PROFESSIONAL
COMPE TENCY
EXAMINATION
INFORMATION FOR APPLICANTS
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1. INTRODUCTION

In line with the Registration of Engineers Act 1967 (Revised 2015), only registered Professional Engineers with a Practising Certificate can submit engineering plans to Local Authorities. In order to apply for a Practising Certificate, Professional Engineers must sit and pass the Professional Competency Examination (PCE) in their relevant branch of practice.

Presently, the PCE for the following branches of practice for the construction industry are in place:

- Civil engineering
- Mechanical engineering
- Electrical engineering
- Chemical engineering

Candidates who want to sit for other branches of practice need to write to the Board of Engineers Malaysia (BEM) to prepare PCE for these other branches of practice.

On passing the Professional Competency Examination, the candidate may apply to be registered as a Professional Engineer with a Practising Certificate.

This document is issued by the Board of Engineers Malaysia as information for Professional Engineers to prepare for the Professional Competency Examination.

2. AIMS OF THE PROFESSIONAL COMPETENCY EXAMINATION

The Professional Competency Examination will test the candidates within the limits of “professional engineering services” as defined in the Registration of Engineers Act 1967.

The examination will also test the candidate's knowledge, experience and application of:

(a) Regulations and rules of engineering practice by BEM
(b) Statutory laws, codes, regulations
(c) Standards of professionalism and ethical behaviour imposed by BEM
3. THE PROFESSIONAL COMPETENCY EXAMINATION

The Professional Competency Examination is conducted by the Board of Engineers Malaysia pursuant to Section 38A of the Registration of Engineers Act 1967 (Revised 2015).

The Board shall appoint an Examination Panel, consisting of such members from amongst the registered Professional Engineers to assist in conducting the Examination.

4. ELIGIBILITY TO SIT FOR THE EXAMINATION

Professional Engineers wishing to sit for the Professional Competency Examination (PCE) shall apply to the Board of Engineers Malaysia by completing the BEM Form PCE-A.

Eligible candidates for the examination must be Professional Engineers registered with the Board in the appropriate disciplines.

On approval of the candidate’s application by the Board, the candidate is allowed to sit for the examination.

5. FEE TO SIT FOR THE EXAMINATION

**First Time Candidate**

The fee to sit for the Professional Competency Examination is RM1,000.00 with an additional fee of RM100.00 (non-refundable) as processing fee.

**RE-SIT candidate**

The fee re-sit for the Professional Competency Examination is RM500.00 for each papers taken with an additional fee of RM100.00 (non-refundable) as processing fee.

6. DATE OF EXAMINATION

The Professional Competency Examination will be held on **29th - 30th November 2017**.
7. EXAMINATION VENUE

The examination centre will be in Kuala Lumpur. Candidates whose application have been approved will be duly informed of the final location not later than two (2) weeks before the examination.

8. APPLICATION FORM

Application forms are obtainable from the office of the Board or may be downloaded from the Board's website at http://www.bem.org.my.

All applications are to be submitted to the Board with the application fees and complete documents.

The CLOSING DATE for application is 30TH OCTOBER 2017.

Applicants would be informed of the status of his/her application by post within one month after the application date.

9. FINAL RESULTS AND NOTIFICATION

- Candidates for the examination will be notified of their results four months after the examination date.
- Examination results will be given to candidates on a Pass/Fail basis by post.
- No examination scores or marks will be given to the candidates.

10. EXAMINATION APPEALS

A candidate who fails the examination may submit a written appeal to review his/her performance together with a payment of RM400.00. The appeal is to be made within two (2) weeks after the receipt of the results. Late appeals will not be entertained. The result of the appeal will be sent by written mail to the appeal candidate. The findings of the appeal by the BEM will be final. No further appeal will be allowed.

11. COURSES FOR THE EXAMINATION

The Board does not endorse any course conducted or provide material as study aids for the examination.
12. REFUND OF EXAMINATION FEES

When the applicant has been accepted but is unable to sit for the examination subsequently, the Board may, at its discretion, refund RM500.00 to the applicant if the applicant informs the Board at least two weeks before the examination or submit a medical certificate within two weeks after the examination.

There will be no refund if the applicant informs the Board less than two weeks before the examination date.

13. NO SHOW BY THE CANDIDATES FOR THE EXAMINATION

Candidates who do not attend the examination sitting for whatever reasons will be marked as “No Show”. Their examination fees will be forfeited and no refund or credit will be transferred for the next sitting.

14. IDENTIFICATION OF THE CANDIDATES AT THE EXAMINATION CENTRE

Candidates sitting for the examination must bring along identification documents for inspection at the examination centre. The identification documents for local candidates shall be their identity cards while for foreign candidates, it shall be their passports.

15. FORMAT OF THE EXAMINATION PAPERS IN THE VARIOUS DISCIPLINES

The Examination is an open book examination and shall be in two parts: Part A and Part B.

A candidate must pass both Part A and B in order to pass the whole examination.

A candidate at his/her first sitting must sit for both Part A and B together.

Subsequently, a candidate who has failed Part B but passed Part A is allowed to sit for Part B only but within the following three years.

In the event of failure in Part B in the following three years, the applicant has to re-sit the whole examination again. This ruling will be similarly applied to the case when an applicant has passed Part B but failed Part A.

The syllabus for the examination in the various disciplines are provided in Appendices A-E.
The Part A and Part B of the examination are as follows:

### Part A

Common paper to be taken by all candidates, which will be non-technical in nature but will test the candidates’ knowledge on laws governing the profession, the responsibility of a professional towards the general public and standards of professionalism and ethical behaviour.

There are two papers for this Part i.e. Paper 1 and Paper 2. Candidates must pass both papers at one sitting.

| Common Paper 1 | 40 objective questions to be answered in 1.5 hours  
|                | Passing mark is 50% |
| Common Paper 2 | 5 long/essay questions of which 3 are to be answered in 2 hours  
|                | Passing mark is 50% |

### Part B

This will be the technical paper which shall be on civil & structural, mechanical and electrical engineering. Candidates shall sit for the paper in the relevant subject which they wish to practice. The Examination shall test the candidates’ competency within his/her respective field of practice.

There are two papers for this Part i.e. Paper 1 and Paper 2. Candidates must pass both papers at one sitting.

| Civil Paper 1 | 40 objective questions to be answered in 1.5 hours  
|               | Passing mark is 50% |
| Civil Paper 2 | 5 long/essay questions of which 3 are to be answered in 2 hours  
|               | Passing mark is 50% |
| Mechanical Paper 1 | 40 objective questions to be answered in 1.5 hours  
|                   | Passing mark is 50% |
| Mechanical Paper 2 | 5 long/essay questions of which 3 are to be answered in 2 hours  
<p>|                    | Passing mark is 50% |</p>
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| **Electrical Paper 1**| - 40 objective questions to be answered in 1.5 hours
|                       | - Passing mark is 50%                                                  |
| **Electrical Paper 2**| - 5 long/essay questions of which 3 are to be answered in 2 hours     |
|                       | - Passing mark is 50%                                                  |
| **Chemical Paper 1**  | - 40 objective questions to be answered in 1.5 hours                  |
|                       | - Passing mark is 50%                                                  |
| **Chemical Paper 2**  | - 5 long/essay questions of which 3 are to be answered in 2 hours     |
|                       | - Passing mark is 50%                                                  |
COMMON PAPER SYLLABUS

Laws and regulations governing the engineering profession in Malaysia

(i) The Registration of Engineers Act 1967 (Revised 2015)
(ii) The Registration of Engineers Regulations 1990 on the following items:
   - The procedural and legal aspects of the Letter of Release in case of termination of professional services,
   - Professional conduct and
   - Methods of dispute resolution between the Professional and his client e.g. by arbitration, mediation/conciliation, adjudication etc.

1. Engineer’s responsibility to society and to the public

(i) An introductory knowledge on the following areas:
   - Common laws as practised in Malaysia
   - Awareness of legal issues such as the various categories of law, classification of law, sources of Malaysian Law etc.
   - Understanding the hierarchy of the Malaysian courts and their different jurisdictions
   - “Civil law’ and basic concepts of ‘Torts’ other than mere negligence for misrepresentation, defamation, nuisance etc.
   - Where the professional owes a duty of care, standard level of expertise and due diligence expected under tort laws for requirements of UBBL, local authorities and Certificate of Completion and Compliance (CCC) / Certificate of Fitness of Occupation (CFO) / Occupation Certificate (OC) / Occupation Permit (OP) to the public.
   - Awareness of the professional design liability for his work with the following factors:
     - Risks and factors of safety and codes of practice
     - Limitation Act
     - Difference of liability based on “reasonable skill and care” and “fit for purpose.”

(ii) A reasonable understanding of professional responsibility pertaining to duty of care and due diligence to the Client under contractual and tortuous relationship.
2. **Professionalism**

   (i) Professionalism with respect to basic concepts of (1) public interest (2) fiduciary interest to the client and public (3) professional conduct and (4) expert knowledge.

   (ii) Code of professional conduct (The Registration of Engineers Regulations 1990)

   (iii) Common professional practice issues:

      ▪ Statutory responsibilities of a Submitting Engineer under the UBBL Street & Drainage Act / Sarawak/Sabah Building Ordinance (SBO)

      ▪ Supplanting and taking over

      ▪ Certificate of Completion and Compliance (CCC) / Certificate of Fitness of Occupation (CFO) / Occupation Certificate (OC) / Occupation Permit (OP) submission and the responsibilities thereof.

      ▪ Personal performance by a consulting engineer (no “subcontracting” of his assignment)

      ▪ The duties and responsibilities arising from endorsing a design or a document as a Professional Engineer.

3. **Knowledge of laws having relevance**

   A basic knowledge of laws having relevance to the practice of civil and structural, mechanical or electrical engineering, as applicable to the discipline of the practice. Basic knowledge should only cover the function and aim of the particular law that has relevance to a Professional Engineer’s practice.

   - Local Council Act
   - Town Planning Act
   - Street, Drainage & Building Act and the Uniform Building By Law (for candidates in Sabah or Sarawak the appropriate Building Acts shall be referred to)
   - Fire Services Act – Guide to Fire Protection in Malaysia
   - Environmental Quality Act
   - The Electricity Supply Act
   - The Gas Supply Act
   - The CIDB Act
   - The Construction Industry Payment and Adjudication Act (CIPAA)
   - The Energy Commission Act
   - OSH Act – MS1722 Occupational Safety and Health Management System
   - Factory and Machinery Act
   - Water Services Industry Act 2006
4. Knowledge of Contract Laws in Malaysia with respect to the construction industry

(i) Basic concept of common law as practiced in Malaysia.
   • Introduction to Contract Law;
   • Offer and Acceptance
   • Considerations
   • Intention to create a legal relationship
   • Legal capacity
   • Formalities
   • Conditions when contract is void and voidable.
   • Conditions when contract is unenforceable
   • Privity of Contract

(ii) Various types of construction contracts:
   • Direct contract
   • Nominated sub contract
   • Direct sub contract
   • Turnkey contract for design and build
   • PAM 1998 and PAM 2006 Main Contract Form
   • JKR 203 Main Contract Form
   • JKR Design and Build Contract
   • FIDIC Contract Form

(iii) Issues relating to construction contracts
   • Functions of Memorandum of Understanding, Letter of Intent, Letter of Acceptance etc.
   • Remedies for breach of contract
   • Dispute resolution and arbitration

(iv) Understanding the duties and responsibilities of the different roles of a professional engineer as:
   • Consultant
   • Site Agent
   • Superintending Officer
   • Adjudicator

(v) The consultancy agreement with the client
5. An in-depth knowledge of the functions of the consulting engineer during the various stages of project implementation in accordance with BEM Model Form of Agreement.

(i) Feasibility and preliminary stage
(ii) Design stage I
(iii) Design stage II
(iv) Tender stage
(v) Construction stage
(vi) Post construction stage

6. Management of Engineering Consultancy Practice

(i) Good governance practice in accordance with the Companies Act and Regulations.
(ii) Awareness of the implications of the penalties involved for violation of the intellectual property.
(iii) Methods of charging professional fees and reimbursable items to the client for services rendered in accordance with the revised BEM Scale of Fees.
(iv) Basic knowledge of local labour laws.
The candidates who are sitting for the Civil Engineering are expected to have sufficient knowledge and understanding of the latest relevant Acts, Regulations, By-Laws, Standards, Codes of Practices, good engineering practices in Malaysia. There will be questions set on the application of engineering judgement and solving engineering issues in the local practice.

1. Civil engineering practice in Malaysia

Proficiency and good working knowledge and experience of Civil engineering practice in Malaysia covering general matter, geotechnical works, structural works and civil works as follows:

(A) GENERAL MATTER

(A1) Procurement & Contract (Pre and Post) administration

(A2) Regulatory practice and submission procedure for civil engineers

(a) "Street, Drainage & Building Act" and the Uniform Building By Law Malaysia (UBBL) where it pertains to the civil engineer as:
   (i) submitting engineer for purely civil works; and
   (ii) submitting engineer for structural works.

(b) Earth Works By-Laws

(c) Submission procedures for planning approval, building plan and relevant Form Gs and Form F for Certificate for Completion and as:
   (i) submitting engineer for purely civil works; and
   (ii) submitting engineer for structural works.

(d) Fire Services Act where it pertains to Civil engineer submission.

(e) Environmental Quality Act introductory level and only on those sections of the Act (or regulations) dealing with scheduled waste discharge and air quality.

(B) GEOTECHNICAL WORKS

(B1) Soil Investigation Works

(a) Planning of subsurface investigation field works and sampling
   • For filling (embankment or platform) in soft ground.
   • For cut and fill in hill-site development and roadworks on hilly terrain.
   • For earthworks and foundation (cut and fill) on good flat ground.
   • For foundation design (shallow and deep foundation) in soft ground.
• For foundation design on hill-site.
• For foundation design in limestone area.

(b) Planning of laboratory testing and interpretation of results
   (i) Types of laboratory tests for items listed in B2 (a) above.
   (ii) Interpretation of laboratory tests for necessary soil and rock design parameters for items listed above.

(B2) Earthworks
   (a) General Earthworks
      (i) Determination of materials (acceptable materials vs unsuitable materials for filling or excavation).
      (ii) Compaction requirements.
      (iii) Construction control of filling at site (e.g. loose thickness, testing, filling layer by layer, no tipping etc.).
      (iv) Construction control of cutting at site (e.g. to cut from top, to turf within certain time, etc.).
      (v) Erosion, sediment, control plan (ESCP).

   (b) Design of Earthworks for hill-site
      (i) Selection of subsoil and rock parameters for analysis (e.g. shear strength, groundwater levels, etc.).
      (ii) Analysis and design of slope stability for cut and fill (e.g. type of analysis and factor of safety, etc.).
      (iii) Slope stabilization system.
      (iv) Earth retaining structure.

   (c) Design of Filling / Embankment on Soft Ground
      (i) Selection of subsoil parameters for analysis (e.g. shear strength, stiffness and consolidation parameters).
      (ii) Analysis and design of slope stability for fill/embankment.
      (iii) Settlement analysis (e.g. immediate settlement, consolidation settlement, secondary compression, etc.).
      (iv) Ground treatment selection.
      (v) Ground treatment analysis and design (commonly used vertical drains, geotextile, surcharging, etc.).

(C) STRUCTURAL WORKS

   (C1) Statutory requirements for Structure by UBBL
      (a) Loading requirements.
      (b) Fire resistance requirements.

   (C2) Structural Analysis
      (a) Wind loading.
      (b) Sub-frame analysis.
(c) Moment distribution analysis.
(d) Lateral earth pressure.

(C3) Foundation Design
(a) Pad and strip footings.
(b) Raft foundation.
(c) Pile cap - bending and truss analogy.
(d) Design of different types of piles.
(e) Design of earth retaining walls and basement walls.
(f) Design of sheet pile wall and other types of wall for basement construction.

(C4) Reinforced Concrete Design
(a) Beam design - flexure, shear, span/depth ratios, crack width, curtailments, laps etc.
(b) Solid slab design - flexure, shear, span/depth ratios, curtailments, laps, etc.
(c) Flat slab design (with and without column head).
(d) Rectangular and circular column design - short and slender.
(e) Design of walls - braced and unbraced.

(C5) Prestressed Concrete
(a) Single and multispans slab and beam design for both ultimate limit state and serviceability state.
(b) Prestressed concrete bridge beams (I, M, T, U and box beams).
(c) Prestressing strands – Creep, shrinkage, frictional losses, curvature, etc.

(C6) Water Retaining Structure
(a) Slab and wall design subject to hydrostatic forces.
(b) Crack width control calculation.

(C7) Structural Steel Design
(a) Beam section design.
(b) Column section design.
(c) Steel truss and frame analysis and design.
(d) Connection design by welding and bolting.
(e) Protective coating.
(f) Welding.

(C8) Composite Steel Design
- Concrete slab and steel beam design.
CIVIL WORKS

(D1) Water supply design to SPAN Guidelines
   (a) External water supply for housing and building development.
   (b) Water demand calculations.
   (c) Pipe network analysis.
   (d) Hydraulics calculations.

(D2) Sewerage Design
   (a) External sewerage for housing and building development.
   (b) Population equivalent calculations.
   (c) Sewer network calculations.
   (d) Sewerage treatment plant design.
   (e) Pumping station.

(D3) Road and highway designs
   (a) Design to JKR Arahan Teknik
      (i) Horizontal and vertical curves for road alignment.
      (ii) Acceleration, deceleration lanes and junction design.
      (iii) Superelevation design.
      (iv) Areas & volumes for cuttings and embankments for earthworks.
      (v) Road pavement design.
      (vi) Road signboard and marking.

(D4) Drainage design
   (a) Design to Manual Baru Saliran Mesra Alam Malaysia (MSMA):
      (i) Hydrologic design
         • Estimation of Design Rainstorm.
      (ii) Runoff Quantity Controls
         • Detention.
         • Retention.
         • Rain Water Harvesting.
      (iii) Runoff Conveyance
         • Roof and property drainage.
         • Open drains.
         • Pipe drains.
         • Culverts and bridge crossings.
      (iv) Runoff Quality Controls
         • Erosion and sediment control plans (ESCP).
         • Gross pollutant trap.
         • Oil separators.

(b) Pumped Drainage

(c) Sub-Soil Drainage
1. Air Conditioning and Ventilation System

(a) Relevant Regulations
   (a) Uniform Building By-Laws, 1984 / Sarawak Building Ordinance, 1994
   (b) Certificate of Completion and Compliance / Certificate of Fitness for Occupation / Occupation Certificate / Occupation Permit
   (c) Environmental Quality (Refrigerant Management) Regulations

(b) Applicable Standards
   (a) ASHRAE Standards
   (b) MS 1525 : Code of Practice on Energy Efficiency & Renewable Energy for Non Residential Buildings
   (c) MS 1472 : Smoke Control in Protected Escape Routes using Pressurization
   (d) MS 1780 : Smoke Control using Natural (Displacement) or Powered (Extracted) Ventilation
   (e) MS 2586-7 : Smoke duct sections
   (f) MS 2449 : Performance rating of water-chilling packages using the vapour compression cycle
   (g) MS 2578-2 : Cooling tower

(c) Type of Systems and Local Applications
   (a) Air-cooled Split Systems
   (b) VRF Systems
   (c) Package Units – Air-cooled & Water-cooled
   (d) Centralized Chilled Water Systems
   (e) District cooling systems

(d) Design Considerations
   (a) Design Parameters – Temperatures, Air movement etc.
   (b) Overall Thermal Transfer Value (OTTV)
   (c) Roof Thermal Transfer Value (RTTV)
   (d) Energy Efficiency & Building Energy Intensity
   (e) Sustainability and Green Building Index
2. Fire Protection

(i) Relevant Regulations
   (i) Uniform Building By-Laws, 1984 / Sarawak Building Ordinance, 1994
   (ii) Fire Services Act, 1988
   (iii) Fire Services (Designated Premises) Order 1998
   (iv) Fire Services (Fire Certificate) Regulations, 2001
   (v) Certificate of Completion & Compliance / Certificate of Fitness for Occupation / Occupation Certificate / Occupation Permit

(ii) Applicable Standards
   (a) MS 1489 : Hydrant Systems, Hose Reels and Foam Inlets
   (b) MS 1539 : Portable Fire Extinguishers
   (c) MS 1745 : Fire Alarm and Detection Systems
   (d) MS 1910 : Automatic Sprinkler Systems
   (e) MS 1590 : Carbon Dioxide Extinguishing Systems
   (f) Environmental Quality (Halon Management) Regulations 1999

(iii) Fire Safety Requirements
   (a) Type of occupancy and purpose groups
   (b) Fire safety systems for different purpose groups
   (c) Limits of compartmentation in buildings
   (d) Firefighting systems required for various types of buildings

(iv) Design Considerations
   (a) Portable fire extinguishers
   (b) Hose reel systems
   (c) Dry riser systems
   (d) Wet riser systems
   (e) Automatic sprinkler systems
   (f) Gaseous extinguishing systems
   (g) Fire alarm and detection systems
   (h) Voice evacuation and firemen intercom systems
   (i) Emergency generating systems
   (j) Emergency lighting and exit signs
   (k) Fire lifts

(v) Local Practices
   (a) Design submission procedures to Jabatan Bomba dan Penyelamat Malaysia.
   (b) Documents required for application for inspection
   (c) Application of Forms C1, C2 and C3
3. Hydraulics

(i) Relevant Regulations
(a) Water Services Industry Act, 2006
(b) Water Services Industry (Water Reticulation and Plumbing) Rules
(c) Water Services Industry (Water Services Fees and Charges) Regulations
(d) SPAN Uniform Technical Guidelines
(e) Sabah Land Ordinance Water Supply Enactment 2003
(f) Water Service Regulations under the following Sarawak Act - JKR, LAKU & Water Boards for Sarawak
(g) Drainage, Sanitation and Sanitary Plumbing By-Laws, 1973
(h) Certificate of Completion & Compliance / Certificate of Fitness for Occupation / Occupation Certificate / Occupation Permit

(ii) Applicable Standards
(a) BS EN 6700: Water Supply for Domestic Use within Buildings
(b) MS 1402: Code of Practice for Sanitary Systems in Building

(iii) Design Considerations
(a) Cold water storage required
(b) Design pressures
(c) Water storage tanks
(d) Booster pumps
(e) Pump controls
(f) Sanitary plumbing systems
(g) Kitchen waste plumbing
(h) Hot Water Plumbing
(i) Metering

(iv) Local Practices
(a) Design submission procedures to water service licensees
(b) Design submission to local authorities for sanitary plumbing

4. Other Mechanical Systems
5. Gas Distribution

(i) Relevant Regulations
   (a) Gas Supply Regulations 1997

(ii) Applicable Standards
   (a) MS 830 : Code of Practice for Storage, Handling and Transportation of LPG
   (b) MS 930 : Code of Practice for the Installation of Fuel Gas Piping Systems and Appliances

6. Lifts and Escalators

(i) Relevant Regulations
   (a) Gas Supply Regulations 1997 Factory and Machinery (Electric Passenger and Goods Lift) Regulations 1967
   (b) Certificate of Completion & Compliance / Certificate of Fitness for Occupation / Occupation Certificate / Occupation Permit

(ii) Applicable Standards
   (a) BS 2655 : Specification for lifts, escalators, passenger conveyors and paternosters. General requirements for electric, hydraulic and hand powered lifts.
1. Regulatory Practice

(a) Registration of Engineers Act 1967 (Revised 2015)
   • A Guide to Good Engineering Practice for M&E Engineers

(b) Street, Drainage and Building Act (Act No 133)
   • Assume understanding of topics covered under “Common Paper”:
     ▪ Introduction and a general overview on function of the Act.
     ▪ ‘Principal Submitting Person’ and role of PSP
     ▪ UBBL as by-law under the Act
     ▪ Ministry and Government agency responsible.
     ▪ Street lighting

   • Role of Professional Engineer with Practising Certificate PEPC) Electrical in support of
     PSP’s duty and responsibilities.

(c) Uniform Building By-Law
   • Understanding of the topics covered under the “Common Paper”:
     ▪ UBBL as a uniform building design code for Peninsular Malaysia.
     ▪ Introduction to UBBL and general description of the various Parts of the UBBL
     ▪ Part VII – Fire Fighting. Understanding ‘life safety’ concept as prescribed in the
       UBBL (exit discharge, fire barriers/walls)
     ▪ Responsibilities of PEPC in the certification process of Certificate of Completion
       and Compliance issuance.

   • Lighting requirement
   • Requirements of MS 1525
   • Lightning Protection requirement to MS IEC62305
   • Lifts requirement
   • Part VII – Fire Fighting Requirement pertaining to purpose/hazard class for building,
     fire barriers, etc
   • Part VIII – Fire Protection System, Fire Alarm, Fire Detections, Emergency power,
     Power Isolation, etc.
(d) The Electricity Supply Act 1990 (Act 447) and Sarawak Electricity Ordinance (Chapter 50)
- Ministry and Government agency responsibilities
- Introduction to the Acts, Ordinance, Rules and Regulations, its function; Electrical safety, Regulator for electricity production, distribution and retail (licensing for IPPs, approval of tariffs, license premises, notification of accidents etc. electrical efficiency)
- Competent persons registered under the Act in the submission procedure
- Safety and 'control item' list under the Regulations.
- Other Regulations under the Act:
  - Efficient Management of Electrical Energy Regulations (2008);
  - Electricity Regulations 1994 (Peninsular Malaysia & Sabah);
  - Electricity Rules 1999 (Sarawak).
  - Codes (Grid, Distribution, etc)

(e) The Energy Commission Act 2001 (Act 610)
- Ministry and Government agency responsible.
- Part III, Functions and Power of the Commission

(f) Factories and Machinery Act 1967
- Electric Passenger and Goods lift Regulations

(g) Fire Services Act 1988 (Act 341)
- Ministry and Government agency responsible
- Function and Power of the DG of fire services
- General Overview of the Act
- Regulations under the Act

(h) The Communications and Multimedia ACT 1998 (Act 588)
- Ministry and Government agency responsible
- Function and Power of the DG of Multimedia Commission
- General Overview of ACT pertaining to telecommunications
- “Technical Standards, Infrastructure Requirements” (TSIR, issued by MCMC).
2. The Electricity Supply System

(a) Generation, transmission and distribution system

Electrical transmission and distribution systems in Peninsular Malaysia, Sabah and Sarawak.
- General description of the public distribution system in Peninsular Malaysia, Sabah and Sarawak (500kV, 275kV, 132kV, 33kV, 11kV, 400/230V), generation levels.
- Generation systems (Smart Grid, PV, etc).
- Design and application of power supply to private installation; EHV intake, 33kV intake, PPU for township, 33kV and 11kV switch rooms for private installation, single-chamber & double chamber substation. Load estimation and substation design; selection of tariff. TNB Supply Handbook, Contribution Charges Handbook and Sarawak Electricity Rules.
- Power factor correction (tariff requirement and method of PF correction).
- Standby Power supply system; generator set, battery pack, changeover system.
- MV and HV intake design configurations (1-feeder, 2-feeder, H-formation, double-bus, single bus system).
- Fault level and Basic Insulation level design considerations.
- Safe operation working procedures for the distribution system.

(b) HV Systems

- Transmission System

Basic understanding and role of the transmission system in the electricity supply industry as listed below.
- Transmission voltages in Malaysia
- Equipment (and their key characteristics thereof) used in transmission networks eg overhead lines, underground cables, circuit breakers, disconnectors, transformers, protection relays, dc systems etc. The terms commonly used to rate equipment eg rated current, short circuit breaking capacity or in the case of transformers, the impedance voltage etc.
- Common configurations of high voltage switchyards and their effects on operation and maintenance, understanding of the types of clearances as applied to transmission technology,
- Earthing as applied to high voltage substations and basic knowledge of key concepts in IEEE Standard 80 - Guide for Safety in AC Substation Grounding
• **Generation System**

Basic understanding and identification of main elements used in the generation of electricity in Malaysia as listed below,

- Knowledge of the process of power generation in hydro, coal fired and gas turbine combine cycle power plants etc.
- Knowledge of the design and operating characteristics of the synchronous generator, and key words used to describe the rating of the generator eg MVA, short circuit ratio, types of impedances etc
- Commonly used excitation systems; able to explain the function from block diagrams, etc
- Knowledge of common electrical configurations of a power plant, the role of the generator, generator transformer, unit and station service transformer, circuit breakers, DC and UPS systems
- Safety and equipment isolation procedures for maintenance

(c) **MV Systems and Equipment**

- MS/IEC 60076; Transformer types (cast resin, ONAN, etc)
- MV switch gears; load break switch, isolator, circuit breakers, arc breaking/suppression technology in switching (vacuum, arc chute, magnetic suppression, SF6 etc.)
- MV System and Substation Design
- MV cabling systems
- Earthing system for MV substations

(d) **L.V. Distribution System**

- MSIEC 60364 – Electrical Installation in Building (Part 1 to Part 7).
- MS 1979 : Electrical Installation of Buildings – Code of Practice
- MS 1936 : Electrical Installation of Building – Guide to MS IEC 60364

The above cover the topics such as types of earthing (TNC, TNS, TI), SPD, selection of protection devices, wiring installation, voltage drop calculation, cable selection, verification, etc.
(e) Power Quality (PQ) and Electromagnetic Compatibility (EMC)

- **PQ**
  - MS1760 and IEC 61000-2-8; Definition of PQ phenomenon (surge, dip, transient).
  - MS-IEC 61000-4 Mitigating Measures for PQ & immunity levels

- **EMC**
  - Understanding of EMC phenomena, its definition, classification which is generally based on IEC 61000 family of standards and UK Engineering Council recommendations ERP28 5/4 and 29. Common EMC phenomena include voltage unbalance, step changes in voltage, fluctuations, flicker and harmonic distortion.
  - Understanding of the EM Environment, emission and immunity limits, the testing and measurement techniques as applied for EMC.
  - Understanding of mitigating concepts e.g. by the use of mitigating disturbances, classification, protection zones, earthing and suitable design of cabling systems.

3. **System Protection**

(a) **Basic concepts**
- Classification of protection (zone, unit protection, pilot wire).

(b) **Short Circuit & System Discrimination**
- Understanding of short circuit, short circuit calculation, per unit calculation.
- Discrimination and system protection, protection setting, protection discrimination curve.

(c) **Types of protection relay**
- Overcurrent and Earth Fault
- Motor Protection
- Transformer Differential Protection
- Transformer Restricted Earth Fault
- Cable Feeder Protection
- Overhead Line Protection (Auto-reclosure, Distance, Line Differential)
- Generator Protection
(d) Instrumentations

- Types and class of metering CT.s and PTs; Protection Class (Class X, Class XPXX, knee point voltage), Metering Class.

(e) Unit Protection Requirements

- Transformer protection
- Generator Protection

D. BUILDING SYSTEMS

(a) Lighting Systems

- Knowledge of various lighting concepts:-
  - Luminous intensity (candela)
  - Luminance (candela/sqm)
  - Illuminance (Lux)
  - Colour rendering index (CRI)
- The different types of light sources and colour effects selections for energy efficiency.
- Local authorities requirements
- Daylighting concept for energy efficiency (MS 1525)
  - Switching and control strategies for energy savings
- MS ISO 8995; Lighting of Indoor Work Places-

(b) Lightning Protection

- MS IEC 62305-Protection of building structures against lightning strikes.
  - The assessment of risks and provision of measures to protect building structures.

(c) Fire Protection For Electrical Engineers

- MS 1745 Fire Alarm and Detection System
- BS5839 Part 8 and 9 (Emergency call system)
- Emergency standby generating system.
- Emergency lighting and exit signs
- Fire lifts
(d) Extra Low Voltage Systems
   - Telecommunication System
     - Fixed network infrastructure and space planning
     - In-building structured and fibre cabling
     - Public address
   - SMATV Systems
     - System design
     - CCTV Surveillance System
     - Camera and video fundamental
     - Equipment selection
     - Analogue versus digital
   - Security System
     - Security components
     - Perimeter and interior protection
     - Access control
   - Building Automation System
     - Control – type of inputs and outputs
     - System infrastructure
     - Integration with other systems such as Energy Management System, etc

(e) Vertical and Horizontal transportations
   - Control and Safety issues
   - Harmonics mitigation

(f) Hazardous Environment
   - Hazardous area classifications
   - Risks mitigation
   - Equipment and cable selection

(g) Energy Efficiency

MS1525: Code Of Practice On Energy Efficiency And Use Of Renewable Energy For Non-Residential Buildings
   - Application for Green Building Index grading of Buildings
E. INFRASTRUCTURE

(a) Exterior Lighting

- Roads, junctions, roundabout, interchanges and housing.
  MS 825 Part 1; Code of Practice for the Design of Road Lighting – Part 1: Lighting of Roads and Public Amenity Areas
  - Roads, junctions, roundabout, interchanges and housing.
  - Boulevards
  - Open car park
  - Tunnels, underpass and vehicular box culvert (VBC)
- MS 825: Part 4, Part 5 and Part 6
- Department of Civil Aviation (DCA) - ICAO Annexe 14
  - Obstruction lights
- Wharfs, ports, jetties
- Façade lighting
- Landscape lighting

(b) Telecommunication Infrastructure

- Manholes and ducting
- Termination and interfacing points
- Avoidance of microwave communication paths

(c) Traffic Control System

- Traffic Signal System
- CCTV monitoring

(d) Special Systems

- Railway earthing system
- Aircraft hangar power supply system for aircrafts
F. COMMON REQUIREMENTS

(a) Work acceptance
   - Understanding Technical Standards, types of standards (basic standards, components standards, assembly standards).
   - Understanding certifications, basic safety certification, conformance certification, type test certification.
   - Types of work certification; first party, second party and third party certification.
   - The work acceptance procedures in the construction process.
   - Commissioning (type of tests and commissioning procedures)

(b) Ingress Protection (IP) Classifications for Enclosures

(c) Switchboard forms of segregation – IEC 60439.1
1. Regulatory Practice

(i) Environment Quality Act 1974 (Act No. 127)
   (a) Waste water treatment unit operation
       • Grit Chamber
       • Equalisation tank
       • Coagulation and flocculation tank
       • Dissolve air flotation
       • Clarifier
       • Aeration tank
       • Sequential batch reactor
       • Sand filter
       • Activated carbon filter
       • Sludge dewatering units
       • Sludge thickening tank
       • Sludge holding tank
       • Membrane filters
       • Ozoniser and etc.
   (b) Design of waste water treatment process
       • Primary treatment
       • Secondary treatment
       • Tertiary treatment
   (c) Crude palm oil regulations and order 1977
   (d) Raw natural rubber regulations and order 1978
   (e) Environmental Impact Assessment)Order 1987
   (f) Scheduled Wastes Treatment And Disposal Facilities regulations and order 1989
   (g) Prohibition On The Use Of Cfc’s And Other Gases As Propellants And Blowing Agents Order 1993
   (h) Prohibition On The Use Of Controlled Substance In Soap, Synthetic Detergent
       And Other Cleaning Agents Order 1995
   (i) Refrigerant Management Regulations 1999
   (j) Halon Management Regulations 1999
   (k) Dioxin And Furan Regulations 2004
   (l) Scheduled Wastes Regulations 2005
   (m) Sewage Regulations 2009
   (n) Control Of Pollution From Solid Waste Transfer Station And Landfill
       Regulations 2009
   (o) Industrial Effluent Regulations 2009
(ii) Occupational Safety and Health Act 1994 (Act No. 514)
(a) Local ventilation system
   • Layout and diagram
   • Hood
   • Exhaust fan
   • Air cleaner
   • Ducting
(b) Design of local ventilation system
   • Pressure drop
   • Fan / Exhaust fan pressure, exhaust air volume, fan motor
   • Hood controlled air velocity, exhaust air volume
   • Dust collector capacity
   • Exhaust gas disposal system
(c) Control of Major Accident Hazards
(d) Classification, labelling and safety datasheet of hazardous chemicals
(e) Prohibition of use of substance
(f) Occupational health and safety management systems OSHAS 18001:2007
(g) Malaysian Guidelines for the Formulation of a Chemical Safety Datasheet 1997
(h) Malaysian Guidelines for the Classification of Hazardous Chemicals 1997
(i) Malaysian Guidelines for Labelling of Hazardous Chemicals 1997
(j) Malaysian Guidelines for the Preparation of a Chemical Register 2000
(k) Malaysian Guidelines on the Control of Chemicals Hazardous to Health 2001
(l) Malaysian Guidelines for HS (Environmentally Hazardous Substance) Notification & Registration

(iii) Food Act 1983 (Act 281)
(a) Food Regulations 1985
(b) Food Hygiene Regulations 2009
(c) Food Irradiation Regulations 2011

(iv) Pesticides Act 1974 (Act 149)
(a) Highly toxic pesticides regulations 1996
(b) Labelling regulations 1984
(c) Licensing for manufacturing rule 2011
(d) MS 409:2012 packaging and storage of pesticides - code of practice

(v) Factories and Machinery Act 1967 (Revised 1974) (Act 139)
(a) Steam Boiler and Unfired Pressure Vessel Regulations 1970
(b) Fencing of Machinery and Safety Regulations 1970
(c) Safety, Health and Welfare Regulations 1970
(d) Notification, Certificate of Fitness and Inspection Regulations 1970
(e) Lead Regulations 1984
(f) Asbestos Regulations 1984
(g) Noise Exposure Regulations 1989
(h) Mineral Dust Regulations 1989
(i) MS ISO 14159:2005 (confirmed:2011) safety of machinery - hygiene requirements for the design of machinery
(j) MS ISO 12100:2011 Safety of machinery - general principles for design - risk assessment and risk reduction
2. Plant Operation

(i) Process safety
   (a) Process safety management OSHA 3132
   (b) Management of change

(ii) Loss Prevention and layer of protection
   (a) Layer of protection analysis (LOPA)
   (b) Safety integrity level (SIL)

(iii) Risk assessment
   (a) Hazard Identification
      • Process hazards
      • Operational hazards
      • Environmental hazards – noise, dust, etc.
   (b) Risk Analysis of operations
      • Consequence & Probability analysis of failures
   (c) Risk reduction
      • Minimise, substitute, simplify, moderate
   (d) Residual Risk management
      • Critical system operating procedures
      • Safeguarding systems – alarms, trips & shutdowns
      • Emergency management when failures occur
   (e) Quantitative & Qualitative Risk Assessment (QRA)
   (f) Health Risk assessment (HRA)
   (g) Environmental Risk Assessment (ERA)

(iv) Fire and explosion
   (a) NFPA 654 standard for the prevention of fire and dust explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids
   (b) MS 1745:2004 fire detection and fire alarm systems

(v) Toxicity

(vi) Hazard analysis
   (a) HAZOP
      • Understanding HAZOP process
      • Continuous operations HAZOP
      • Sequential Operations HAZOP/ Procedural HAZOP
• Computerised Process System HAZOP
  (b) Process hazard analysis NFPA 654
  (c) IChemE Guide on HAZOP

(vii) Process control
  (a) Process control diagram
  (b) Relief design

(viii) Process design
  (a) Hydraulic design
  (b) Piping API 14E

3. Professional Drawing

(i) Process flow diagram (PFD) and Utility flow diagram (UFD)
  (a) Ability to describe a PFD or UFD example

(ii) Process & Instrumentation diagram (P&ID)
  (a) Ability to describe a P&ID example

4. Handling of Materials

(i) Handling of liquid
  (a) Common types of liquid behaviour
  (b) Tank discharge

(ii) Gas processing
  (a) MS 830:2003 code of practice for the storage, handling and transportation of liquefied petroleum gases
  (b) MS 930:2010 code of practice for the installation of fuel gas piping systems and appliances

(iii) Handling of particulate solids
  (a) Storage and flow of particulate solids in silos

5. Unit Operation

(i) Reaction
  (a) Reactor sizing
  (b) Types of reactor

(ii) Separation and purification
  (a) Distillation
  (b) Absorption and adsorption
(c) Membrane separation
(d) Extraction
(e) Evaporation
(f) Drying
(g) Filtration, sedimentation and centrifugal separation

(iii) Equipment
   (a) Pump
       • Examples of different types of pumps and their applications
       • Hydraulic calculation and system curve
   (b) Compressor
   (c) Turbine
   (d) Storage tank
       • API 650

(iv) Pressure vessel
   (a) Design of pressure vessel
       • ASME code & local authority inspection requirements
       • Types of vessels
       • Materials of construction
       • Pressure / temperature limitations
       • Types of fluids in the process
       • Vessel insulation
   (b) Pressure relief
       • Types of Pressure Safety Valves for different fluids & process conditions
       • Bursting Discs
       • Blowdown systems

(v) Refrigeration and heat pump

(vi) Water supply treatment and distribution

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6. Chemical Engineering Principles

(i) Thermodynamics
(ii) Heat and mass transfer
(iii) Energy and material balances
(iv) Fluid mechanics and fluid dynamics
(v) Ventilation and humidification
(vi) Psychrometrics
7. Role of Chemical Engineer in Society

(i) Environmental impact and sustainability
   (a) Environmental impact assessment
      • Life cycle analysis
   (b) Risk assessment
   (c) Discharge and disposal
   (d) Waste management

(ii) Green technology
   (a) Example of green technology and practices
   (b) Recent development in the industry
      • Example: turning sewage effluent into grey water, recover household sewage as grey water
      • Example: turning EFB into syn gas and etc.

(iii) Code of Practice
   (a) Engineer’s responsibility to society and to the public
   (b) Professionalism on a conceptual basis
   (c) Ethical conduct and professional practice
   (d) IChemE forms of contract
   (e) BP Process Safety Series – including what went wrong

(iv) Continual professional development (CPD)
   (a) Aware of the recent technological development in the area of services
      • BEM magazine
      • New advancement