustainable development. The Institution of Engineers, Malaysia or “Engineers Malaysia” has long been concerned about the declining number of science students in schools which will affect the future supply of engineers and technologists. Hence, Engineers Malaysia lauds the decision by the Education Ministry to have 40% of all Form 4 students to be in the science stream.

Several factors have been cited by the Education Ministry as possible reasons for the declining interest in Science subjects, including badly equipped laboratory facilities, poor teaching methods and lack of career incentives. Rehabilitating the laboratories and thereafter making the learning of sciences fun and exciting must go hand in hand. Towards this end, Engineers Malaysia has set up Engineering Clubs in a number of schools with the objective of providing interesting activities that help motivate students at an early age to develop the interest in Science.

With limited financial resources but enormous enthusiasm, Engineers Malaysia will contribute its human resources; mainly from its Young Engineers Section (YES) as well as its strategic engagement with stakeholders in schools; especially primary schools.

Career incentives have also been a reason of concern for Engineers Malaysia. Prospects for engineers and technologists to reach the top and of drawing a high remuneration as well as status, falls short of other non-science based professions. Until and unless special incentives are drawn up to address any such discrepancies, the school student will not be motivated to take up science nor to pursue a career in engineering and technology.

Engineers Malaysia will be happy to lend its support needed for any Science, Engineering and Technology initiatives, including those from the Education Ministry, to contribute to its success. ■

**Ir. Choo Kok Beng, FASc**  
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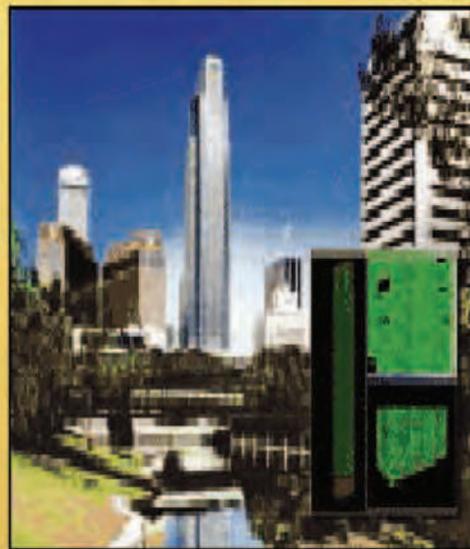
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## TNB Picked for Manjung Power Plant Job

Tenaga Nasional Bhd (TNB) has been selected as the preferred bidder by the Energy Commission in the most recent Fast Track Project 3A international competitive bidding to develop a 1,000MW coal-fired power plant at Manjung, Perak.

TNB said it has been invited to negotiate in the bid, project documents and the proposed offset programme. "The letter of award will be issued upon successful completion of the negotiations," it said in a statement to Bursa Malaysia.

The power plant, which is expected to start commercial operation on October 1 2017, will take 45 months to be completed.

*(Sourced from Business Times, 17 July 2013)*

## Scomi Energy Wins RM159mil Coal Contract from TNB Fuel

Scomi Energy Services Bhd, a subsidiary of Scomi Group Bhd, has secured a bulk coal affreightment contract worth RM158.7mil from TNB Fuel Services Sdn Bhd. Energy said the contract was for a period of two years commencing September 1, with an option to be extended for another year.

Under the contract, Scomi Energy Services is expected to transport about three million tonnes of coal per year to and from various locations.

*(Sourced from The Star, 16 July 2013)*

## Rail Project for Iskandar a Private Sector Initiative

Iskandar Malaysia's rail project is not a government-driven project but a private sector initiative, said Malaysia Steel Works (KL) Bhd (Masteel) managing director and chief executive officer Datuk Seri Tai Hean Leng.

He said Metropolitan Commuter Network Sdn Bhd (MCN) was not "awarded" the contract by the government. "MCN is undergoing the process of obtaining the necessary approvals from various government ministries and has not been granted full approval to undertake the project," he said.

MCN, the joint-venture company that is 60 per cent owned by Masteel and 40 per cent by KUB Malaysia Bhd, will build and operate the rail transit system at Iskandar Malaysia in Johor, he said.

*(Sourced from Business Times, 17 July 2013)*

## Plan to Produce 50% More Biodiesel

Malaysia is expected to increase biodiesel production by 50 per cent to 375,000 tonnes this year due to price differential between crude oil and palm oil prices that is favourable in the export market.

Plantation Industries and Commodities Minister Datuk Seri Douglas Uggah Embas said this after launching the rollout of the B5 for the southern region in Pasir Gudang yesterday.

B5 is a blend of 95 per cent regular diesel and five per cent palm biodiesel. It was launched in June 2011 covering Malacca, Negeri Sembilan, Putrajaya, Selangor and Kuala Lumpur.

*(Sourced from Business Times, 23 July 2013)*

## Petronas: Decision on 2nd FLNG Project in H2

Petronas will make a final decision on its second floating liquefied natural gas project for the Rotan field in Block H, offshore Sabah, in the second half of the year.

"Once sanctioned, production from this second FLNG vessel is expected to commence in 2016," said a company spokesman.

He said the Petronas FLNG2 project is currently undertaking a dual front-end engineering and design (FEED) competition.

"Two consortiums are involved at this stage, with one being JGC Corp and Samsung Heavy Industries, and the other being MITC, which consists of Modec, IHI, Toyo Engineering and CB&I.

*(Sourced from Business Times, 23 July 2013)*

## Canada Rail Disaster Probably Killed 50

A Canadian rail disaster on 6 July that "probably" killed as many as 50 people was likely the result of an engineer's failure to set the brakes on an unmanned train owned by a US railway company, officials said.

Twenty people died and 30 unaccounted for with little hope of being found alive following the explosive train crash.

Quebec provincial police inspector Michel Forget said the 30 were "missing and most probably dead".

The freight train carrying oil crashed after rolling down a hill from a nearby town and flying off a curve in the track, sparking a massive inferno that tore through part of Lac-Mégantic, a town of 6,000 located east of Montreal near the US border.

*(Sourced from The Star, 12 July 2013)*

## Posco Drops Karnataka Steel Mill

South Korea's Poscowill pull out of a US\$5.3 billion (RM16.85 billion) steel mill development in India's Karnataka state, but will proceed with another US\$12 billion project billed as the country's largest foreign direct investment.

The world's fifth-biggest steelmaker said it had agreed to cancel the project with the government of southern Karnataka state because of delays in receiving iron ore mining rights and opposition from residents which had held back land acquisition.

*(Sourced from Business Times, 17 July 2013)*

# SAFE TIME

## More Fruit For Thought



by Ir. Shum Keng Yan

**WHETHER** an incident becomes a full blown crisis or an opportunity depends very much on the machinery to handle the incident. It has been said that crisis and opportunity are two sides of the coin\*. So let's have a look at our PEAR again. Here are the simple steps for thought.

Process   Exercise   Awareness   Review

### PROCESS

Now that you have your BCCM Team in place and your Business Impact Analysis figured out, the next step is to put in Contingency Plans for each of the Potentially High Impact (PHI) incidents. This step involves identifying the critical assets and processes that require back up. Comprehensive procedures are written down to address each of the incidents identified.

### EXERCISE

Your contingency plans are ready? Great. It is time to test it out. The exercises can be e-learning, followed by desktop drills and mock drills. The scenario chosen should be written up based on the PHI incidents. Usually the drill can be in stages (e.g. desktop drill) as the scenario unfolds. It can incorporate a combination of PHI events to test the readiness of the team. The frequency of the exercises should be decided based on the organisational needs.

*\* It is worth noting that the actual word for Crisis (危机) and Opportunity (机会) is not a reverse. The words sound almost like a reverse and this is how the phrase "Turning Crisis Into Opportunity" has come about. However, the machinery (机) to handle them is the same.*

Ir. Shum Keng Yan is a chemical engineer and a certified accident prevention and safety practitioner. He advises on EHS in the chemical, fast moving consumer goods, heavy metal manufacturing and building services industries across Asia Pacific and beyond. He regularly delivers talks at conferences, forums and universities.

### AWARENESS

It is not enough to keep the plans within the BCCM Team. An awareness and promotion programme should be put in place in order that all employees understand their roles and the processes. You may need to work with Corporate Communications or Corporate Affairs for this.

### REVIEW

Finally, as with any good management system, review the Business Impact Analysis annually or if there are any new changes that may affect the organisational readiness to put the plan into operation. Incorporate lessons learned from incidents (internal and external). Put in the best practices you can pick up in the industry.

In summary:

Place a Person-in-Charge  
Establish the Business Crisis and Continuity Management Team  
Assess the risks using a Business Impact Analysis  
Run exercises and drills

These are the low hanging fruit for you to start. To share your own fruit for thought, email: [pub@iem.org.my](mailto:pub@iem.org.my). ■

## OBITUARY

With deep regret, we wish to inform the passing of the following members:

Ir. Chua Chai Guan, 19 July 2013

Ir. Kor Chan Wah, 29 July 2013

Ir. Lim Chean Fung, 15 August 2013

On behalf of the IEM Council and Management, we wish to convey our deepest condolences to the family members.

*The IEM Editorial Board*

# Why Engineers "Rock"

CHEMICAL ENGINEERING TECHNICAL DIVISION



by Ir. Prof. Dr Dominic Foo Chwan Yee

A forum entitled "Engineers Are Not Kayu" was held at Taylor's University Lakeside Campus on 11 May 2013, specially dedicated to the September issue of IEM *JURUTERA*. The forum was jointly organised by Chemical Engineering Technical Division (CETD), Young Engineers Section (YES) of IEM and Taylor's University. Seven panel speakers were invited to talk about their professional work duties along with their interests and talents.

When the forum started at 11.15 a.m., two academic members of CETD, Engr. Dr Chong Chien Hwa (Taylor's University) and Engr. Assoc. Prof. Dr Denny Ng Kok Sum (University of Nottingham Malaysia Campus) shared with participants about their professional work as lecturers and researchers. Apart from performing their academic duties, both have other interests that are lesser known to their students and academic colleagues.



Figure 1: Engr. Dr Chong Chien Hwa and some of his signature dishes

Engr. Dr Chong Chien Hwa enjoys cooking during his free time and some of his signature recipes are for fish and other seafood (see Figure 1). On the other hand, Engr. Assoc. Prof. Dr Denny Ng loves to travel and play badminton. He shared a few photographs of himself taking part in badminton competitions (Figure 2), as well as his trips to various Asian and European cities. He also shared his tips on how to travel on a tight budget.

Next, Engr. Rafil Elyas, a consultant with East 101 Sdn. Bhd., talked about his professional work in the oil and gas business. In his spare time, he enjoys writing fiction and short stories, playing and composing music, as well as recording music.

One common interest that he and Ir. Prof. Dr Dominic Foo share is music. The latter is a chemical engineering professor whose regular work duties include being a researcher, author, editor, teacher and "social worker" (his service with IEM). Playing their guitars, the duo performed a new song that Engr. Rafil had composed



Figure 2: Engr. Assoc. Prof. Dr Denny Ng in action during a badminton competition

specially for the forum, titled "I Want To Be An Engineer". The forum participants were also given a copy of the song lyrics (see box for song lyrics and Figure 3 for photo) and invited to sing along. Video clips of the performance can now be viewed on the blog of CETD (<http://iemcetd.blogspot.com/>).

## I WANT TO BE AN ENGINEER

Composer: Engr. Rafil Elyas

I want to build a rocket ship, I want to grow a giant turnip  
I want to break covalent bonds, maybe find a Higgs boson  
I want to make some gasoline, put it in my speedy machine  
Drive it over to your house, build a giant robot mouse

(Chorus)

***I wanna be an engineer, you wanna be an engineer!  
I don't wanna be no doctor, I don't want to be no lawyer  
I want a hard hat, safety boots, don't want no designer shoes  
One ton beam falls on my toes, dance around in my coveralls***

I like chemistry and physics, diff EQs and stochastics  
I really dig fluid mechanics, gotta have my thermodynamics  
Willard Gibbs is the Taikor! Bernoulli, Maxwell and Euler!  
Now we can make anti freeze, build space stations, refineries!

***I wanna be an engineer, you wanna be an engineer!  
I don't wanna be no doctor, I don't want to be no lawyer  
I want a hard hat, safety boots, don't want nice designer shoes  
One ton beam falls on my toes, dance around in my coveralls***

I wanna make my car go faster, I wanna make my bridge span longer  
I wanna make my sub go deeper, I wanna make my plane fly higher  
I wanna end all world hunger, make sure everyone's got clean water  
Everyone's healthy there and here! So everyone can be engineer!

***I wanna be an engineer, you wanna be an engineer!  
I don't wanna be no doctor, I don't want to be no lawyer  
I want a hard hat, safety boots, don't want nice designer shoes  
One ton beam falls on my toes, dance around in my coveralls***

You want to be an engineer, you momma wants to be an engineer  
Your papa wants to be an engineer, you brother wants to be an engineer  
Your kid wants to be an engineer, your neighbour wants to be an engineer  
Everyone can be engineer! Everyone can be engineer! ENGINEER!



Figure 3: Song performance by Ir. Prof. Dr Dominic Foo (left) and Engr. Rafil Elyas

Engr. Lim Mei Ling was the next panel of the forum. She shared about her professional work as a mechanical engineer at Technip Geoproduction (M) Sdn. Bhd., a project management, engineering and construction company. To the surprise of all forum participants, the young lady revealed that she is actually a tough sport woman who enjoys outdoor activities such as mountain hiking, running marathons and mountain biking! She has hiked up many mountains in the country, including Gunung Batu Putih, Gunung Irau and Gunung Nuang. She has also finished three 42 km marathons and cycled to Bukit Fraser, Cameron Highland and Bukit Tinggi, among others (Figure 4).



Figure 4: Sports activities of Engr. Lim Mei Ling

The next speaker, Engr. Mohd. Khairul Kamaruddin, is also another sports enthusiast. Apart from working as a piping engineer at Technip Geoproduction (M) Sdn. Bhd., he spends his spare time paragliding and rock climbing. He had worked as a rock climbing instructor and is now a member of the Malaysian national paragliding team. His past achievements include a silver and two bronze medals in Southeast Asia (SEA) Games 2011 that was held at Indonesia (Figure 5). He will soon represent the country again in the coming 2013 SEA Games in Myanmar. He



Figure 5: Engr. Mohd. Khairul Kamaruddin at SEA Games 2011

also shared how he appreciates the knowledge in fluid mechanics through paragliding activities.

Ir. Razmawata Mohd. Razalli, the last panel of the forum, is an oil and gas consultant in Synergy Oil & Gas Engineering. However, the 2012/13 Session Chairman of the Oil, Gas & Mining Technical Division (OGTD) told the audience that not all his offshore trips are work related. Ir. Razmawata, who has a professional scuba diving licence, explained that it was also to satisfy his interest in the many micro-organisms and other creatures in the deep sea. He showed pictures that he had taken of some of these unique and amazing creatures that lived under the waves (see Figure 6) and these left a deep impression on the forum participants.



Figure 6: Ir. Razmawata and pictures he had taken of some of the lovely creatures that lived in the deep blue sea (cowrie shell and a squid)



Figure 7: Group photo at the end of the forum

The forum ended at 1.00 p.m., with a group photo (Figure 7) and lunch session. Many in the audience felt that an engineer's life can be very interesting provided that we know how to enjoy it. The forum left some good memories especially for undergraduate Engineering student participants. ■

Ir. Prof. Dr Dominic Foo is the Professor of Process Design and Integration at the University of Nottingham Malaysia Campus, and the Founding Director for the Centre of Excellence for Green Technologies. He is a Fellow of the Institution of Chemical Engineers UK (IChemE), and 2012/3 session Chairman for the Chemical Engineering Technical Division (CETD) of IEM. Professor Foo is the Chief Editor for IEM Journal and Subject Editor for Transactions of IChemE Part B. He is the winners of the Innovator of the Year Award 2009 of IChemE, Young Engineer Award 2010 of IEM, as well as the Outstanding Young Malaysian Award 2012.



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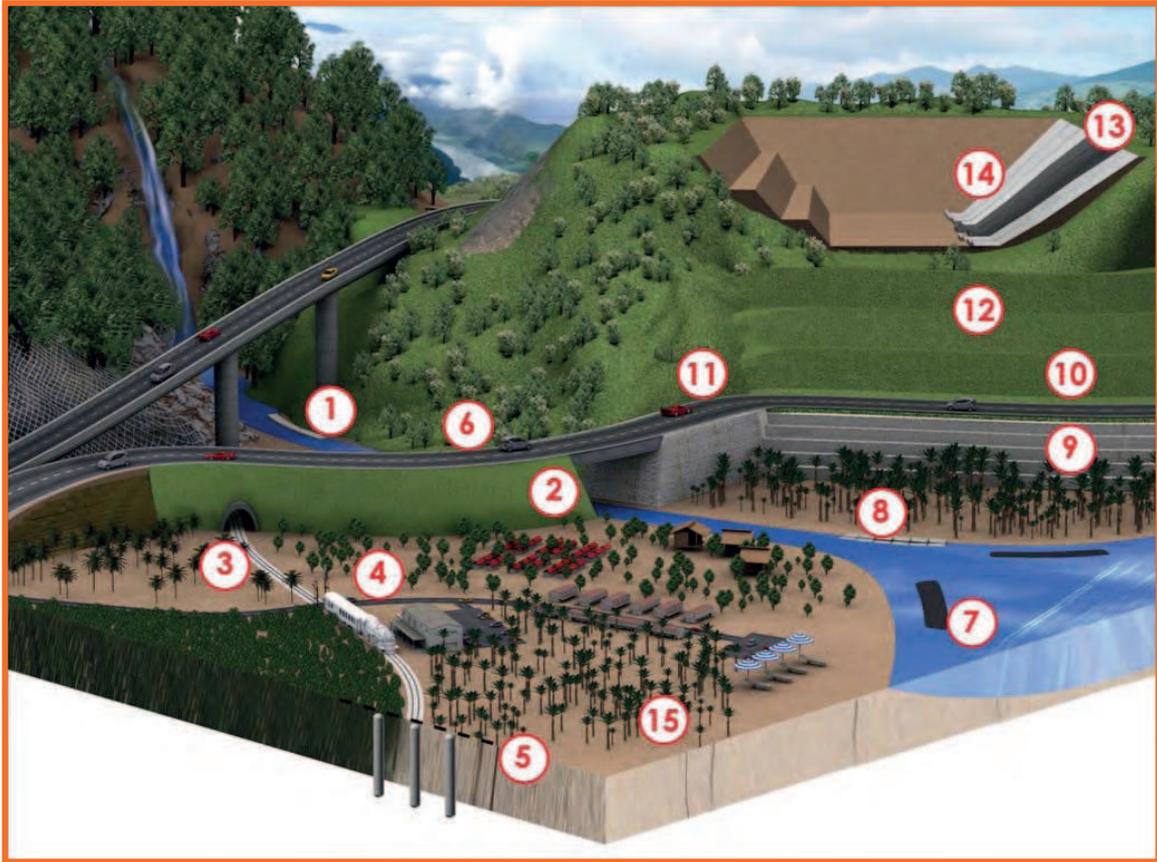
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# Report on IEM Chemical Engineering Technical Division Research Paper Competition

CHEMICAL ENGINEERING TECHNICAL DIVISION



by Ir. Dr Lee Tin Sin

**IN** conjunction with the 15th APCCChE Congress (Asian Pacific Confederation of Chemical Engineering) on 18-23 August, 2013, at Coex, Seoul, Korea, the Chemical Engineering Technical Division (CETD) organised the 3rd Research Paper Competition.

The competition was opened to current chemical/biochemical/process engineering postgraduate students in public or private universities in Malaysia. Two winners were awarded travelling grants of RM3,000 each, to enable them to attend the Congress and present their papers.

Postgraduate students from Universiti Malaysia Pahang, University of Nottingham Malaysia and Universiti Kuala Lumpur took part. After the first round of evaluation of full research papers by the internal panels, six students were invited to give an oral presentation on 30 March, 2013. In general, the areas of research for the participants included process modelling, extraction and catalytic reaction.

After a thorough evaluation of both the full paper and oral presentation, the judges decided to give the awards to Mr. Ng Tong Lip (PhD student of University of Nottingham Malaysia Campus) and Miss Lee Hua Chyn (MEng student of Universiti Malaysia Pahang) for their outstanding works.



Ir. Prof. Dr Dominic Foo presenting the certificate to Mr. Ng Tong Lip



Ir. Prof. Dr Dominic Foo presenting the certificate to Ms Lee Hua Chyn

Mr. Ng presented "A Disjunction Modelling Approach for Synthesis and Optimisation of Industrial Symbiosis in Palm Oil Industry" while Miss Lee's work was on "Bio-syngas Production from Glycerol Dry Reforming Over Cement Clinker-supported Nickel Catalyst".

Finally, the CETD chairman Ir. Prof. Dr Dominic Foo presented certificates to the participants and wished them luck for their presentation at the coming APCCChE Congress. ■

Ir. Dr Lee Tin Sin is assistant professor at the Chemical Engineering Department of Universiti Tunku Abdul Rahman (UTAR). He has been a committee member of IEM Chemical Engineering Technical Division (CETD) since 2011. Ir. Dr Lee won the 2012 Young Engineer Award of IEM.



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# 8th Malaysian Chem-E-Car Competition 2013

CHEMICAL ENGINEERING TECHNICAL DIVISION



by Engr. Dr Chong Chien Hwa





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## ENERGY: CHEMICAL TRANSFORMATION

Energy has been identified by the National Academy of Engineering, USA, as one of the grand challenges for engineering that we need to address in order to move into 22nd century. In the 21st Century, energy prices increased, energy availability and security diminished and growing environmental concerns were like a perfect storm affecting modern life (Foster *et al.*, 2010). Imagine what will happen in the future as global population is projected to increase to 9 billion in the next 40 years (McElroy, 2010). Future chemical engineers will not only play a major role in securing sustainable energy but they will also need to ensure that future energy is green.

On 8-9 April 2013, the 8th Malaysian Chem-E-Car Competition 2013, organised by the Chemical Engineering Technical Division (CETD) of The Institution of Engineers, Malaysia (IEM) and hosted by Taylor's University, was held at Taylor's Grad Hall (TGH) in Taylor's University, Lakeside Campus.

Taking part were undergraduates from Malaysia (public and private universities) and international universities who designed chemical-powered cars. There were 34 teams of students from Universiti Tunku Abdul Rahman, Urmia University of Technology, Curtin University, Universiti Malaysia Pahang, Universiti Teknologi PETRONAS, Universiti Malaysia Sabah, SEGi University, UniKL MICET, Taylor's University, International Islamic University, Universiti Malaya, Universiti Sains Malaysia, UNIMAS, UiTM, Universiti Tunku Abdul Rahman (Setapak Campus) and Universiti Putra Malaysia.



Table 1: Results of 8th Chem-E-Car Competition

Rank	Poster Presentation Competition	Car Performance Competition	Taylor's University Special Award	Innovation Award
1	Apsara 0813 (UTP)	NGU (UTAR)	Samen (Urmia)	Apsara 0813 (UTP)
2	Cattle-Ace (USM)	Marwan! (Taylor's)		
3	The Imagineers (UNIMAS)	Rumbling Star (UMP)		

The aim of the competition was to contribute towards research and development with emphasis on energy efficiency and discovering new sources of energy. The cars were designed to be powered by chemical reactions. Multi-disciplinary teams were encouraged but each team had to have at least two Chemical Engineering students.

The event started at 9.00 a.m. with a welcome speech from Ir. Mohamad Fadzil Adnan @ Nan, Organising Chairman, Chem-E-Car competition 2013, Professor Dato' Dr Hassan Said, Vice Chancellor and President, Taylor's University and Mr. Paul Wong Kok Kiong, Under-Secretary, Green Technology Policy Division, Ministry of Energy, Green Technology and Water (KeTTHA).

### SESSION 1

A model car race and poster competition started at 10.10 a.m. and ended at 4.00 p.m. The maximum travelling distances of the model car was 25m. The race started with the model car immediately behind the starting line. The distance was measured with respect to the front-most point of the car. The model cars then stopped nearest to the finish line while carrying a specific load. The course was wedge-shaped with a starting line and the prescribed distance clearly marked in an arc of constant distance from the starting point. The car carried a certain load of water and stopped within two minutes. The winners were the teams with cars that stopped nearest to the designated finish line.

For the poster presentation competition, assessment criteria included descriptions of the chemical reaction/power source/stopping mechanism, design creativity and unique features of the vehicle, environmental and safety features, economic aspects and quality of the poster and team member presentations.

### SESSION 2

The prize-giving ceremony started at 4.00 p.m. Table 1 shows the results of poster presentation, car performance competitions, special awards and innovation award. Team Apsara 0813 from Universiti Teknologi PETRONAS won the poster presentation and innovation award while Team NGU from Universiti Tunku Abdul Rahman was the champion of car performance competition.

Team Cattle-Ace from Universiti Sains Malaysia, team Marwan! from Taylor's University, The Imagineers from UNIMAS and Rumbling Star from Universiti Malaysia Pahang shared the 1st Runner-Up awards for the poster presentation and car performance competitions. The Taylor's University Special Award went to Team Samen from Urmia University, Iran.

The organising committee of the 8th Chem-E-Car Competition would like to express its gratitude to Multimedia Development Corporation Sdn. Bhd., *Kementerian Tenaga, Teknologi Hijau dan Air* (KeTTHA) and Taylor's University for sponsoring the event. ■

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Engr. Dr Chong Chien Hwa is the Associate Dean (Learning & Quality) of School of Engineering, Taylor's University. He is a Chartered Engineer, Engineering Council, UK, Member of Institution of Chemical Engineers (IChemE), UK and Member of Institution of Engineering Technology (IET), UK.



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# Reprise of 52nd Rankine Lecture “Performance-Based Design in Geotechnical Engineering” by Professor Malcolm Bolton



by Ir. Yee Thien Seng

GEOTECHNICAL ENGINEERING TECHNICAL DIVISION

ON 10 December 2012, Professor Malcolm Bolton of the University of Cambridge delivered a reprise of his Rankine Lecture with the theme “Performance-Based Design in Geotechnical Engineering” to 125 participants at the Auditorium Tan Sri Ir. Professor Chin Fung Kee, IEM in Petaling Jaya. The lecture started at 5.30 p.m. His original Rankine Lecture was made in London on 12 March 2012.



Figure 1: Professor Malcolm Bolton giving his Rankine Lecture at IEM, Petaling Jaya

The lecture presented findings from centrifuge studies on steep slopes and use of the Mobilizable Strength Design method for braced deep excavations; both in clays to demonstrate that it is possible to evaluate the performance of earth structures. Professor Bolton argued that geotechnical engineering designs must strive to limit deformations to tolerable magnitudes instead of merely factoring down soil strengths.

## 1. SLOPES

Professor Bolton presented data from centrifuge tests on a physical model of a steep 36° slope in clay. The clay used possessed the critical state friction angle of 24° and the tests featured subjecting the slope to cyclical loadings (exposures) from wet and dry climatic seasons with detailed measurement of pore water pressures and soil particle movements. In each wet season, he pointed out

that whenever the averaged shear strengths mobilized in the slope exceeded the critical state values as the result of diminished soil suctions, large strains developed which were mostly irrecoverable in the ensuing dry season whereas below the critical states these were small and recoverable. The irrecoverable strains led to creep in the slope. A critical state diagram is shown in Figure 2.

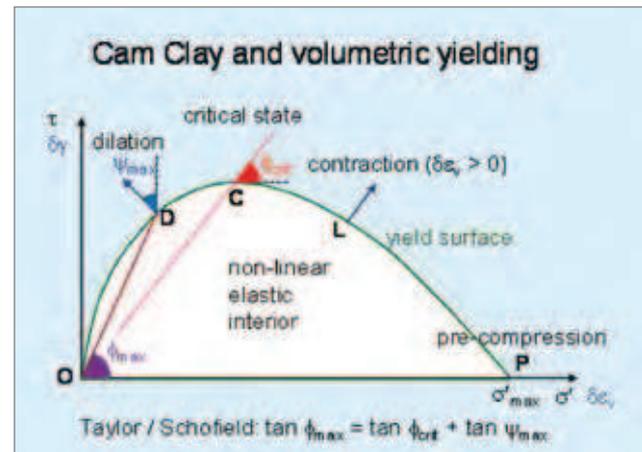


Figure 2: Critical States Soil Mechanics with the original Cam-Clay yield locus

Professor Bolton revealed that the strains associated with the mobilization of super-critical strengths resulted in dilation or swelling in the clay which grew cumulatively through successive wet seasons. Softening or strength degradation in the clay accompanied the cumulative slope swelling and creep, eventually leading to local failure at the toe of the slope after repeated wet seasons to inevitably trigger off progressive failure in the slope.

This has been provided as the mechanism for delayed failure of steep slopes in wet climatic regions.

Professor Bolton emphasised that limiting shear strengths mobilized in slopes to below critical state values would keep deformations in the ground small and recoverable to ensure freedom from first time slope failures; just as the late Professor Alec Skempton had advocated in 1970.

(Continued on page 43)



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## 2. EXTENDED MOBILIZABLE STRENGTH DESIGN METHOD FOR BRACED EXCAVATIONS

Professor Bolton demonstrated that with clays and silts, the mobilized strength factor (a proportion of the undrained shear strength value) variation with the shear strain parameter conforms reasonably well to a power law. He had chosen to normalize shear strains with the strain value at 50 percent undrained shear strength as the shear strain parameter for use in his power curve expression after a study of 115 laboratory tests reported on 19 different clays and silts. The expression fitted the test data well in the mobilized strength factor ranging from 0.2 to 0.8; a spread relevant to most field situations in service. (Please refer to a separate report on Professor Malcolm Bolton's short course on 9 December 2012 at IEM for further details on this.)

This permitted his development of the Mobilizable Strength Design (MSD) method to facilitate deformations of a geo-structure or geotechnical engineering construction under load to be made possible with 'simple' hand calculations to assess its performance in service. He then proceeded to describe the application of the MSD method to estimate the accompanying deformations in the retaining wall for varying excavation depths and supporting strut configurations.

The method was then improved by invoking the principle of energy conservation where the loss of potential energy in the deforming ground is balanced by the sum of work dissipated in plastic shearing of the soil and elastic energy stored in bending the bracing wall. It employs a sine wave function to represent the incremental displacement profiles in the ground and the wall below the lowest support prop for the stage of prop deployment. It is called the extended MSD method. In solving for energy conservation incrementally, the deformations in the ground and wall would be obtained for each increment. The resultant deformation at each propping stage is simply the summation of the incremental deformations up to that stage. This extended MSD method is still executable manually though the calculations have become considerably more involved to accommodate the required number of propping stages and undrained shear strength variation in the ground.

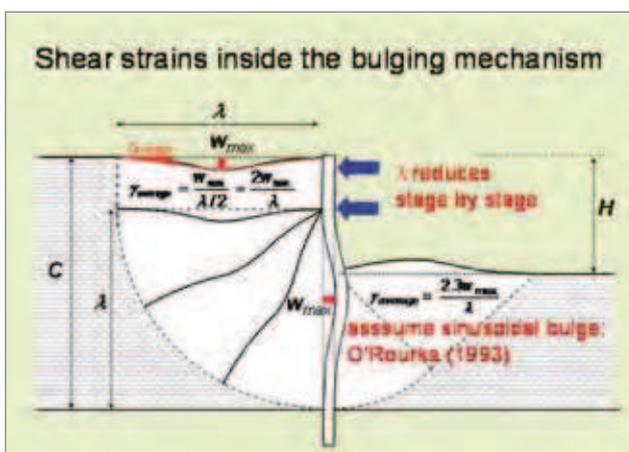


Figure 3: Deformation Mechanisms for Braced Excavation in Clay

Figure 3 illustrates the mechanisms involved for the extended MSD method. The wave-length,  $\lambda$ , for the sine function, representing the width of the incremental subsidence trough behind the braced wall at each excavation stage, had been observed in centrifuge tests to approximate the depth of clay below the lowest prop for that stage. Professor Bolton pointed out that this runs counter to the long-held position that the distance for ground deformations outside a deep excavation is a function of the total depth of the excavation. Only in the case of an unpropped embedded retaining wall does the lateral extent of ground deformation depend on the total excavation depth.

Professor Bolton presented deformations obtained using the extended MSD method for a great variety of excavations and ground conditions which compared very favourably to results from evaluations conducted with the finite element analysis employing a very sophisticated constitutive soil model. The method calibrated within an error factor of less than 1.4 against documented performances for 110 excavations in 9 cities across the world! He stated that safe excavation depths in normally consolidated clay should have the mobilized strength factor in excess of 1.25.

The extended MSD method permits the mobilized strength factor in the ground to be determined from measured deformations. Using data available in the report on the public enquiry into the collapse of the Nicoll Highway tunnel's braced excavation in Singapore in 2004, Professor Bolton demonstrated the extended MSD method's ability to 'predict' the excavation's collapse.

## 3. ON PERFORMANCE-BASED DESIGN

Professor Bolton concluded his lecture with an impassioned plea for geotechnical engineers to examine if current design methods dominated by safety factors are appropriate when it is deformations that cause problem. He reiterated that the performance of soil structures can be predicted by designers using the MSD method as a matter of routine to prevent both ultimate limit state and serviceability limit state failures. As long as the shear strain parameter is measured and known, MSD calculations are no more complicated than conventional design methods.

He pleaded for performance-based design to be adopted since it satisfies performance requirements of strength, deformation and durability in a set of design situations that define "worst credible conditions".

After graciously fielding a number of questions from the floor, Professor Bolton ended his lecture at 7.30 p.m. He was given a warm round of applause from the floor before being presented with an IEM memento by the Chairman of IEM's Geotechnical Engineering Technical Division. ■

In 1994, Ir. Yee set up his own practice, Geo.Consult, to support the construction industry with both expert and specialist consultancy, in particular on geotechnical engineering aspects. He has authored/co-authored more than a dozen technical papers in local and international conferences. Ir. Yee is an expert witness and accredited checker for design of geotechnical engineering works registered with the Board of Engineers Malaysia.

# Talk on the Challenges of Managing Renewable Energy Projects

PROJECT MANAGEMENT TECHNICAL DIVISION



by Ir. Noor Iziddin Abdullah bin Haji Ghazali

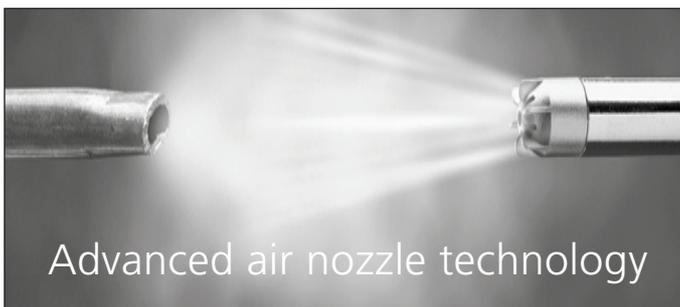
**THE** Project Management Technical Division (PMTD) of The Institution of Engineers, Malaysia, organised a talk titled Challenges Of Managing Renewable Energy Projects on 18 December 2012 at Wisma IEM. It was attended by 72 participants.

The speaker was Ir. Ali Askar Sher Mohamad, M.Sc. (Power Eng), B.Sc. (Elect. Eng), P Eng, MIEM, who was previously a Senior Lecturer at the College of Engineering, UNITEN and now is the Chief Operating Officer of the newly set up Sustainable Energy Development Authority of Malaysia (SEDA). According to Ir. Ali Askar, the passing of the Renewable Energy Act 2011 and the introduction of the Feed in Tariff (FiT) has resulted in RE projects taking off in a big way in Malaysia.



Ir. Ali Askar (Speaker) and Ir. Noor Iziddin (Session Chairman) during the opening of the talk

However, almost a year after the launch, many of these RE projects are way behind schedule and quite a number have even failed to start. The FiT implementing agency, SEDA Malaysia, closely monitors these approved projects and terminates projects which fail to meet milestones without satisfactory justification, resulting in big losses for the developers. Among the major obstacles are the lack of project financing since local banks are new to RE technology, the lack of understanding of the technology by the developers themselves and, most importantly, that the project management techniques may not be suited to this new technology as well as the implementation approach taken by SEDA Malaysia.



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4) 200MW floating offshore projects at...	0.030	0.030	0.030	0.030
5) 200MW floating offshore projects at...	0.035	0.035	0.035	0.035
6) 200MW floating offshore projects at...	0.040	0.040	0.040	0.040
7) 200MW floating offshore projects at...	0.045	0.045	0.045	0.045
8) 200MW floating offshore projects at...	0.050	0.050	0.050	0.050
9) 200MW floating offshore projects at...	0.055	0.055	0.055	0.055
10) 200MW floating offshore projects at...	0.060	0.060	0.060	0.060

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Table 1: Quota System, according to technology category

Available MW installed capacity for FiT Applications	2012		2013		2014		2015	
	H1	H2	H1	H2	H1	H2	H1	H2
Biogas	N/A	4.41	7.78	5.65	8.75	8.95	0.00	TBA
Biogas (Landfill/Sewage)	N/A	0.88	0.00	4.38	4.38	0.00	0.00	TBA

Ir. Ali Askar started by explaining the traditional objectives which comprise time (meeting the schedule), cost (keeping within the budget) and specifications.

As for contemporary objectives meeting client expectations, he said the client may not be satisfied even though all specifications are met and transparency ensured. Some of the ways to measure project success are completing on schedule, keeping within the budget, meeting project goals, satisfying the client (quality) and zero casualties (either to the team or relationships).

Subsequently, the speaker talked about Feed in Tariff (FiT), the mechanism that allows electricity produced from indigenous RE resources to be sold to power utilities at a fixed premium price and for a specific duration of time. This would create a conducive and secured investment environment which would reassure financial institutions so that they would be comfortable about providing loans for a longer period (>15 years).

In addition, Ir. Ali Askar also presented the RE Project Implementation where all applications for Feed in Approval must be made through the SEDA online system, the eFiT. At the point of application, SEDA requires the developer to show proof of financial capability, ownership of site, and other details, as well as submit the project milestones. Once the project milestones are submitted, the developer is committed and will risk having the FiT revoked if he does not comply to the milestones. However, project milestones are often proposed in haste to enable booking the RE quota for a particular commissioning year.

One problem that developers face is the lengthy loan processing on the part of the banks. Even after approval, drawdown may require some time since banks would want to verify that the EPC is credible and that the technology used is certified. Banks may withdraw the loan if there are delays in implementation since the banks fear SEDA may cancel the FiT. There are 3 types of utilities problem such as Renewable Energy Power Purchase Agreement (REPPA) with TNB or the Distribution Licensee, interconnection design and testing and commissioning. Land issues and authority approval can also be a big issue for developer.

Lastly, Ir. Ali Askar explained other problems of managing renewable energy projects such as raising equity capital, updating info on e-FiT, power plant quality issues on commissioning, delays in getting approval for tax exemption on imported equipment, delays in getting equipment from overseas and contractor delays.

He concluded the talk by saying that RE projects which qualify for FiT are lucrative and very attractive to developers. However, the developer or his project manager must understand:



The participants at the talk



Ir. Ali Askar receiving IEM memento from Ir. Noor Iziddin at the end of the talk

- The RE technology and propose a reasonable project timeline
- The cause of delays and how to mitigate them
- That the FIA may be revoked if project milestones are missed, especially the commissioning date, causing the developer to suffer huge losses.

During the Q&A session, Ir. Ali Askar answered questions raised by the participants. The talk ended before 7.30 p.m., according to the allotted time, in line with the Project Management on timely delivery.

At the end of the talk, Ir. Noor Iziddin presented Ir. Ali Askar with a certificate of appreciation and a memento. ■

Readers may wish to read further materials at PMTD web site <http://iem-pmtd.blogspot.com> or join the interest group at [www.facebook.com/IEM.PMTD](http://www.facebook.com/IEM.PMTD), or email to the speaker at [aliaskar@SEDA.gov.my](mailto:aliaskar@SEDA.gov.my) for any enquiry.

Ir. Noor Iziddin Abdullah bin Haji Ghazali is currently Secretary/Treasurer of Project Management Technical Division and Council Member of IEM. He is now with Sunway Property as a Manager (Electrical) under Facility Management Division.

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# IEM President Pays Courtesy Call on Minister of Works



by Ir. Cheang Kok Meng  
 Executive Director, IEM

**IEM** President Ir. Choo Kok Beng, together with Vice President Ir. Prof. Dr Wan Mahmood bin Wan Abdul Majid, Honorary Secretary Ir. Prof. Dr Jeffrey Chiang Choong Luin and I, paid a visit to Works Minister Y.B. Datuk Haji Fadillah bin Haji Yusof, on 18 June 2013. Also present were Datuk Himmat Singh, the Ministry's Secretary General, Dato' Seri Ir. Hj. Mohd. Noor bin Yaacob, Director General of the Public Works Department, and En. Murali Jayabalan, Ketua Penolong Setiausaha Kanan, Ministry of Works.



Group photo prior to the discussion



Presentation of souvenir to Y.B. Datuk Haji Fadillah bin Haji Yusof

The objective of the meeting was to discuss how IEM and JKR could work together. The salient points from the meeting were:

- IEM would like to work with JKR to enable more of its engineers to be accepted as Corporate Members of the Institution.
- The difference between IEM and other engineering organisations such as TAM, ACEM, MySET, etc. was explained to the Minister.
- IEM centres on engineering but will diversify into facilitating mobility as well as commercial opportunities in the ASEAN region as well as host both AFEO and FEIAP secretariats.
- IEM will continue its role as a "learned society of engineers".
- IEM is actively promoting science in schools to ensure a sufficient pool of motivated and qualified students who take up engineering as a career.
- IEM is registering university students as IEM Graduate Members even before they leave university to ensure they retain their link with the Institution upon graduation.
- The Minister of Works commented that IEM should have a database of engineers in the various areas of specialisation which could be drawn upon to collaborate with the government and other organisations to tackle the various challenges facing the nation. IEM explained that there are volunteers with the expertise in research but funding is required as resources are limited.

The meeting ended with an exchange of souvenirs and a general agreement for closer collaboration. ■

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# The Taroko Gorge of Taiwan



by Ir. Chin Mee Poon  
[www.facebook.com/chinmeepoon](http://www.facebook.com/chinmeepoon)

**NATURE** lovers visiting Taiwan cannot afford to miss the Taroko Gorge, the island nation's foremost scenic attraction that is often touted as one of the most spectacular natural wonders of the world.

Stretching 19km inland from the east coast of the island at a point about 15km north of the town of Hualien, the gorge had been etched by Liwu River in a very slow and lengthy process that lasted a few million years, resulting in sheer cliffs of solid marble over 300m high in places.

In 1956, the government of Taiwan, under Generalissimo Chiang Kai Shek, decided to construct a road cutting through the central mountain ranges from the east coast to the west coast for the ease of troop movements in the event of an attack from communist Mainland China. Retired Kuomintang servicemen were employed for the task. Work was so tough and dangerous that 450 men lost their lives during the 4-year construction period.

In recent years, the Tourism Board of Taiwan has worked with local bus companies to provide tourists with regular and economical bus services from major train and bus terminals throughout the island to tourist attractions in the vicinity. So my wife and I decided to go on a one-day visit to the Taroko Gorge from its entrance to Tianxiang, taking in all the major sights.

We boarded the earliest bus for Taroko Gorge and got off at the entrance arch. Crossing the Liwu River via a nearby bridge, we spent sometime at the Visitors Centre located a 10-minute walk away and then trudged through a long tunnel to Shakadang, a 1.5km-long footpath cut into the sheer cliff along the river.

We hopped aboard the next bus for Buluowan Recreation Area and watched a documentary on the Taroko tribe there. Then we walked down to the main road and went through another tunnel to reach Swallow's Grotto, a series of magnificent cliffs with road tunnels chiselled through them. This is truly one of the most spectacular stretches of the Gorge.

About 1km further up is another equally, if not more, spectacular stretch – the Tunnel Of Nine Turns – which cuts a twisted road of short tunnels and half tunnels through solid marble cliffs. Unfortunately it was closed for maintenance at the time of our visit.

A third bus took us to Tianxiang on the western terminus of the Gorge where I spent some time exploring the temples and pagoda perched high on a hill slope. From the pagoda I enjoyed a most impressive overview of the Gorge.

Back on the main road, I walked through two tunnels and quite a long stretch of road to reach Lvshui, just in time to catch the bus to the last stop of our visit – the Eternal Spring Shrine. I spent almost two hours exploring the shrine and the hill slope behind it, visiting the Light of Zen Temple on an adjacent hill before finding my way back to the carpark to catch the last bus leaving the Gorge. ■

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Ir. Chin Mee Poon is a retired civil engineer who derives a great deal of joy and satisfaction from travelling to different parts of the globe, capturing fascinating insights of the places and people he encounters and sharing his experiences with others through his photographs and writing.





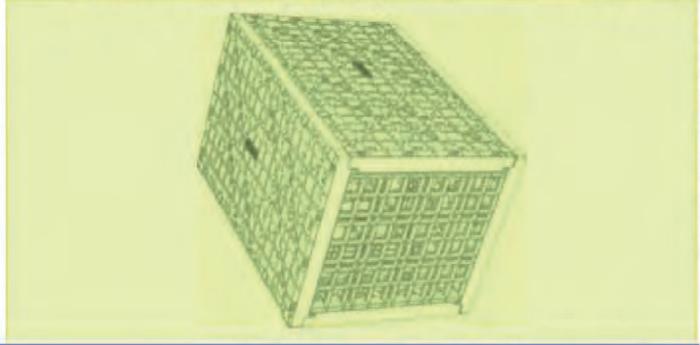
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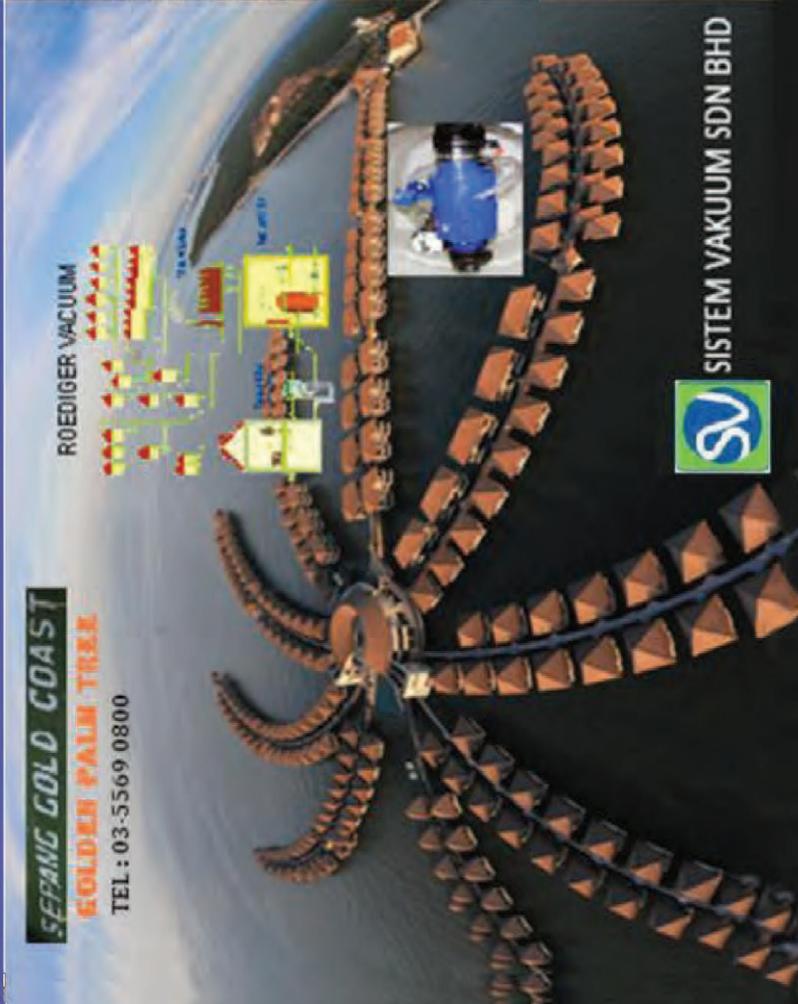
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Mengikut Undang-Undang Kecil IEM, Seksyen 3.9, nama-nama seperti tersenarai berikut diterbitkan sebagai calon-calon yang layak untuk menjadi Ahli Institusi, dengan syarat bahawa mereka lulus Temuduga Profesional tahun 2013.

Sekiranya terdapat Ahli Korporat yang mempunyai bantahan terhadap mana-mana calon yang didapati tidak sesuai untuk menduduki Temuduga Profesional, surat bantahan boleh dikemukakan kepada Setiausaha Kehormat, IEM. Surat bantahan hendaklah dikemukakan sebulan dari tarikh penerbitan dikeluarkan.

**Ir. Prof. Dr Jeffrey Chiang Choong Luin**  
Setiausaha Kehormat, IEM

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24733	LEE LIN KHENG	BE HONS (UNITEN) (ELECTRICAL & ELECTRONICS, 2003) MSc (MANCHESTER) (ELECTRICAL POWER, 2007)
44596	LIM KEE TONG	BE HONS (BATH) (ELECTRICAL POWER, 2006) ME (ADELAIDE) (ELECTRICAL & ELECTRONIC, 2010)
45326	NORIZAN BIN MAT	BE HONS (UTM) (ELECTRICAL, 2007)
39048	NURSALEHA BINTI MOHAMMAD @ MOHD AMAN	DIPLOM-INGENIEURIN (FACHHOCHSCHULE MANNHEIM) (ELECTRICAL, 2008)
52386	REDZUAN BIN ZAINAL ABIDIN	BE HONS (UiTM) (ELECTRICAL, 2009)
30613	SOO SIEW PHANG	BE HONS (MMU) (ELECTRICAL, 2006)
19391	TAN HANG KIAK	BSc (MISSISSIPPI STATE) (ELECTRICAL, 1997)

<b>KEJURUTERAAN ELEKTRONIK</b>		
19579	GOI BOK MIN	BE HONS (UM) (ELECTRICAL, 1998) MSc (MMU) (2002) PHD (MMU) (2006)
31761	TAN HEAN GAY, RODNEY	BSc (THE ROBERT GORDON) (ELECTRONIC & ELECTRICAL, 1994) MSc (LIVERPOOL JOHN MOORES) (MICROELECTRONIC & INFORMATION SYSTEMS, 1996) PHD (UNITEN) (ELECTRONIC, 2013)

<b>KEJURUTERAAN KAWALAN &amp; INSTRUMENTASI</b>		
29539	MOHD SHAHRIZAN BIN SAHRI	BE HONS (UMP) (CONTROL & INSTRUMENTATIONS, 2008)

<b>KEJURUTERAAN KIMIA</b>		
47560	KHAIRUL ANWAR BIN MOHAMAD ZAWAWI	BE HONS (UTM) (CHEMICAL-GAS, 2008) ME (UKM) (CHEMICAL, 2012)

<b>KEJURUTERAAN MEKANIKAL</b>		
53732	ABDUL QAYYUM BIN ABDUL HALIM	BE HONS (STEVEN INS. OF TECHNOLOGY, USA) (MECHANICAL, 2009)
52464	ABDULLAH BIN DIN SUHAIMI	BSc (PENNSYLVANIA STATE) (MECHANICAL, 2007)
43088	AHMAD KHAIRUDDIN BIN AHMAD KAMAL	BE HONS (UTP) (MECHANICAL, 2008)
42057	CHAI WEI SIAN	PART I, II, III (IEM/BEM) (MECHANICAL, 2009) BE HONS (SHEFFIELD HALLAM) (MECHANICAL, 2000)
38800	GOH KHENG LENG	BE HONS (UTM) (MECHANICAL, 1999)
38790	KHAIROL NIZAM BIN MANSOR	BE HONS (UTM) (MECHANICAL, 2002)

29158	KHALID BIN ABU BAKAR	BE HONS (KUITTHO) (MECHANICAL, 2005)
37997	MOHD AZMI BIN HASHIM	BE HONS (UTM) (MECHANICAL, 2003)
37085	MOHD HISAM BIN SA'AT	BE HONS (KUITTHO) (MECHANICAL, 2006)
47571	PHANG CHEN FONG	BE HONS (UNITEN) (MECHANICAL, 2003)
24133	ROHAIZAT BIN OMAR	BE HONS (UNITEN) (MECHANICAL, 2002) ME (UTM) (MECHANICAL, 2007)
49234	SUHAIMI BIN RASHID	BE HONS (UTM) (MECHANICAL, 2001)

<b>KEJURUTERAAN PEMBUATAN</b>		
26041	ASNUL HADI BIN AHMAD	BE HONS (UTEM) (MANUFACTURING, 2006) ME (UPM) (MANUFACTURING SYSTEMS, 2009)

### CORRECTION

Adalah dimaklumkan bahawa terdapat satu kesilapan atas kelayakan calon berikut dalam senarai yang diluluskan untuk menduduki Temuduga Profesional dalam buletin bulan Ogos. Nama betul calon adalah seperti berikut:

PERPINDAHAN AHLI		
No. Ahli	Nama	Kelayakan
<b>KEJURUTERAAN MEKANIKAL</b>		
53771	MICHAEL TAN LOONG PENG	BE HONS (UTM) (ELECTRICAL, 2003) ME (UTM) (ELECTRICAL, 2007) PHD (CAMBRIDGE) (ELECTRONIC, 2011)

Solution for 1Sudoku published on page 26 of this issue.

1Sudoku									
5	2	4	9	1	3	5	8	6	7
	3	6	5	2	8	7	1	4	9
20	7	8	1	6	4	9	3	5	2
	4	7	3	8	5	6	2	9	1
	9	5	2	7	1	3	6	8	4
11	6	1	8	9	2	4	7	3	5
	5	9	7	3	6	2	4	1	8
12	1	2	6	4	9	8	5	7	3
	8	3	4	5	7	1	9	2	6

## PERMOHONAN BARU / PEMINDAHAN AHLI

Persidangan Majlis IEM yang ke-388 pada 15 July 2013 telah meluluskan sebanyak 2,188 ahli untuk permohonan baru dan pemindahan ahli. Berikut adalah senarai ahli mengikut disiplin kejuruteraan:

DISIPLIN	GRED KEAHLIAN							
	FELO	AHLI	SISWAZAH	"INCORPORATED"	"AFFILIATE"	"ASSOCIATE"	SISWA	JUMLAH
Aeronautikal		1	1				1	3
Aeroangkasa			1					1
Pertanian								
Automotif								
Biokimia			2					2
Bioperubatan			1				3	4
Bioteknologi							1	2
Perkhidmatan Bangunan								
CAD/CAM								
Kimia		3	29				154	186
Awam	1	45	160				220	426
Komunikasi							1	1
Komputer		2	1				26	29
Sistem Komputer								
Komputer & Komunikasi								
Pembinaan								
Sistem Kawalan								
Elektrikal & Elektronik							77	77
Elektrikal		12	75				198	285
Elektronik		11	43				97	151
Elektronik & Kawalan Instrumentasi								
Elektromekanikal								
Tenaga								
Alam Sekitar		2						2
Proses & Makanan			2					2
Geoteknik		1						1
Lebuh raya								
Industri		1						1
Sistem Maklumat								
Teknologi Maklumat								
Instrumentasi								
Kawalan & Instrumentasi		3						3
Pembuatan		1	4				245	250
Sistem Pembuatan								
Marin								
Bahan			5					5
Metallurgi								
Mekanikal		23	135	2		1	543	704
Mekatronik			1				24	25
Mikroelektronik								
Mineral								
Sumber Mineral			1					1
Perlombongan								
Arkitek Naval								
Petroleum							27	27
Polimer								
Pengeluaran								
Struktur								
Telekomunikasi		1						
Sumber Air								
<b>JUMLAH</b>	<b>1</b>	<b>106</b>	<b>461</b>	<b>2</b>		<b>1</b>	<b>1,617</b>	<b>2,188</b>

Senarai nama ahli dan kelayakan adalah seperti di muka surat 54 – 59. Institusi mengucapkan tahniah kepada ahli yang telah berjaya.

**Ir. Prof. Dr Jeffrey Chiang Choong Luin**

Setiausaha Kehormat

Institusi Jurutera Malaysia

# KEAHLIAN

## PERMINDAHAN AHLI KEPADA AHLI FELLOW

No. Ahli	Nama	Kelayakan
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### KEJURUTERAAN AWAM

13382	MOHD AZMI BIN ALI	BE HONS (UM) (CIVIL, 1987)
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## PEMINDAHAN AHLI KEPADA AHLI KORPORAT

No. Ahli	Nama	Kelayakan
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### KEJURUTERAAN ALAM SEKITAR

24925	CHEN KOON HEE	BE HONS (USM) (CIVIL, 2003)
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### KEJURUTERAAN AWAM

22447	AHMAD KHAIRUL HAKIMIN BIN IBRAHIM	BE HONS (UTM) (CIVIL, 2001)
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26392	CHONG KON WAH	BE HONS (NEWCASTLE UPON TYNE) (CIVIL, 1998) MSC (NEWCASTLE UPON TYNE) (STRUCTURAL & CONSTRUCTION MANAGEMENT, 2001)
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25414	CHOO HEW SENG	BE HONS (UM) (CIVIL, 2004)
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32233	FAKHRUL ARIFFIN BIN BAHARUDIN	BE HONS (UiTM) (CIVIL, 2000)
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33825	HAR WAI LEARN	BE HONS (UPM) (CIVIL, 2007)
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15952	HOO GOH HUNG	BE HONS (MONASH) (CIVIL, 1995) MSC (SINGAPORE) (CIVIL, 1998)
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36270	JAMAIS BIN JUNIM	BE HONS (UKM) (CIVIL & STRUCTURAL, 1999)
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28969	JOHARI BIN MATSAH @ SYLVESTER MICHAEL	BE HONS (UKM) (CIVIL & STRUCTURAL, 1999)
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28290	JOSHUA LEONG CHEE K'IZ	BE HONS (USM) (CIVIL, 2007)
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22641	KAMALENDRAN A/L N RAJASVARAN	BE HONS (UTM) (CIVIL, 2001) ME (UTM) (CIVIL - GEOTECHNICS, 2008)
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44174	KUGANESWARAN A/L NADARASA	BE HONS (UTM) (CIVIL, 2006)
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38079	LEONG CHEE SOON	BE HONS (MANCHESTER) (CIVIL, 1998)
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26507	LIM LEE WEE	BE HONS (UTM) (CIVIL - CONSTRUCTION MANAGEMENT, 2003)
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28911	MERVYN FOONG YEW HONG	BE HONS (UPM) (CIVIL, 2007)
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38016	OMAR BIN ISMAIL	BSC (NORTHERN ARIZONA) (CIVIL, 1989)
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23506	PUI YIN JUN	BE (ADELAIDE) (CIVIL, 2002)
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33953	SITI WAN MARHAMAH BINTI ZAID	BE HONS (UKM) (CIVIL & STRUCTURAL, 2000)
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38333	SULAIMAN BIN MOHAMED DAUD	BE HONS (UiTM) (CIVIL, 2006)
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28414	TAN KENG MENG	BE HONS (USM) (CIVIL, 2007)
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35601	TAN SU LEAN	BE HONS (UTM) (CIVIL, 2005)
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29163	TEE CHIN SEONG	BE HONS (UNITEN) (CIVIL, 2006)
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27563	TING LEE YUNG	BE HONS (UMS) (CIVIL, 2006)
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27959	WAI JIT SOON	BE HONS (UM) (CIVIL, 2006)
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49876	WAN HAZMAN BIN WAN NOOR	BE HONS (UiTM) (CIVIL, 2000)
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19145	WONG CHEE LOONG	BE HONS (UTM) (CIVIL, 2000) ME (UTM) (ENVIRONMENTAL, 2002)
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19406	WONG KIM CHEN @ DICKSON YONG	BE HONS (NEWCASTLE UPON TYNE) (CIVIL, 1998)
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39981	YONG YOONG YEN	BE HONS (UTM) (CIVIL, 2005)
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12459	ZAINAL ALAM BIN BAKAR	BSC (LOWELL) (CIVIL, 1986)
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### KEJURUTERAAN ELEKTRIKAL

38796	ALBERT CHIA KET SHIN	BE (NEW SOUTH WALES) (ELECTRICAL, 2005)
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34041	MOHAMED ZAIMIR BIN MOHAMED SUFFIAN	BE HONS (UMIST-MANCHESTER) (ELECTRICAL & ELECTRONIC, 1997)
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46839	MOHD FARRIZ BIN HJ MD BASAR	BE HONS (UTM) (ELECTRICAL, 2002) ME (UTM) (ELECTRICAL - POWER, 2009)
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29096	TAI SHU LING	BE HONS (UTM) (ELECTRICAL, 2001)
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49221	TAN CHOON CHET	BE HONS (UM) (ELECTRICAL, 2008)
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34574	TEO CHURN CHUAN	BE HONS (MULTIMEDIA) (ELECTRICAL, 2008)
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26805	TIEW RI CHARD	BE HONS (UNITEN) (ELECTRICAL & ELECTRONICS, 2002) ME (UM) (2009)
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### KEJURUTERAAN ELEKTRONIK

27973	FIRDAUS HAKIM BIN JALALUDIN	BE HONS (UTM) (ELECTRICAL - TELECOMMUNICATIONS, 2002)
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29756	MANDEEP SINGH A/L JIT SINGH	BE HONS (NORTHUMBRIA) (ELECTRICAL & ELECTRONIC, 1998) MSC (USM) (ELECTRICAL & ELECTRONIC, 2001) PHD (USM) (2006)
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46753	NIK GHAZALI BIN NIK DAUD	BSC (TEXAS AT AUSTIN) (ELECTRICAL ENGINEERING, 1986)
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### KEJURUTERAAN INDUSTRI

49267	MOHD KHAIROL ANUAR BIN MOHD ARIFFIN	BE HONS (NORTHUMBRIA) (MANUFACTURING SYSTEMS, 1998) MSC (UPM) (MECHANICAL, 2002) PHD (SHEFFIELD) (2006)
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### KEJURUTERAAN KAWALAN & INSTRUMENTASI

48866	MUHD TAHIR HUSAINI BIN SAMSUDIN	BE HONS (UiTM) (ELECTRICAL, 2003)
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### KEJURUTERAAN KIMIA

36273	POK BOON LEK	BE HONS (UTM) (CHEMICAL, 1997)
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24896	WAI YEE HUNG	BE HONS (UTM) (CHEMICAL, 2003) MASTER OF TECHNOLOGY (CURTIN) (PETROLEUM TECHNOLOGY, 2012)
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### KEJURUTERAAN MEKANIKAL

33896	EZRAL BIN ABDULLAH	BE HONS (UiTM) (MECHANICAL, 2003)
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22420	FONG KIN KEONG	BE HONS (NORTHUMBRIA) (MECHANICAL, 1998)
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49592	HUZAIRIYAH BINTI HUSSIN	BE HONS (UPM) (MECHANICAL, 2003)
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13524	JUNAIDI BIN MUSLIM	BE HONS (CNAA-THE POLYTECHNIC OF CENTRAL LONDON) (MECHANICAL, 1990) MSC (HERIOT-WATT) (BUILDING SERVICES, 1999)
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49612	MOHD KHOUSHAINI BIN MOHD NAIM	BE (MELBOURNE) (2005)
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35537	MOHD NAZIR BIN MANSOR	BE HONS (UTM) (MECHANICAL, 2004)
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31419	MOHD SYAHRIR BIN MOHD SHAH	BE HONS (UiTM) (MECHANICAL, 2008)
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30575	MURSYIDI BIN MOHAMMAD	BE (AUCKLAND) (MECHANICAL, 2007)
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54042	RASYIDI BIN MOHD TAHIR	BE HONS (UTHM) (MECHANICAL, 2006)
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15844	RAZALI BIN SULAIMAN	BSC (WALES) (MECHANICAL, 1983) MSC (CRANFIELD) (AUTOMOTIVE PRODUCT, 1993)
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32591	TAN HUCK TEE	BSC (NATIONAL CHENG KUNG) (MECHANICAL, 1998)
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22502	VISWAM RAJARATNAM	BE HONS (NOTTINGHAM) (MECHANICAL, 2000)
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21414	ZULFAHMI BIN AZIZ	BE HONS (UiTM) (MECHANICAL, 2001)
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### KEJURUTERAAN PEMBUATAN

36304	KHAIRUL SALLEH BIN MOHAMED SAHARI	BE (WASEDA) (MECHANICAL, 2000) ME (KANAZAWA) (2002) PHD (KANAZAWA) (2006)
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## LULUS PPP (BEM)

No. Ahli	Nama	Kelayakan
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### KEJURUTERAAN AWAM

5242	MOHD ZAHARI BIN MANSOR	BE HONS (LIVERPOOL) (CIVIL, 1978)
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### KEJURUTERAAN ELEKTRIKAL

18354	NAZMAN IDRIS BIN MOHD AMAN	BE HONS (UTM) (ELECTRICAL, 2001)
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### KEJURUTERAAN ELEKTRONIK

26510	MOHAMMAD FAIZAL BIN AHMAD FAUZI	BE HONS (LONDON) (ELECTRICAL & ELECTRONIC, 1999) PHD (SOUTHAMPTON) (2004)
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### KEJURUTERAAN KOMPUTER

18605	MOHD RIZON BIN MOHAMED JUHARI	BE (TOKUSHIMA) (ELECTRICAL & ELECTRONIC, 1993) ME (TOKUSHIMA) (ELECTRICAL & ELECTRONIC, 1995) PHD (OITA) (MATERIALS SCIENCE & PRODUCTION, 2002)
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### KEJURUTERAAN MEKANIKAL

14938	WONG YII HUI	BSC (SOUTH DAKOTA) (MECHANICAL, 1985) MSC (SOUTH DAKOTA) (1987)
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## PERMOHONAN MENJADI AHLI KORPORAT

Nama	Kelayakan
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### KEJURUTERAAN AERONAUTIKAL

NURULHASNAN BIN ABDUL MAJID	BSC (TEXAS AT AUSTIN) (AEROSPACE, 1985) MSC (NEW SOUTH WALES) (INFORMATION TECHNOLOGY, 2002)
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### KEJURUTERAAN ALAM SEKITAR

ALLAN GAN CHIN YONG	BE HONS (UM) (ENVIRONMENT, 2001)
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### KEJURUTERAAN AWAM

ADNAN BIN ABD GHANI	BE HONS (UTM) (CIVIL, 2001)
AHMAD MAHAYUDDIN BIN ISMAIL	BE HONS (UTM) (CIVIL - CONSTRUCTION MANAGEMENT, 2003)

AMY SIM POH LING	BE HONS (UTM) (CIVIL, 2001) MASTER OF ENVIRONMENTAL SCIENCE (UNIMAS) (LAND USE & WATER RESOURCE MANAGEMENT, 2008)
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AZRUL RAIMEE BIN RAMLI	BE HONS (UKM) (CIVIL & STRUCTURAL, 2000)
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CHONG SAU HONG	BE HONS (CNAA-ULSTER POLYTECHNIC) (CIVIL, 1984)
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JONG KIAN KIAW	BE HONS (UPM) (CIVIL, 2002)
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JUNAIDAH BINTI JAAFAR	BSC (MISSISSIPPI) (1987)
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KHOO HUI KIANG	BE HONS (UNIMAS) (CIVIL, 2004) ME (UTM) (CIVIL - STRUCTURE, 2006)
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KUMARESWARAN NADARAJAH	BE HONS (LONDON) (CIVIL, 1991)
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LAKHBIR SINGH A/L GURMUKH SINGH	BE HONS (UTM) (CIVIL, 2004) MSC (UTM) (CONSTRUCTION MANAGEMENT, 2008)
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MOHD SHAHRIL BIN MOHD	BE HONS (UPM) (CIVIL, 2002)
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NG CHIN KHUANG	BE HONS (UKM) (CIVIL & STRUCTURAL, 2002)
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TUNG SOW HOONG	BE HONS (UPM) (CIVIL, 2001) MSC (UPM) (MECHANICAL, 2007)
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ZALEHA BINTI SALEHODDIN	BE HONS (UMS) (CIVIL, 2000) MSC (UiTM) (CIVIL - CONSTRUCTION, 2012)
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### KEJURUTERAAN ELEKTRIKAL

MOHAMAD SYAIFUL EZHAM MOHAMED ZINI	BE HONS (SOUTHAMPTON) (ELECTRICAL, 2002)
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MOHAMMAD ZUBAIRI B. HJ. MOHD. NOR	BE HONS (UNITEN) (ELECTRICAL POWER, 2007)
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NIK IBRAHIM BIN NIK ABDULLAH	BE HONS (UiTM) (ELECTRICAL, 1998)
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ROYHAIZAD BIN MOHAMAD ISMAIL	BE HONS (UiTM) (ELECTRICAL, 2007)
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### KEJURUTERAAN ELEKTRONIK

AHMAD ASHRIF BIN A BAKAR	BE HONS (UNITEN) (ELECTRICAL & ELECTRONICS, 2002)
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IRYANI BINTI MOHAMED RAWI	BE HONS (UTM) (ELECTRICAL - TELECOMMUNICATIONS, 2002)
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LAU KEAN HONG	BSC (MONASH) (1995) BE HONS (MONASH) (ELECTRICAL & COMPUTER SYSTEMS, 1996) MENGSC (MONASH) (RESEARCH, 2000)
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LEONG WAI YIE	BE (QUEENSLAND) (ELECTRICAL, 2001) PHD (QUEENSLAND) (ELECTRICAL, 2006)
---------------	--

RAYMOND TAN SENG LOON	BE HONS (MULTIMEDIA) (ELECTRONICS-TELECOMMUNICATION, 2006)
-----------------------	--

SHEIKH KAMAR BIN SHEIKH ABDULLAH	BE HONS (USM) (ELECTRONIC, 1992) MSC (BRADFORD) (REAL-TIME ELECTRONIC SYSTEMS, 1993)
----------------------------------	--

TAY SIANG HUI	BE HONS (SUSSEX) (ELECTRICAL & ELECTRONIC, 1998) MENGSC (MULTIMEDIA) (2003)
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### KEJURUTERAAN GEOTEKNIKAL

ZAITON BINTI ZAINAL BADRI	BE HONS (UTM) (CIVIL, 2003) ME (UTM) (CIVIL-GEOTECHNICS, 2004)
---------------------------	--

### KEJURUTERAAN KAWALAN & INSTRUMENTASI

MOHD FAHAMI JAAPAR	BE (MEIJI, JAPAN) (ELECTRICAL & ELECTRONIC, 2005)
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SYAHMI AZHAN  
BIN MHD NOR

BE HONS (UTM) (ELECTRICAL -  
ELECTRONICS, 2006)

## KEJURUTERAAN KIMIA

ROSMARIA BINTI  
ABU DARIM

BE HONS (UTM) (CHEMICAL-  
BIOPROCESS, 2006)

## KEJURUTERAAN KOMPUTER

CHUAH JOON HUANG

BE HONS (UTM) (COMPUTER,  
1999) ME (SINGAPORE) (2002)  
MPHIL (CAMBRIDGE) (2008)

## KEJURUTERAAN MEKANIKAL

CHIN KAI SHOONG

BE HONS (UTM)  
(MECHANICAL, 2001)

HANIZAN B.  
MOHD HUSIN

BE HONS (UTM)  
(MECHANICAL, 1997)

HOR KOK LUEN

BE HONS (USM)  
(MECHANICAL, 2001)

JAZLEE BIN MOHD  
ALIAS

BE HONS (SALFORD)  
(MECHANICAL, 1997)

LING TUONG THAI

BE HONS (UTM)  
(MECHANICAL, 2003)  
ME (UTM) (MECHANICAL, 2006)

MUHAMAD RIZANI BIN  
MOHD RIFFIN

BE HONS (UM)  
(MECHANICAL, 2002)

PAN KHEE KEONG

BE HONS (LIVERPOOL JOHN  
MOORES) (MECHANICAL, 1999)

SATESH NARAYANA  
NAMASIVAYAM

BE HONS (LONDON)  
(MECHANICAL, 2002)  
PHD (LONDON) (2006)

ZAMRI BIN KANIP

BE HONS (UTP)  
(MECHANICAL, 2002)

## KEJURUTERAAN TELEKOMUNIKASI

OTHMAN BIN ISMAIL

BSC (SOUTHERN ILLINOIS AT  
CARBONDALE) (ELECTRICAL  
SCIENCE & SYSTEMS  
ENGINEERING, 1985)

## LULUS PPP (BEM)

Nama	Kelayakan
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### KEJURUTERAAN AWAM

AZIZUL AZHAM BIN MOHD NADZRI	BE HONS (UTM) (CIVIL, 2002)
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JOHNNY MALCOM ANAK EDWARD DUOD	BE HONS (UITM) (CIVIL, 2001)
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## PEMINDAHAN KEPADA AHLI SISWAZAH

No. Ahli	Nama	Kelayakan
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### KEJURUTERAAN AWAM

29380	AHMAD KHAIRI BIN MOHD	B.E.HONS.(UITM) (CIVIL, 2008)
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40494	BOH WEN HAN	B.E.HONS.(UTM) (CIVIL, 2012)
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41444	CHANG SHING KEONG	B.E.HONS.(UPM) (CIVIL, 2011)
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34599	CHEE FONG WAH	B.E.HONS.(UPM) (CIVIL, 2012)
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21261	CHEOK HOU SENG	B.E.HONS.(UTM) (CIVIL, 2003) ME (UTM) (CIVIL, 2006)
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51623	CHONG CHEE LOONG	B.E.HONS.(UTM) (CIVIL, 2012)
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47487	CHONG KAI LIANG	B.E.HONS.(UKM) (CIVIL & STRUCTURAL, 2012)
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32141	CHOU KUOK LUNG	B.E.HONS.(USM) (CIVIL, 2011)
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30148	DUANE ALVIN WILLIAM	B.E.HONS.(UNITEN) (CIVIL, 2012)
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32859	GAN KIM CHUAN	B.E.HONS.(UNIMAS) (CIVIL, 2011)
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51488	GOH KWANG YAW	B.HONS.(SWINBURNE) (CIVIL, 2012)
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41646	HABIB MUSA BIN MOHAMAD	B.E.HONS.(UNISEL) (CIVIL, 2012)
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36731	KHAIRUL ZAIM BIN ZAKARIAH	B.E.HONS.(UNITEN) (CIVIL, 2010) M.SC. (ENG.)(UNI OF LEEDS) (TRANSPORT PLANNING & ENGINEERING, 2012)
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50240	KHONG JIA WEI	B.E.HONS.(UMP) (CIVIL, 2012)
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43318	LEE KEE YUAN	B.E.HONS.(UMS) (CIVIL, 2012)
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29879	LEE LE QIN	B.E.HONS.(USM) (CIVIL, 2008)
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41443	LIEW CHIT YOUNG, ROBIN	B.E.HONS.(UITM) (CIVIL, 2011)
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31143	LIEW YU HAO	B.E.HONS.(UTM) (CIVIL, 2009)
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36774	LIM BOON LIN, COLIN	B.E.HONS.(MMU) (CIVIL, 2012)
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43302	LIM CHEN YII, YVONNE	B.E.HONS.(UPM) (CIVIL, 2012)
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47524	LIM CHONG HUI	B.E.HONS.(UKM) (CIVIL & STRUCTURAL, 2012)
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43381	LIM CHUN KIAT	B.E.HONS.(UMS) (CIVIL, 2012)
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51627	LIM KEAN FAN	B.E.HONS.(UTM) (CIVIL, 2012)
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29371	LOO SHOU WOEI	B.E.HONS.(UPM) (CIVIL, 2010)
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45966	MARZIDA BINTI ABDUL MANAF	B.E.HONS.(UMP) (CIVIL, 2011)
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23343	MOHAMMAD RAZI BIN RAHIMAN	B.E.HONS.(UITM) (CIVIL, 2005)
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27031	MOHD FALIQ IQBAL BIN MOHD SALEH	B.E.HONS.(UITM) (CIVIL, 2006)
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27806	MOHD HAIDIR BIN HARON	B.E.HONS.(UITM) (CIVIL, 2008)
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36745	MOHD KHUIZHAM BIN ABD HALIM	B.E.HONS.(UNITEN) (CIVIL, 2012)
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44439	MUHAMAD HILFI BIN KAMSANI	B.E.HONS.(UITM) (CIVIL, 2011)
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50119	MUHAMMAD ALIF BIN OTHAMAN	B.E.HONS.(UITM) (CIVIL, 2012)
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36551	MUHAMMAD JAHIDUDDIN BIN ABU JAMAL	B.E.HONS.(UMP) (CIVIL, 2012)
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28918	NASRUL HAFIZAH BINTI MD ZAHIL	B.E.HONS.(UNISEL) (CIVIL, 2007)
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27791	NG CHOK CHEN, CHRISTOPHER	B.E.(SWINBURNE) (CIVIL, 2012)
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32058	NOOR FARHANA BINTI MAZLAN	B.E.HONS.(USM) (CIVIL, 2011)
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45968	NOOR SYAZWANI BINTI NOOR SAZALI	B.E.HONS.(MALAYA) (CIVIL, 2011)
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32741	NOORDINI HARLIYATI BINTI RAMLI	B.E.HONS.(KLIUC) (CIVIL, 2009)
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41710	NOR AISYAH BINTI YUSOFF	B.E.HONS.(UKM) (CIVIL & STRUCTURAL, 2011)
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37176	NORSHAWANA BINTI JAMALUDIN	B.E.HONS.(UTHM) (CIVIL, 2010)
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33311	NUR AZWA BINTI MUHAMAD BASHAR	B.E.HONS.(UITM) (CIVIL, 2009)
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39628	NURUL HUSNA BINTI MOHAMAD RADZUAN	B.E.HONS.(UTHM) (CIVIL, 2012)
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47238	OOI JINGWEN	B.E.HONS.(UKM) (CIVIL & STRUCTURAL, 2012)
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28919	ROSEFAIZAL BIN MOHAMAD SOYOTI	B.E.HONS.(UNISEL) (CIVIL, 2007)
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43285	SAMANTHA LAU ZHILING	B.E.HONS.(UMS) (CIVIL, 2012)
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32809	SYLVESTER IPOH	B.E.HONS.(UITM) (CIVIL, 2009)
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51625	TAN SIANG LOONG	B.E.HONS.(UTM) (CIVIL, 2012)
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44025	TAN SOON HAW	B.E.HONS.(UTAR) (CIVIL, 2012)
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42170	TEH BOON KOON	B.E.HONS.(USM) (CIVIL, 2010)
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31253	TEH ZHI HUAN	B.E.HONS.(MALAYA) (CIVIL, 2009)
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## KEJURUTERAAN BAHAN

45741	TEO PAO TER	B.E.HONS.(USM) (MATERIALS, 2012)
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## KEJURUTERAAN ELEKTRIKAL

49206	HONG WENG TAT	B.E.HONS.(USM) (ELECTRICAL, 2012)
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33056	MOHAMMAD AFIF BIN AYOB	B.E.HONS.(UTHM) (ELECTRICAL, 2011)
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37865	MOHD AMIRUDDIN BIN ZAINOL	B.E.HONS.(UNITEN) (ELECTRICAL & ELECTRONICS, 2009)
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37797	MOHD IQBAL QHASMIE BIN AFFANDI	B.E.HONS.(UNITEN) (ELECTRICAL POWER, 2011)
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39733	MOHD ROSDI BIN ABDUL GHANI	B.E.HONS.(UTHM) (ELECTRICAL, 2011)
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49840	NUR AZILA BINTI ABU ZAKI	B.E.HONS.(UTHM) (ELECTRICAL, 2012)
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48827	NUR DIYANA FARHANA BINTI SAHARIMAN	B.E.HONS.(UTHM) (ELECTRICAL, 2011)
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49712	NURSYUHADA BINTI RADZALI	B.E.HONS.(UTHM) (ELECTRICAL, 2012)
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34600	SOO YONG ZHENG	B.E.HONS.(UPM) (ELECTRICAL & ELECTRONICS, 2012)
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## KEJURUTERAAN ELEKTRONIK

21403	LIM SOO YONG	B.E.HONS.(MMU) (ELECTRONICS, 2003) PHD (HAWAII) (ELECTRICAL, 2010)
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28467	MOHD HAZMAN BIN IBRAHIM	B.E.HONS.(UKM) (MICROELECTRONICAL, 2009)
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60670	PARVATHY A/P RAJENDRAN	B.E.HONS.(USM) (AEROSPACE, 2004)
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59968	AKMAL HALIMY BIN HARON	B.SC.(RENSSELAER POLY)(AERONAUTICAL- MECHANICAL, 2001 M.E.(UNITEN) (MECHANICAL, 2012)
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59964	ABD. LATIF BIN SALEH	B.E.HONS.(THAMES POLY)(CIVIL, 1986) M.E.(UTM)(CIVIL- STRUCTURES, 1989) PHD(PORTMOUTH) (CIVIL, 1995)
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59964	ABD. LATIF BIN SALEH	B.E.HONS.(THAMES POLY)(CIVIL, 1986) M.E.(UTM)(CIVIL- STRUCTURES, 1989) PHD(PORTMOUTH) (CIVIL, 1995)
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59964	ABD. LATIF BIN SALEH	B.E.HONS.(THAMES POLY)(CIVIL, 1986) M.E.(UTM)(CIVIL- STRUCTURES, 1989) PHD(PORTMOUTH) (CIVIL, 1995)
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59964	ABD. LATIF BIN SALEH	B.E.HONS.(THAMES POLY)(CIVIL, 1986) M.E.(UTM)(CIVIL- STRUCTURES, 1989) PHD(PORTMOUTH) (CIVIL, 1995)
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59964	ABD. LATIF BIN SALEH	B.E.HONS.(THAMES POLY)(CIVIL, 1986) M.E.(UTM)(CIVIL- STRUCTURES, 1989) PHD(PORTMOUTH) (CIVIL, 1995)
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59964	ABD. LATIF BIN SALEH	B.E.HONS.(THAMES POLY)(CIVIL, 1986) M.E.(UTM)(CIVIL- STRUCTURES, 1989) PHD(PORTMOUTH) (CIVIL, 1995)
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59964	ABD. LATIF BIN SALEH	B.E.HONS.(THAMES POLY)(CIVIL, 1986) M.E.(UTM)(CIVIL- STRUCTURES, 1989) PHD(PORTMOUTH) (CIVIL, 1995)
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59964	ABD. LATIF BIN SALEH	B.E.HONS.(THAMES POLY)(CIVIL, 1986) M.E.(UTM)(CIVIL- STRUCTURES, 1989) PHD(PORTMOUTH) (CIVIL, 1995)
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## KEJURUTERAAN MEKANIKAL

50023	ABANG MOHAMMAD SYAFIQ IDZUAN BIN RAZAK	B.E.HONS.(UPNM) (MECHANICAL, 2012)
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30236	ABU HANIFAH BIN ZAMBERI	B.E.HONS.(UITM) (MECHANICAL, 2011)
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50039	AHMAD FIRDAUS BIN AHMAD TARMIZI	B.E.HONS.(UPNM) (MECHANICAL, 2012)
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34954	AHMAD HAZRIL BIN ABD HALIM	B.E.HONS.(UITM) (MECHANICAL, 2012)
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34258	ALEXIUS ANAK AN'YAN	B.E.HONS.(UMP) (MECHANICAL- MANUFACTURING, 2009)
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50030	CHAN JUN SHEN	B.E.HONS.(UPNM) (MECHANICAL, 2012)
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28677	CHEONG CHAN HOONG	B.E.HONS.(MMU) (MECHANICAL, 2010) M.SC.(MANCHESTER) (AEROSPACE, 2012)
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50089	CHUNG WEI NING, TIFFANY	B.E.HONS.(UCSI) (MECHANICAL, 2012)
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37673	GOH THEN YIK, SHIRLEY	B.E.HONS.(UITM) (MECHANICAL, 2011)
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50027	HAADI BIN MOHAMMAD	B.E.HONS.(UPNM) (MECHANICAL, 2012)
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55792	HADI SUFIYAN BIN SAIDIN	B.E.HONS.(UNISEL) (MECHANICAL, 2012)
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34479	HILMI SAFUAN BIN JAPAR	B.E.HONS.(UTEM) MECHANICAL (THERMAL- FLUIDS, 2010)
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34587	KHO JIA JIAN	B.E.HONS.(UPM) (MECHANICAL, 2012)
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52601	LINGESHWARAN RAMACHANDRAN	B.E.HONS.(UNITEN) (MECHANICAL, 2012)
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54402	LOGARAJEN A/L THOMAS	B.E.HONS.(UNITEN) (MECHANICAL, 2012)
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46878	MAHENDRAN A/L MOORTHY	B.E.HONS.(UMP) (MECHANICAL, 2011)
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22789	MOHAMAD HALIM BIN IBRAHIM	B.E.HONS.(UITM) (MECHANICAL, 2004) ME (UKM) (MANUFACTURING, 2012)
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# KEAHLIAN

59890	ABDULL SULAIMAN BIN ISMIL	B.E.HONS.(KUITTHO)(CIVIL,2003)	60054	LOW SHEUE LIH	B.E.HONS.(UNITEN)(CIVIL,2007)	59992	TAN WEI JIN, KEVIN	B.E.HONS.(UNITEN)(CIVIL,2012)
59864	AHMAD SHAMSULARIZAM BIN MOHAMAD	B.E.HONS.(UTM)(CIVIL,2009)	59862	MAZLAN BIN MAIDIE	B.E.HONS.(UMS)(CIVIL,2008)	59874	TAN WEI KEAT	B.E.HONS.(UTM)(CIVIL,2002) M.SC.(UTM)(CONSTRUCTION MANAGEMENT,2008)
60643	AKHTAR NURFITRI BIN MAT ZAIN	B.E.HONS.(UTM)(CIVIL,2012)	60649	MELVIN @ FRANCIS HUMOC	B.E.HONS.(UMS)(CIVIL,2001)	61195	TANG MUN CHUN	B.E.HONS.(EAST LONDON)(CIVIL,2011) M.SC.(EAST LONDON)(STRUCTURAL,2012)
59946	ALIREZA ZABIHI SHAHRI	B.E.(ISLAMIC AZAD)(CIVIL,2008) M.E.(UPM)(STRUCTURAL & CONSTRUCTIONS,2012)	60634	MOHAMAD NAZIF BIN MOHAMAD RIDZUAN	B.E.HONS.(UNIMAS)(CIVIL,2006)	59898	TAY GUAN KIAT, JEFFREY	B.E.HONS.(UTM)(CIVIL,2006) M.E.(UTM)(CIVIL-GEOTECHNICS,2011)
61190	ANG ING HSIEN	B.E.HONS.(RMIT)(CIVIL & INFRASTRUCTURE,2011)	61118	MOHAMED FAUZI BIN MD ISA	B.E.HONS.(UTM)(CIVIL,2009) M.E.(UTM)(CIVIL-GEOTECHNICS,2011)	60668	TEH HEE MIN	B.E.HONS.(UTM)(CIVIL,2000) M.E.(UTM)(COASTAL & MARITIME,2003)
61146	ANG VUI SIANG	B.E.HONS.(CURTIN)(CIVIL & CONSTRUCTION,2012)	60017	MOHAMMAD IZZAT BIN ABD KARIM	B.E.HONS.(UTHM)(CIVIL,2010)	59969	TING BIN FON	B.E.HONS.(UCL)(CIVIL,2011)
59959	ANWAR RIDHWAN BIN DZAINUDDIN	B.E.(SYDNEY)(CIVIL-ENVIRONMENTAL,2011)	61158	MOHD FIRDAUS HAFIFI BIN AZIZUL RAHMAN	B.E.HONS.(UTHM)(CIVIL,2013)	59903	TIONG INN SENG, COLLIN	B.E.HONS.(UNIMAS)(CIVIL,2010)
59920	AZMIR BIN ZAINAL ABIDIN	B.E.HONS.(UTHM)(CIVIL,2011)	59947	MOHD LIZAM BIN GHAZALI	B.E.HONS.(UTM)(CIVIL,2000)	59916	VEERAN A/L PALRAJU	B.E.HONS.(UNITEN)(CIVIL,2011)
60681	BALACHANTER A/L RAMASAMY	B.E.HONS.(UMP)(CIVIL,2011)	60622	MOHD NASRUL NIZAM BIN NASRI	B.E.HONS.(UiTM)(CIVIL,2009)	59922	WAN MOHD IZAN AZRI BIN WAN MUDA	B.E.HONS.(UTM)(CIVIL,2010)
60641	BAVANI A/P RENGARAJOO	B.E.HONS.(UTM)(CIVIL,2006)	59889	MOHD NIZAMUDDIN BIN MOHD DAWANG	B.E.HONS.(KUITTHO)(CIVIL,2003)	60002	WAN MOHD KAMIL BIN WAN AHMAD	B.E.HONS.(ITM)(CIVIL,1998)
61157	CHAN KUM HOONG	B.E.HONS.(UNITEN)(CIVIL,2009)	61177	MOHD NORHALIM BIN MOSTAIPOR JARIP	B.E.HONS.(UKM)(CIVIL & ENVIRONMENTAL,2006)	61170	WAN MUHAMAD FAHMI BIN WAN ZAKI	B.E.HONS.(UiTM)(CIVIL,2007)
60656	CHANG CHEE KHIONG	B.E.HONS.(CANTERBURY)(CIVIL,2003) M.E.(CANTERBURY)(TRANSPORTATION, 2004)	60004	MOHD RIZAL BIN AHMAD	B.E.HONS.(UNISEL)(CIVIL,2009)	60685	WAN YAHAYA BIN WAN AHMAD	B.E.HONS.(UTM)(CIVIL,2012)
60669	CHEAH SAU WEI	B.E.HONS.(UTM)(CIVIL,2002)	59934	MOHD SALEHIN BIN MAZELAN	B.E.HONS.(UTM)(CIVIL,2010)	59926	WONG KAM LEONG	B.E.HONS.(UTM)(CIVIL,2010)
60650	CHEN KAI CHIN	B.E.HONS.(UNIMAS)(CIVIL,2010)	59891	MOHD. FAZLI BIN HJ. ABD. RAHMAN	B.E.HONS.(KUITTHO)(CIVIL,2003)	61134	YANG AINIHIDAYAH BT. MOHAMED YAACOB	B.E.HONS.(UNIMAS)(CIVIL,2010)
60045	CHIN WOON KHEONG	B.E.HONS.(KLIUC)(CIVIL,2010)	60625	MOK KEN LOONG	B.E.HONS.(UKM)(CIVIL & STRUCTURAL,2004)	61168	YANG KING HOE	B.E.(WOLLONGONG)(CIVIL,2012)
59908	CHONG CHEN WAY	B.E.HONS.(UPM)(CIVIL,2012)	59911	MUHAMMAD UMAR BIN ZULKEFLI	B.E.HONS.UTM(CIVIL,2007)	59980	YUSTACE ALEX KAKALA	B.E.(BANGALORE)(CIVIL,1991) M.E.(UPM)(HIGHWAY & TRANSPORTATION,2013)
60055	CHONG JIA HOE	B.E.HONS.(UTAR)(CIVIL,2011)	59892	NGATINAH BINTI JASWADI	B.S.C.HONS.(UTM)(CIVIL,2002)	59956	ZAILAN BIN SUDIN	B.S.C.(AKRON)(CIVIL,1986)
59909	CHOONG THIAM CHYE, DARRELL	B.E.HONS.(UPM)(CIVIL,2012)	60633	NOOR FAZLINA BINTI RAMLI	B.E.HONS.(UPM)(CIVIL,2002)	59895	ZULKIFLI BIN SAMSUDIN	B.E.HONS.(ITM)(CIVIL,1998)
61155	CHUA SHYI SHEN	B.E.HONS.(UNITEN)(CIVIL,2008)	59981	NOOR ILIFADHILAH BINTI SAMSUDIN	B.E.HONS.(UiTM)(CIVIL,2008)	<b>KEJURUTERAAN BAHAN</b>		
59902	CHUNG MUI ZHI	B.E.HONS.(UNIMAS)(CIVIL,2010)	61124	NOORFAKHRIAH BINTI YAAKUB	B.E.HONS.(UTP)(CIVIL,2010)	61150	CHOO JERN YUE	B.E.HONS.(UNI OF LONDON)(MATERIALS SCIENCE & ENGINEERING,2004)
59900	DAUD BIN MOHAMAD	B.E.HONS.(UiTM)(CIVIL,2008)	60030	NOR AFIFI BIN MOHD ARIF	B.E.HONS.(UPNM)(CIVIL,2012)	61181	LAU CHUI CHUI, MICHELLE	B.E.(MONASH)(MATERIALS,1996)
60646	EE PEI LIAN	B.E.HONS.(SWINBURNE)(CIVIL,2010)	59863	NOR HISHAM BIN NGADIMIN	B.E.HONS.(UTM)(CIVIL,2000)	61186	MOHD FADLI BIN AHMAD RASYID	B.E.HONS.(USM)(MATERIALS,2009)
59995	ERNI DIANA BINTI ZAHRI	B.E.HONS.(KLIUC)(CIVIL,2012)	59877	NOR SALEHEEN BINTI ABDUL RAZA	B.E.HONS.(UTM)(CIVIL,2007)	60009	ZALEHA BINTI MUSTAFA	B.E.HONS.(USM)(MATERIALS,2003)
59928	EZLIANA BINTI GHAZALI	B.E.HONS.(UiTM)(CIVIL,2009) M.SC.(UiTM)(CIVIL-CONSTRUCTION,2011)	60642	NURERRINNA BINTI MOHD NASIR	B.E.HONS.(UiTM)(CIVIL,2010)	<b>KEJURUTERAAN BIODIKIMIA</b>		
59944	FADZLI BIN MOHD NAZRI	B.E.HONS.(USM)(CIVIL,2005) M.SC.(USM)(CIVIL,2008) PH.D.(BRISTOL)(CIVIL,2012)	60652	NURHARNANI BINTI HASSAN	B.E.HONS.(UiTM)(CIVIL,2006)	60014	HUZAIRY BIN HASSAN	B.E.HONS.(UIAM)(BIOCHEMICAL-BIOTECHNOLOGY,2009)
60629	FARAH ADIBAH BINTI KAMSANI	B.E.HONS.(UiTM)(CIVIL,2012)	61194	ONG KIN BEING	B.E.(NATIONAL CHENG KUNG)(CIVIL,1982) M.E.(ASIAN INSTITUTE)(ENGINEERING GEOLOGY & APPLIED GEOPHYSICS,1990)	61114	NOOR ILLI BINTI MOHAMAD PUAD	B.E.HONS.(UIAM)(BIOCHEMICAL-BIOTECHNOLOGY,2007)
61183	FAREEZ ZAINY BIN INSAN	B.E.HONS.(UTHM)(CIVIL,2012)	61135	ONG MING WEI	B.E.HONS.(UNIMAS)(CIVIL,2012)	<b>KEJURUTERAAN BIOPERUBATAN</b>		
61156	FONG KAH WING	B.E.HONS.(UNITEN)(CIVIL,2008)	59971	ONN SOOK YEE	B.E.HONS.(LEEDS)(CIVIL,2004)	59993	MOHAMED FADZLI BIN ISMAIL	B.E.HONS.(KUITTHO)(ELECTRICAL-MEDICAL ELECTRONICS,2003)
59983	G JAGANAT A/L GUNALAN	B.E.HONS.(KUITTHO)(CIVIL,2005) M.E.(UTM)(CIVIL,2008)	61175	Ooi Her Shoei	B.E.HONS.(UTM)(CIVIL,2012)	<b>KEJURUTERAAN ELEKTRIKAL</b>		
60018	HAMIDATU ISLAMIYAH BINTI DAUD	B.E.HONS.(UTM)(CIVIL,2007)	59977	PANG CHEAR LOONG	B.E.HONS.(EAST LONDON)(CIVIL,1995) M.SC.(CITY UNI)(CIVIL,1997)	61196	AHMAD NAJMI BIN ABDULLAH	B.E.(ANNA UNIVERSITY)(ELECTRICAL & ELECTRONICS,1997) M.E.(MALAYA)(ELECTRICAL,2011)
59917	HAMIZAH BINTI JASMI	B.E.HONS.(UMP)(CIVIL,2011)	59967	PHANG SHIH YAN	M.E.HONS.(CARDIFF)(CIVIL,2007)	61182	AHMAD SHAMIRI BIN WAHAB	B.E.HONS.(UTM)(ELECTRICAL,2004)
60631	HASMAN BIN HUSSIN	B.E.HONS.(UTM)(CIVIL,2006)	61199	PUTERI AQILAH BINTI ANWAR	B.E.HONS.(UNITEN)(CIVIL,2011)	61160	AHMAD SUPAWI BIN OSMAN	B.E.HONS.(UTM)(ELECTRICAL,2010)
59915	HAU WAN SONG	B.E.HONS.(UMS)(CIVIL,2002)	60027	RAZALI BIN MD JINAL	B.E.HONS.(UTM)(CIVIL,2004)	59936	AHMAD TARMIDZI BIN MOHD IDERIS	B.E.HONS.(UPNM)(ELECTRICAL & ELECTRONICS-POWER,2011)
59893	HAZLINA BINTI MARWAN	B.E.HONS.(UTM)(CIVIL,2003)	60050	SHAHRIZA BINTI ITHNIN	B.E.HONS.(UTM)(CIVIL,2012)	61141	AMIN SHAHARUDDIN BIN IBRAHIM	B.E.HONS.(USM)(ELECTRICAL,2010)
61163	HENRY TUAH	B.E.HONS.(UNIMAS)(CIVIL,1999)	60677	SHAHRUL SHAFIQ BIN HAMDAN	B.E.(CARLETON)(CIVIL,2012)	60034	AMIRUL AIZAD NORAKMAN BIN KAMARUZAMAN	B.E.HONS.(UPNM)(ELECTRICAL & ELECTRONICS-POWER,2012)
60626	IZRINDA FARINI BINTI ROSLI	B.E.HONS.(MALAYA)(CIVIL,2011)	61198	SHAMSUL ARIFIN BIN ABDUL HAMID	B.E.HONS.(UTM)(CIVIL,1996)	59919	AZAM FAEZ BIN ARSHAD	B.E.HONS.(USM)(ELECTRICAL & ELECTRONICS, 2000) M.E.(MALAYA)(2012)
59913	JASMI BIN ISMAIL	B.E.HONS.(UKM)(CIVIL & STRUCTURAL,2008)	61151	SITI AZIREEN HEZZA BINTI AZAHAR	B.E.HONS.(MALAYA)(CIVIL,2011)	61147	CHENG WENG SIONG	B.E.(MONASH)(ELECTRICAL & COMPUTER SYSTEMS,2008)
60628	KHAIRUL FAIZAL BIN NORDIN	B.E.HONS.(UiTM)(CIVIL,2011)	61126	SITI MARIAM BINTI JUSOH	B.E.HONS.(UMP)(CIVIL,2010)	60011	CHEONG CHEE LEONG	B.E.HONS.(UNITEN)(ELECTRICAL POWER,2012)
59899	KHAIRUL HAKIM BIN MOHD RASID	B.E.HONS.(UTM)(CIVIL,2008)	61136	SITI NURULHUDA BINTI MOHAMAD ANUAR	B.E.HONS.(UiTM)(CIVIL,2011)	59950	CHIENG HENG PING	B.S.C.(ROBERT GORDON)(ELECTRICAL & ELECTRONICS,1994) M.SC.(USCI)(ELECTRICAL,2012)
60682	KIEW YUH HWAN	B.E.HONS.(CURTIN)(CIVIL & CONSTRUCTION,2012)	60655	SITI RABIAH BINTI ABU BAKAR	B.E.HONS.(UTM)(CIVIL,2010)			
61171	LEE ZI SHUN	B.E.HONS.(QUEENSLAND)(CIVIL,2008)	59965	SO HOW TOON	B.E.HONS.(HERTFORDSHIRE)(CIVIL,2000)			
60673	LEONG SHUH ONN, TERENCE	B.E.HONS.(UNIMAS)(CIVIL,2008)	59938	SOO ZINE SHEN, KEVIN	M.E.HONS.(NOTTINGHAM)(CIVIL,2011)			
61138	LIM EU SHAWN	B.E.HONS.(UTP)(CIVIL,2012)	59921	SYED MOHD SYAWAL BIN SYED AHMAD	B.E.HONS.(USM)(CIVIL,2005)			
59932	LIM JEE HOCK	B.E.HONS.(UTM)(CIVIL,2006)	61128	TAN HUI SIN	B.E.HONS.(UPM)(CIVIL,2012)			
59970	LIM ZI JEAT	B.E.HONS.(MONASH)(CIVIL,2009)	60048	TAN KAH HOW	B.E.HONS.(UTHM)(CIVIL,2012)			
61152	LIU YONG JING, MICHAEL	B.E.HONS.(MALAYA)(CIVIL,2011)	59935	TAN MIN WEE	B.E.HONS.(MALAYA)(CIVIL,2004)			

60021	CHRISTIANA LINUS MAJAIL	B.E.HONS.(UMS) (ELECTRICAL & ELECTRONICS,2004)	59966	RAZALI BIN ABD. HADI	B.E.HONS.(ABERDEEN) (ELECTRICAL,1996)	60667	KARTHIGEYAN A/L TAMALINGAM	B.E.HONS.(UCSI) (COMMUNICATION & ELECTRONICS,2011)
59861	DEVAN RAJ V DORASAMY	B.E.HONS. (HERTFORDSHIRE) (ELECTRICAL & ELECTRONICS,1998)	61111	SAIYED ABDUL FATAH BIN SAIYED RASOL	M.E.HONS.(LIVERPOOL) (ELECTRICAL & ELECTRONIC,2009)	59949	LIM KIM CHUAN	B.E.HONS.(SHEFFIELD) (ELECTRONICS SYSTEMS,2003) M. SC.(SHEFFIED) (ELECTRONICS & INFORMATION TECHNOLOGY,2005)
60016	EDMOND SIMON ITAL	B.E.HONS.(UMS) (ELECTRICAL & ELECTRONICS,2007)	60686	SITI NURAI SHAH BINTI OMAR	B.E.HONS.(KUITTHO) (ELECTRICAL,2006)	60624	MAY DELIAN STANISLAUS	B.E.HONS.(KUITTHO) (ELECTRICAL-TELECOMMUNICATION, 2006)
60023	HIPNI BIN AHMAD	B.E.HONS.(MALAYA) (ELECTRICAL,1993)	60058	SIVACHANDRAN A/L R. PERUMAL	B.E.HONS.(UTHM) (ELECTRICAL,2009)	60658	MOHD NASRUDDIN BIN ZAINUDIN	B.E.HONS.(UTEM) (ELECTRONICS-TELECOMMUNICATION ELECTRONICS,2012)
59896	HO CHEE WAI	B.E.HONS.(USM) (ELECTRICAL,2012)	59948	SOO YEW GUAN	B.E.HONS.(UTM) (ELECTRICAL- INSTRUMENTATION & CONTROL,2001)	60033	MOHD NURFITRI BIN MOHD WAHID	B.E.HONS.(UPNM) (ELECTRICAL & ELECTRONICS-COMMUNICATIONS,2012)
61193	JAVADIUS BIN BOLLAH	B.E.HONS.(UMS) (ELECTRICAL & ELECTRONIC,2001)	59991	SURESH NAIKER A/L SIVANAYAN	B.E.HONS.(UNITEN) (ELECTRICAL POWER,2010)	61127	MOHD RIZAL BIN JOHARI	B.SC.(TULSA) (ELECTRICAL,1996)
60029	JEFREY NURI	B.E.HONS.(UMS) (ELECTRICAL & ELECTRONICS,2002)	60638	SUWAN A/L BONMA	B.E.HONS.(UTAR) (ELECTRICAL & ELECTRONIC,2011)	60621	MOHD SHAHRIZAL BIN ISHAK	B.E.HONS.(UTM) (ELECTRICAL- INSTRUMENTATION & CONTROL,2010)
61137	KENEDDY BIN JIVET	B.E.HONS.(UTM) (ELECTRICAL,2008)	59906	SYAHRUL NIZAM BIN MD SAAD	M.E.(UNITEN) (ELECTRICAL,2012)	59885	MOHD ZAIHAM BIN HAMZAH	B.E.HONS.(KUITTHO) (ELECTRICAL,2003)
60623	LAILATUL AKMAL BINTI ABDUL RAUF	M.E.HONS.(IMPERIAL COLL) (ELECTRICAL & ELECTRONICS,2009)	59929	SYAMSOL ANUAR BIN MUDA	B.E.HONS.(UNITEN) (ELECTRICAL,2010)	59954	MOHD ZAMRI BIN HASAN	B.E.(MIYAZAKI UNI) (ELECTRONICS,2005)
61116	LEE CHOON SIEN	B.E.HONS.(UTAR) (ELECTRICAL & ELECTRONIC,2009)	60663	SYAZWANI BINTI YAHAYA	B.E.HONS.(UITM) (ELECTRICAL,2011)	60660	MUHAMAD SABRI BIN RAZALI	B.E.HONS.(MMU) (ELECTRONICS-MULTIMEDIA,2007)
61142	LEMAN BIN ZAKARIA	B.E.HONS.(UTM) (ELECTRICAL,2000)	59904	TAN CHEE SIONG	B.E.HONS.(UNIMAP) (ELECTRICAL SYSTEMS,2009)	59984	MUHAMMAD AIZZAD BIN MUSHAIMI	B.E.HONS.(UITM) (ELECTRICAL,2011)
59871	LEOHATTA SHAHDIEKN SAMSON	B.E.HONS.(UTP) (ELECTRICAL & ELECTRONICS,2009)	60627	TAN KHAI CHUAN	B.E.HONS.(MMU) (ELECTRICAL,2012)	60639	MUHAMMAD SHAFIZAL BIN MAT IBRAHIM	B.E.HONS.(UTHM) (ELECTRICAL,2010)
59180	LIM SZE HUE	B.E.HONS.(UTM) (ELECTRICAL,2012)	60060	TENGKU MARIAZAITUL AKMAL BT TENGKU KAMARUL BAHARIN	B.E.HONS.(UPM) (ELECTRICAL & ELECTRONICS,2008)	60032	MUHAMMAD SYAHIR BIN BADRUDDIN	B.E.HONS.(UPNM) (ELECTRICAL & ELECTRONICS-COMMUNICATIONS,2012)
60007	MARIAM BINTI MD GHAZALY	B.E.HONS.(UTM) (ELECTRICAL,2004) M.E.(UTM)(ELECTRICAL-MECHATRONICS & AUTOMATIC CONTROL,2005) M.E.(TOKYO INSTITUTE OF TECH)(MECHANO-MICRO,2009) P.HD.(TOKYO INSTITUTE OF TECH)(MECHANO-MICRO,2012)	60665	VAHID NAHANI	B.E.HONS.(UNITEN) (ELECTRICAL POWER,2012)	61119	NELIDYA BINTI MD. YUSOFF	B.E.HONS.(UTM) (ELECTRICAL-TELECO MMUNICATIONS,2002) M.SC.(LOUGHBOROUGH) (DIGITAL COMMUNICATION SYSTEMS,2004)
61125	MOHD AZRI AFIFI BIN MOHAMAD SANUSI	B.E.HONS.(UTM) (ELECTRICAL,2009)	59942	YONG BOON HENG	B.E.HONS.(UNITEN) (ELECTRICAL & ELECTRONICS,2010)	59976	NGIENG SENG CHING	B.SC.(KENTUCKY) (ELECTRICAL,1999)
61130	MOHD AZUAN IZADEE BIN MD NORDIN	B.E.HONS.(MALAYA) (ELECTRICAL,2009)	59943	YONG SUE ANN	B.E.HONS.(UNITEN) (ELECTRICAL & ELECTRONICS,2010)	60020	NORHAYATI BINTI MOHD ZAINEE	B.E.HONS.(UTEM) (ELECTRONICS-INDUSTRIAL ELECTRONICS,2007)
60648	MOHD FARID FAISAL BIN MOHD NOOR	B.E.HONS.(UNITEN) (ELECTRICAL POWER,2009)	61188	YUSRIZAL BIN MOHD YUSOF	B.E.HONS.(UITM) (ELECTRICAL,2004)	59878	NORZILAH BINTI HUSSIN	B.E.HONS.(UTM) (ELECTRICAL,1997)
61143	MOHD FIRDAUS BIN MOHAMAD IDRIS	B.E.HONS.(UTM) (ELECTRICAL,2012)	61149	ZAFIRAN BIN AHMAD	B.E.HONS.(UPM) (ELECTRICAL & ELECTRONIC,2002)	61172	NUR LATIF AZYZE BIN MOHD SHAARI AZYZE	B.E.HONS.(UTM) (ELECTRICAL-MECHATRONICS,2008)
59930	MOHD FIRDAUS BIN MOHD FAUZI	B.E.HONS.(UNITEN) (ELECTRICAL POWER,2012)	60035	ZURAIN BINTI ABDUL WAHAB	B.E.HONS.(UPNM) (ELECTRICAL & ELECTRONICS-POWER,2012)	59879	RODZAH BINTI HJ YAHYA	B.E.HONS.(UTM) (ELECTRICAL,1998)
61123	MOHD FIRDAUS BIN SHAARI	B.E.HONS.(UITM) (ELECTRICAL,2007)	<b>KEJURUTERAAN ELEKTRONIK</b>		59884	ROZAINI BINTI RAHI	B.E.HONS.(KUITTHO) (ELECTRICAL,2002)	
59914	MOHD HAFIZ FIKRI BIN MAT DESA @ ISMAIL	B.E.HONS.(UKM) (ELECTRICAL & ELECTRONICS,2007)	59883	AIZURA BINTI ABU BAKAR	B.E.HONS.(KUITTHO) (ELECTRICAL,2003)	59886	ROSITA BINTI ZAINAL	B.E.HONS.(UTM) (ELECTRICAL,1999)
59927	MOHD HUZEKRI IZUAN BIN MOHAMMAD YASIN	B.E.HONS.(UPNM) (ELECTRICAL & ELECTRONICS-POWER,2011)	60031	AMIRUL ARIFF BIN MOHAMAD	B.E.HONS.(UPNM) (ELECTRICAL & ELECTRONICS-COMMUNICATIONS,2012)	59894	ROSMAWATI BINTI JALAL	B.E.HONS.(KUITTHO) (ELECTRICAL,2004)
59941	MOHD KHIRUDIN BIN ARSHAT	B.E.HONS.(UPNM) (ELECTRICAL & ELECTRONICS-POWER,2011)	59880	AZLILAWATI BINTI ABU BAKAR	B.SC.HONS.(UTM) (ELECTRICAL,1997)	60636	SHAHRIZAT BINTI SHAIK MOHAMED	B.E.HONS.(UITM) (ELECTRICAL,2006) M.SC.(UITM) (TELECOMMUNICATION & INFORMATION,2010)
61122	MOHD NAZAM BIN MOHD NASIR	B.E.HONS.(UTM) (ELECTRICAL,2008)	61176	CHAN WEI JIAN	B.E.(ADELAIDE) (ELECTRICAL & ELECTRONIC,2010)	59937	SHAMSUL HAIRI BIN DURANI	B.E.HONS.(UITM) (ELECTRICAL,2001)
59918	MOHD ZAKIR BIN ZAHRI	B.E.HONS.(UTM) (ELECTRICAL POWER,2000)	59982	CHEONG WENG WAI	B.E.HONS.(MMU) (ELECTRONICS-COMPUTER,2006)	59924	SUHANA BINTI MOHD TAHIR	B.E.HONS.(UPNM) (ELECTRICAL & ELECTRONICS-COMMUNICATIONS,2011)
60059	MOHD ZULKHAIRI BIN MOHD FAUZI	B.E.HONS.(UTHM) (ELECTRICAL,2012)	60672	CHOONG CHIAO MEI, FLORENCE	B.E.HONS.(MMU) (ELECTRONICS-COMPUTER,2002) M.E.(MMU) (SCIENCE,2005) P.HD.(MMU) (2011)	59905	TAN SWEE TIANG	B.E.HONS.(UTEM) (ELECTRONICS-COMPUTER,2012)
59955	MOO KEN JOON	B.E.HONS.(MONASH) (ELECTRICAL & COMPUTER SYSTEMS,2008) M.E.(UNITEN) (ELECTRICAL,2012)	61165	CHUN KOK TZE, BERNARD	M.E.HONS.(HULL) (ELECTRONIC,2012)	61161	YUSRI BIN HARUN	B.E.(YOKOHAMA) (ELECTRICAL & COMPUTER,2003)
59988	MUHAMMAD ARIFF BIN YAHYA	B.E.HONS.(UTP) (ELECTRICAL & ELECTRONIC,2007)	59978	ERICHRAJA A/L MUNIANDY	H.ND.(NOTTINGHAM TRENT)(ELECTRICAL & ELECTRONIC,1996) B.E.HONS (NORTHUMBRIA) (ELECTRICAL & ELECTRONIC,2000) M.SC.(UCSI) (ELECTRICAL,2012)	<b>KEJURUTERAAN KIMIA</b>		
59989	MUHAMMAD QA HAR BIN SHARUDIN	B.E.HONS.(UTM) (ELECTRICAL,2008)	59888	FARIDAH BINTI JAMIL @ AMAT	B.SC.HONS.(UTM) (ELECTRICAL,1999)	59996	ABDUL KHALIQ BIN ABU BAKAR	B.E.HONS.(CURTIN) (CHEMICAL,2012)
61117	NAZRUL BIN AZMI	B.E.HONS.(UKM) (ELECTRICAL & ELECTRONIC,2007)	59990	FONG YU CHOOI @ ALBERT	B.E.HONS.(MMU) (ELECTRONICS-ROBOTICS & AUTOMATION,2007)	60664	EDDIE NASHROMA BIN KAMISAN	B.E.HONS.(UITM) (CHEMICAL,2013)
59910	NG ENG HUI	B.E.HONS.(UKM) (ELECTRICAL,2007)	61164	GUAN WEN YIN	M.E.HONS.(HULL) (ELECTRONIC,2012)	61179	KALAIVAANAN A/L MURUGAN	B.E.HONS.(UMP) (CHEMICAL,2011)
59931	NGU KAT LUNG	B.E.HONS.(UMS) (ELECTRICAL & ELECTRONICS,2007) M.E.(MALAYA)(2010)	60683	HALIMATUN SA'ADIAH BINTI MD YUSOF	B.E.HONS.(UTM) (ELECTRICAL,2001)	60012	KHAIRUL IKHWAN BIN ISHAK	B.E.HONS.(UTM) (CHEMICAL-GAS,2008)
59923	NOORYUSHALIZA BINTI MUZLAN	B.E.HONS.(UPNM) (ELECTRICAL & ELECTRONICS-POWER,2011)	61159	HUM YAN CHAI	B.E.HONS.(UTM) (BIO-MEDICAL,2010) P.HD.(UTM)(BIO-MEDICAL,2013)	60006	LEE BOON BENG	B.E.HONS.(UMS) (CHEMICAL,2005)
59901	NORAINERY BINTI MOHD ZAIN	B.E.HONS.(UTM) (ELECTRICAL,2006)	61173	IDA SYAFIZA BINTI MD ISA	B.E.HONS.(UTM) (ELECTRICAL-TELECOMMUNICATIONS, 2007)	61169	LEE HENG CHOONG	B.E.HONS.(MALAYA) (CHEMICAL,1978)
61129	PRATAP A/L CHILAPPAN	B.E.HONS.(UNIMAP) (ELECTRICAL SYSTEMS,2010)				60025	LIM POOI SHUEN	M.E.HONS.(NOTTINGHAM) (CHEMICAL WITH ENVIRONMENTAL,2012)
60659	RAMESH A/L RAMANAIDU	B.E.HONS.(UTM) (ELECTRICAL,2010)				60019	LOI TIEN FUN, ELIZABETH	M.E.HONS.(NOTTINGHAM) (CHEMICAL,2010)
						59912	LYDIA DUNDUN ANAK FRANCIS	B.E.HONS.(UKM) (CHEMICAL,2005) M.E.(UKM) (CHEMICAL,2007)

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60679	MANAL BINTI ISMAIL	B.E.HONS.(BRADFORD)(CHEMICAL,1999) P.HD.(UNI OF LONDON)(2006)	60000	HASIF BIN YAHAYA	B.E.HONS.(UPNM)(MECHANICAL,2011)	59994	MOHD NASIR BIN MAMAT	B.E.HONS.(UTM)(MECHANICAL-MATERIALS,2006)
60046	MISMISURAYA BINTI MEOR AHMAD	B.E.HONS.(UKM)(CHEMICAL,2006)	61132	HAZWAN BIN RAZAK	B.E.HONS.(MELBOURNE)(MECHANICAL & MANUFACTURING MANAGEMENT,2009)	60630	MOHD NAZIR BIN MAT NOR	B.E.HONS.(UTM)(MECHANICAL-AERONAUTICS,1999)
61133	MOHD SYAFIQ BIN NAWAWI	B.E.HONS.(MELBOURNE)(CHEMICAL,2008)	60678	HILMI BIN ABDULLAH	B.S.C.(KOREA UNI)(MECHANICAL,2008)	59945	MOHD NAZWAN BIN DZULKARNINE	B.E.HONS.(UTP)(MECHANICAL,2009)
59985	MUHAMMAD FARID BIN ABU BAKAR	B.E.HONS.(CURTIN)(CHEMICAL,2011)	59897	ISA BIN HALIM	B.E.HONS.(UITM)(MECHANICAL,2003) M.SC.(UITM)(MECHANICAL,2006) PHD.(UITM)(MECHANICAL)(2011)	60052	MOHD NURFADZLY BIN NAJAMUDIN	B.E.HONS.(UKM)(MECHANICAL,2006)
60671	MUHAMMAD SYUKRI BIN ABD RAHAMAN	B.E.HONS.(UTM)(CHEMICAL,2004)	59875	ISHAK BIN MOHAMED BASIR	B.E.HONS.(UTHM)(MECHANICAL,2008)	59975	MOHD RIZAL BIN SALLEH	ADV.DIP.(ITM)(MECHANICAL,1995)
61153	ROSIAH BINTI ROHANI	B.E.HONS.(UTM)(CHEMICAL,2003) M.E.(UTM)(CHEMICAL,2007) P.HD.(AUCKLAND)(CHEMICAL & MATERIALS,2013)	61139	JASANI @ CORNELIUS SHAPI	B.E.HONS.(SHEFFIELD)(MECHANICAL,1995)	61145	MOHD SABRI BIN AHMAD	B.E.HONS.(UTM)(MECHANICAL,2005)
60635	SAHARIZAL BIN ESMAIL	B.E.HONS.(UTM)(CHEMICAL,2003)	60003	JETFRED GERINA ANAK JOSEPH	B.E.HONS.(UMP)(MECHANICAL WITH MANUFACTURING,2008)	60684	MOHD SHAMSUL FARID BIN MOHD OMAR	B.E.HONS.(UTM)(MECHANICAL-MARINE TECHNOLOGY,2004)
61115	SARINA BINTI SULAIMAN	B.E.HONS.(UPM)(CHEMICAL,2004)	61219	JUHARI BIN AB RAZAK	B.S.C.(KANSAS)(MECHANICAL,1985) M.S.C.(SHEFFIELD)(ADVANCED ENGINEERING,1993)	60042	MOHD YUSRI BIN NAWI	B.E.HONS.(UPNM)(MECHANICAL,2012)
61187	SITI HAJAR BINTI OTHMAN	B.E.(VANDERBILT)(CHEMICAL & MATHEMATICS,2006) P.HD.(UPM)(CHEMICAL,2012)	60056	KHAIRUL FIKRI BIN TAMRIN	M.E.HONS.(LOUGHBOROUGH)(MECHANICAL,2008)	60024	MOHD YUSRI BIN YAHYA	B.E.HONS.(UTM)(MECHANICAL-MARINE TECHNOLOGY,2008)
59933	TAN HONG TAT	B.E.HONS.(UPM)(CHEMICAL,2009) M.SC.(UPM)(PROSESS,2012)	61154	KHOO ENG SHYUAN	B.E.HONS.(UNIMAP)(MECHANICAL,2012)	59940	MOHD ZAKI BIN ABDUL MANAF	B.E.HONS.(UTM)(MECHANICAL-AERONAUTIK,2008)
60028	TAN SU EM	M.E.HONS.(NOTTINGHAM)(CHEMICAL,2012)	59939	KOAY LOKE KEAN	B.E.HONS.(USM)(MECHANICAL,2009)	61148	MOKHTAR BIN AB MANAP	B.E.HONS.(UTM)(MECHANICAL,2007)
60026	TAN XHEN JUN	B.E.HONS.(UTAR)(CHEMICAL,2012)	59973	LAU YIN HOCK, KENNY	B.E.(SWINBURNE)(MECHANICAL,2010)	59873	MUHAMMAD AIZUDDIN BIN RUSDI	B.E.HONS.(UTP)(MECHANICAL,2009)
61180	UMI FAZARA BINTI MD ALI	B.E.HONS.(MALAYA)(CHEMICAL,2003) M.E.SCIENCE(MALAYA)(CHEMICAL,2006)	59972	LEE YEN YIH	B.S.C.(OHIO STATE)(MECHANICAL,2005)	59925	MUHAMMAD AMIN BIN HARUN	B.E.HONS.(KUITTHO)(MECHANICAL,2003)
60647	WONG SHIK YEE	B.E.HONS.(UKM)(CHEMICAL,2007)	60022	LIM MUN CHUN	B.E.HONS.(UCS)(MECHANICAL,2012)	60043	MUHAMMAD FADZLI	B.E.HONS.(UPNM)(MECHANICAL,2012)
<b>KEJURUTERAAN KOMPUTER</b>			59958	LOH KEIN YIP	B.E.HONS.(MONASH)(MECHANICAL,2012)	60015	MUHAMMAD HAFIZ BIN AFRAIZAL	B.E.HONS.(KUITTHO)(MECHANICAL,2006)
60049	MUHAMMAD ABDUL RASYID BIN SAFIE	B.E.HONS.(UTM)(COMPUTER,2010)	59987	MOGANA DAS A/L PHILOMEN SIMON BENEDIC	B.E.HONS.(UTAR)(MECHANICAL,2012)	60036	MUHAMMAD MUBASYIR BIN HUSNI	B.E.HONS.(UPNM)(MECHANICAL,2012)
<b>KEJURUTERAAN MEKANIKAL</b>			60044	MOHAMAD AFFIQ BIN JOHARI	B.E.HONS.(UPNM)(MECHANICAL,2012)	60041	MUHAMMAD SAHRIZAN BIN MD SALLEH	B.E.HONS.(UPNM)(MECHANICAL,2012)
61112	AAINA ATHIRAH BINTI ABD RAHMAN	M.E.HONS.(LIVERPOOL)(ELECTRICAL & ELECTRONIC,2009)	60037	MOHAMAD AMIRUL HUSNI BIN RATZUAN	B.E.HONS.(UPNM)(MECHANICAL,2012)	59999	NASRUL IZAN BIN SHAHRIN	B.E.HONS.(UTM)(MECHANICAL,2004)
61113	ABDULLAH AZIZ BIN SAAD	B.E.HONS.(USM)(MECHANICAL,2004) M.SC.(USM)(MECHANICAL,2007) P.HD.(NOTTINGHAM)(MECHANICAL,2012)	60680	MOHAMAD FAUZAN BIN MAT ISA	B.E.HONS.(UNITEN)(MECHANICAL,12)	61216	NOOR AZAMMI BIN ABDUL MURAT	B.E.HONS.(KUITTHO)(MECHANICAL,2002) M.SC.(UIAM)(AUTOMOTIVE,2012)
61197	ABDULLAH ZAWAWI BIN HASAN	B.E.HONS.(MALAYA)(MECHANICAL,1991)	60644	MOHAMAD FAZRIE BIN MAHADI	B.E.HONS.(UTEM)(MECHANICAL-STRUCTURE & MATERIAL,2010)	61215	NOR HISHAM BIN MOHAMED MAHAYUDIN	B.E.HONS.(UIAM)(MECHANICAL-AUTOMOTIVE,2011)
59872	AHMAD YUSRI BIN AHMAD YUSUF	B.E.HONS.(UTM)(MECHANICAL,2005)	59963	MOHAMAD KAMAL PASHA BIN AHMAD	B.E.HONS.(AUCKLAND)(MECHANICAL,2011)	60661	NOR MOHD IRSHAHRIN BIN NORDIN	B.E.HONS.(UTM)(MECHANICAL,2008)
59952	AHMAD ZHAFFRAN BIN AHMAD MAZLAN	B.E.(WASEDA UNI)(MECHANICAL,2008) M.SC.(USM)(MECHANICAL,2013)	60654	MOHAMAD NAJIB BIN MOHAMAD NOR AZLI	B.E.HONS.(UTM)(MECHANICAL-MARINE TECHNOLOGY,2010)	60051	NORAZHAR BIN ALI	B.E.HONS.(UTeM)(MANUFACTURING-MANUFACTURING PROCESSES,2006)
60676	AJAY KUMAR SHARMA	B.S.C.(HANYANG)(MECHANICAL,2010)	59882	MOHAMAD NAZRI BIN ISMAIL	B.S.C.HONS.(UTM)(MECHANICAL,1997)	61191	NURUL MISBAH BINTI BADRUL HISHAM	B.E.HONS.(UPNM)(MECHANICAL,2012)
60038	AMIRUL FAIZ BIN KAMARUDDIN	B.E.HONS.(UPNM)(MECHANICAL,2012)	59876	MOHAMAD SHAHRIL BIN IBRAHIM	B.E.HONS.(UTM)(MECHANICAL,2002)	61162	NURULAIN BINTI MARJONO	B.E.HONS.(UTP)(MECHANICAL,2009)
59870	ASHIRAN BIN HAMID	B.E.HONS.(UTP)(MECHANICAL,2010)	61217	MOHAMMAD EDILAN BIN MUSTAFFA	B.E.HONS.(UTM)(MECHANICAL,1999) M.S.C.(UIAM)(AUTOMOTIVE,2012)	60674	PUA CHEE YONG	B.E.HONS.(UPM)(MECHANICAL,2002)
61218	ASRUL SYAHARANI BIN YUSOF	B.E.HONS.(USM)(MECHANICAL,1999) M.SC.(UIAM)(AUTOMOTIVE,2012)	60040	MOHAMMAD KHAIRUL AKMAL BIN RAMLI	B.E.HONS.(UPNM)(MECHANICAL,2012)	61167	RADHA KRISHNAN A/L PONNAN	B.E.HONS.(UPM)(MECHANICAL,2008) M.E.(UPM)(EMERGENCY RESPONSES & PLANNING,2011)
59866	ASWAD BIN MOHD NASIR	B.E.HONS.(MALAYA)(MECHANICAL,2012)	59887	MOHAMMAD RASYIDI BIN YUSOF	B.S.C.HONS.(UTM)(MECHANICAL,1997)	59867	RAMESH A/L ANNAMALAI	B.E.HONS.(MMU)(MECHANICAL,2011)
61178	CHAN KENG WAI	B.E.HONS.(USM)(MECHANICAL,2006) P.HD.(OXFORD)(ENGINEERING SCIENCE,2011)	59951	MOHAMMADREZA HASSAN	B.S.C.(ISFAHAN UNI)(MECHANICAL,1998) M.E.(MALAYA)(MECHANICAL,2013)	61121	ROSILZAM BIN JAPAR @ JAAFAR	B.E.HONS.(UNITEN)(MECHANICAL,2001)
60666	CHIONG CHUNG JIN	B.E.HONS.(MMU)(MECHANICAL,2010)	60001	MOHD AFANDI BIN IDRIS	B.E.HONS.(UTM)(MECHANICAL,2001)	59881	RUSLAN BIN ABDUL JALIL	B.E.HONS.(KUITTHO)(MECHANICAL,2003) M.E.(UKM)(MANUFACTURING SYSTEMS,2012)
61189	CHONG JEE FATT	B.E.HONS.(UNITEN)(MECHANICAL,2006) M.E.(UNITEN)(MECHANICAL,2012)	60645	MOHD AIZUL AZRI BIN MOHD YUSOFF	B.E.HONS.(UNITEN)(MECHANICAL,2012)	59869	SYAMSULARIFFIN BIN KAMARUDIN	B.E.HONS.(UITM)(MECHANICAL,2008)
59998	CHONG KOK CHUNG	B.E.HONS.(UTAR)(MECHANICAL,2009)	59986	MOHD AMINSANI BIN MOHD RAMLI	B.E.HONS.(UIAM)(MECHANICAL-AUTOMATIVE,2009)	59865	TAN CHUN WEI	B.E.HONS.(MALAYA)(MECHANICAL,2005)
61166	CHONG THIAM HENG	B.E.HONS.(LEEDS)(MECHANICAL,2004)	60662	MOHD ARATAH BIN ABDUL LATIF	B.E.HONS.(UTHM)(MECHANICAL-MANUFACTURING & PRODUCTION,2007)	59953	TAN YONG WAI	B.E.(SWINBURNE)(MECHANICAL,2010)
61192	CHUAH KENG HOO	B.S.C.(KENTUCKY)(MECHANICAL,1997) M.SC.(KENTUCKY)(MECHANICAL,2000) P.HD.(KENTUCKY)(MECHANICAL,2004)	60640	MOHD AZIZI BIN MAT HUSIN	B.E.HONS.(UTM)(MECHANICAL,2008)	61184	TANG HOWE HING	B.E.HONS.(UTM)(MECHANICAL,2002) M.E.(UTM)(MECHANICAL,2005) P.HD.(NEW SOUTH WALES)(ELECTRICAL,2010)
59979	CHUNG YONG HAN	M.E.HONS.(NOTTINGHAM)(MECHANICAL,2012)	60637	MOHD AZRIN BIN MOHD SAID	B.E.HONS.(UNIMAS)(MECHANICAL & MANUFACTURING,2009) M.E.(JPM)(MANUFACTURING SYSTEMS,2012)	60005	TEE CHIN WEE	B.E.HONS.(UTEM)(MECHANICAL-STRUCTURE & MATERIAL,2012)
60008	FATIMAH BINTI MD RADZAI	B.E.HONS.(UTP)(MECHANICAL,2010) M.E.(UTeM)(MANUFACTURING-INDUSTRIAL,2012)	61144	MOHD FAISAL BIN DERASID	B.E.HONS.(UTHM)(MECHANICAL,2012)	60657	TEH WI HOONG	M.E.HONS.(SOUTHAMPTON)(MECHANICAL-ADVANCED MATERIALS,2010)
59907	GERALD VICTOR A/L RICHARD JOSEPH	B.E.HONS.(UTM)(MECHANICAL,1992) M.E.(UKM)(MANUFACTURING SYSTEMS,2005)	61140	MOHD FAIZAL NURHAKIM BIN MOHD ESAH	B.E.HONS.(UTHM)(MECHANICAL,2011)	61185	THAM KAM HON	B.E.HONS.(BRADFORD)(MECHANICAL,2002) M.SC.(NUS)(BUILDING SCIENCE,2008)
			60039	MOHD FIRDAUS BIN SAIDI	B.E.HONS.(UPNM)(MECHANICAL,2012)	59961	TING HOCK SENG, PAUL	B.E.HONS.(NEW SOUTH WALES)(MECHANICAL,2006)
			59962	MOHD HAIRI HAFIEZIE BIN AB HADI	B.E.HONS.(AUCKLAND)(MECHANICAL,2012)	60053	VIJAYAN BATU MALAY	B.E.HONS.(UNISEL)(MECHANICAL,2012)
			61131	MOHD HAZWAN BIN HASSIM	B.E.HONS.(UTM)(MECHANICAL-MARINE TECHNOLOGY,2010)	60651	WAN MOHD ASYRAF BIN WAN IKHRAM ZAKI	B.E.HONS.(UTM)(MECHANICAL-MARINE TECHNOLOGY,2011)

## KEAHLIAN / DANA BANGUNAN

61174	WONG SUNG TIN	B.E.HONS.(UMS) (MECHANICAL,2012)
59957	WONG TIONG HUA, JOSHUA	M.E.HONS.(BIRMINGHAM) (MECHANICAL,2010)
60675	YEN MUN WAH	B.SC.(HANYANG) (MECHANICAL,2010)
59960	ZAQUAN BIN ALIZAN	B.E.HONS.(WESTERN AUSTRALIA) (MECHANICAL,2011)
61120	ZULFADLI BIN MOHD JAIS	B.E.(NIIGATA) (MECHANICAL & PRODUCTION,2010)
59974	ZULKEFLIE BIN ABDULLAH	B.E.(WESTERN ONTARIO) (MECHANICAL,1998) M.E.(UTM)(MECHANICAL- ADVANCED MANUFACTURING,2003)
60010	ZURINA BINTI SHAMSUDIN	B.E.HONS.(UKM) (MECHANICAL,2001)

KEJURUTERAAN MEKATRONIK		
59997	TUNG CHANG WEI	B.E.HONS.(UTAR) (MECHATRONICS,2012)

KEJURUTERAAN PEMBUATAN		
60013	FATIMAH BINTI MUHAMAD	B.E.HONS.(UIAM) (MANUFACTURING,2012)
60632	HAW PEI LI	B.E.HONS.(UKM) (MANUFACTURING,2004) M.SC.(UKM) (MECHANICAL & MATERIALS,2012)
60047	MUNIRA BINTI MOHAMED NAZARI	B.E.HONS.(UTEM) (MANUFACTURING- MANUFACTURING DESIGN,2008)
59868	ZAID UZAIR SERANNA BIN MOHD IKHAS	B.E.HONS.(IIUC) (MANUFACTURING,2008)

PERMOHONAN MENJADI AHLI 'INCORPORATED'		
No. Ahli	Nama	Kelayakan
KEJURUTERAAN MEKANIKAL		
60087	KALDIP SINGH A/L RAYAPPAN	B.SC.(ATLANTIC INT. UNI) (MECHANICAL,2003)
61200	MOHD FAIZAL BIN RAZALI	B.E.(COVENTRY) (MECHANICAL,2011)

PERMOHONAN MENJADI AHLI 'ASSOCIATE'		
No. Ahli	Nama	Kelayakan
KEJURUTERAAN MEKANIKAL		
60057	CHARANJIT SINGH @ BALBIR JR A/L BALBIR SINGH	HND(HUDDERSFIELD) (MECHANICAL & MANUFACTURING,2002)

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RM 2,318,636.70 from  
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(ANOTHER RM 9,189,861.30 IS NEEDED)

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### SENARAI PENDERMA KEPADA WISMA DANA BANGUNAN IEM

Institusi mengucapkan terima kasih kepada semua yang telah memberikan sumbangan kepada tabung Bangunan Wisma IEM. Ahli-ahli IEM dan pembaca yang ingin memberikan sumbangan boleh berbuat demikian dengan memuat turun borang di laman web IEM <http://www.myiem.org.my> atau menghubungi secretariat di +603-7968 4001/5518 untuk maklumat lanjut. Senarai penyumbang untuk bulan Julai 2013 adalah seperti jadual di bawah.

NO.	NO. AHLI	NAMA
1	29597	KANAISAN A/L KARUPIAH
2	10857	ANHAR BIN ANUAR
3	11296	ANUAR BIN LAZIM
4	12196	AZMAN BIN MOHD
5	11946	CHEW YEE CHUAN
6	20086	CHIN TSHUN VUI
7	53588	CLARE YVONNE ANAK REHEN
8	42457	FADHLI BIN ABDULLAH
9	39078	GEORGE JR G J KIMSIN
10	28163	HAIRUL FAHMY BIN ITHNIN
11	24835	HISHAM BIN ABD GHAFFUR
12	10261	HO KEN VUI, WILLIAM
13	18403	LAI CHI KIN
14	21581	LAW YAN CHEE
15	27628	MITHIRENDRA MANIAM

NO.	NO. AHLI	NAMA
16	06538	MOHAMED YAKUB BIN ISMAIL
17	54020	MOHD ARZAHRI BIN ABD RAHMAN
18	30245	MOHD SHAHAR BIN SULAIMAN
19	23175	MOHD SUHAIMI BIN HUSIN
20	41332	MUAMMAR GADAFI HAIRUDIN
21	25276	MUHAMMAD FARID BIN ZULKIPLI
22	09603	NG CHAI MING
23	28208	NURAZZURA BINTI MOHD FUZI
24	26743	PATHMANATHAN A/L KRISHNAN KUTTY RAMAN NAIR
25	29143	QUIRINE @ QUIRINUS JOKINOL
26	22489	SHAMSUHAIME BIN AHMAD
27	16773	SYED ABDUL RAHMAN BIN SYED ABDULLAH
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# MiTS 1.4

## MES Infra Integrated Total Solution

### MSMA 2 Workshop:

Main Speaker: Prof. Dr. Nor Azazi Zakaria

Fee: RM 500/person (RM 100 discount for early bird)

Topics: Design Rainfall, Runoff Estimation, OSD Design, Detention Pond Design

Our next locations are:-



#### Johor Workshop

Date: 02 & 03 September 2013

Venue : Hotel Selesa, Johor Bahru.  
Early Bird Validity Until 23rd Aug

#### Sabah Workshop

Date: 30 Sept & 01 Oct 2013

Venue : The Palace Hotel, K. Kinabalu.  
Early Bird Validity Until 17th Sept

#### Penang 3 days on-site Workshop

Date: to be confirmed

Venue : USM Engineering Campus,  
Nibong Tebal.

Kindly contact us for more information regarding the workshop



Director of REDAC, Prof. Dr. Nor Azazi Zakaria was delivering a topic entitled "An Overview of MSMA 2nd Edition".

Prof. Dr. Nor Azazi (Director of REDAC) & Mr. Bryan Ewe Teik Tsia (Director of MES) presented lucky draw prize (free MSMA2 software) to the participant.



Overwhelming support from C&S consultants from Kuala Lumpur and Selangor



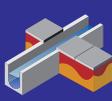
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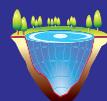
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Contact person Mr Bryan Ewe at 016 - 338 4033 ([bryanewe@mes100.com](mailto:bryanewe@mes100.com))

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# Infravera

## URoad V1.0



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