

**General Guideline on Pre-defined Learning Outcomes for [Mechanical Engineering](#) Students
interning in [Consultancy](#) Built Environment Firms /Contractor Firms**

1. UNDERSTANDING INDUSTRY DOCUMENTATION/ DRAWING STANDARD

- Interpret drawings and plans including design, co-ordination and as-built drawings
 - Perform simple manipulation of drawings in common BIM softwares (such as Xref, block tools, layer system and etc.)
 - If other, please specify*
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2. COMMUNICATION SKILLS FOR WORK

- Apply formal report and business email writing skills
 - Make presentation to seniors / management / clients
 - If others, please specify*
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3. DESIGN DEVELOPMENT PROCESS

❖ **Preparation & Conceptual Design**

- Interpret the execution plan which address the project's requirement
 - Articulate the Mechanical, Electrical and Plumbing (MEP) design concept by means of simple schematic diagrams, as well as relevant Singapore Standards, codes and regulations.
 - Appreciate the submission requirements for various government agencies (e.g. BCA, PUB, SCDF)
 - Perform prelim design calculation for MEP
 - Contribute in the design review and discussion meetings with project lead/ manager
 - Appreciate the inter-disciplinary problem solving process through attending project meetings
 - Recall the key points of discussions in meetings
 - If other, please specify*
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❖ **Building Information Modelling (BIM) for Mechanical, Electrical and Plumbing(MEP)**

- Perform the load template in the following MEP sub-disciplines:
 - Air-Conditioning and Mechanical Ventilation ACMV (Services)
 - Plumbing and Sanitary Services
 - Fire Protection Services
 - Electrical Services
 - Perform check to ensure MEP models are correctly linked and aligned to architecture models
 - Perform simple editing of MEP models in BIM
 - Understand the configuration of pipe and duct settings
 - If other, please specify*
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❖ **Integrated Digital Delivery(IDD)**

- Understand the concept and objectives of IDD
 - Understand the scope of IDD in digital design/digital manufacturing and fabrication/digital construction/digital asset delivery and management
 - Understand the roles and responsibilities of mechanical engineers in IDD
 - Understand the roles and responsibilities of team members from other disciplines in IDD Carry out / support collaborative and coordinated design via BIM/Virtual Design & Construction (VDC) and other computation tools Understand how digital design tools help to optimise downstream process (manufacturing, fabrication, construction and maintenance)
 - If other, please specify*
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❖ **Design for Manufacturing and Assembly (DfMA)**

- Understand the concept and objectives of DfMA
 - Understanding the DfMA continuum and different DfMA construction technologies from prefabricated components to fully-integrated assemblies such as Prefabricated Prefinished Volumetric Construction (PPVC)
 - Application of DfMA construction technologies to different types of developments Understand design considerations and limitations for different DfMA technologies
 - Identify the suitable types of MEP design to be considered (e.g. electrical, lighting protection, water supply, sanitary, gas and etc.)
 - Perform / assist in analysis the tolerance of gradient of pipe works connections
 - Exposure to different joints and connections and their design principles for different DfMA technologies
 - Understand project management consideration in site planning (e.g. staging areas for hoisting machinery and modules) and construction sequencing
 - If other, please specify*
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❖ **Energy Efficiency**

- Passive design
 - Compute Envelop Thermal Transmittance Value (ETTV) for building facades and check for compliance with design specification and codes
 - Appreciate building designs which facilitate natural ventilation
 - If other, please specify*
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- Air-conditioning and Mechanical Ventilation systems
 - Explain the operation for chillers and the interactions of various equipment of an air-conditioning system
 - Perform preliminary design including (but not limited to) the computation of space cooling load, selection of suitable equipment (e.g. air-cooled Chillers, water-cooled chillers, VRF systems, single-split units, multi-split units, Cooling Towers, air distribution system (AHUs, PAHUs, FCUs, Pumps, Fans) and sizing of ducts and pipes

- Compute the efficiency of the chilled-water plant and check for compliance with design specification and codes
 - Check that the permanent instrumentation for measurement and verification installations for chilled water plants comply to the legislation requirements
 - If other, please specify*
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➤ Lighting design

- Perform preliminary lighting design including (but not limited to) the computation of lighting demand, lighting illuminance, selection of suitable lighting system) and lighting power budget
 - Compute lighting system efficiency taking into consideration controls strategies (e.g.: motion sensor, photo sensors etc) and check for compliance with design specification and codes
 - Perform daylighting simulation and preliminary design for the daylighting control of occupied spaces
 - If other, please specify*
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➤ Smart Building Operation

- Perform preliminary design of electrical sub-metering for building performance monitoring (e.g: BMS, energy portal etc) and continuous improvement
 - If other, please specify*
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❖ **Water Efficiency**

➤ Efficient water design

- Design efficient water supply system, including computation of water usage requirement, sizing of pipes and pumps and selection of water-efficient fittings
 - Incorporate designs to monitor and reduce water consumption
 - Incorporate design to reduce the requirement of potable water in cooling towers
 - If other, please specify*
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❖ **Legislation requirements and Green Mark Certification**

- Describe the legislative requirements on environmental sustainability and submission requirements
 - Describe the Green Mark schemes and its criteria
 - Differentiate between the legislative requirements on environmental sustainability and the voluntary Green Mark scheme
 - If other, please specify*
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4. CONTRACT DOCUMENTATION

- Understand the procedure in the preparation of drawings, schedules and specifications as an integrated system of contract documents, appropriate to project size and scope.

- Prepare contract drawings including plan layout, schematic diagrams, reflected ceiling plans, elevations, sections and details.
 - Recall about contractual and administration procedure to issue drawings/document such as drawing transmittal and distribution.
 - If other, please specify*
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5. CONSTRUCTION STAGE

❖ Construction

- Appreciate actual site conditions and the issues faced
 - Develop alternative design solutions to resolve unexpected site constraints
 - Control and distribute incoming and outgoing drawings/documents
 - If other, please specify*
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❖ Overview of Safety, Health & Environment Management

- Learn about Workplace Safety and Health (WSH) Management System
 - Understand the Workplace Risk Assessment (RA)
 - If other, please specify*
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❖ Project Management

- Understand the role and responsibilities of different personnel (e.g. site supervisor, Resident Technical Officer, Resident Engineer, project manager from contractor firm etc) in the project team
 - Understand the contract procurement method used in the project
 - Assist project manager in coordinating / executing certain scope of works
 - If other, please specify*
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6. FACILITY MANAGEMENT RELATED

❖ Design for Maintainability

- Understand the basic principles of design for maintainability in design
 - Understand the different maintenance levels required for various building services (i.e. ACMV, Fire Protection, Plumbing, Lift and Escalators, Surveillance etc.)
 - Propose to improvements to the Mechanical & Electrical systems and/or any Building and Civil Engineering Components
 - If other, please specify*
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❖ Smart FM

- Understand the basic principles of Smart FM
- Identify the potential areas for integration of the various building services

- Understand the various sensors and monitoring systems for various building services (i.e. ACMV, Fire Protection, Plumbing, Lift and Escalators, Surveillance etc.)
 - Acquire basic coding and control logics concepts
 - Carry out data analytics
 - Analyse trend reports to identify abnormality and diagnose fault of equipment/manpower resource
 - Identify potential problem areas and Perform preventive maintenance
 - Optimise resource deployment and utilisation across many systems
 - Understand the functions of common software used for analysing building network (Modbus and BACnet)
 - If other, please specify*
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❖ **Digital Asset Delivery**

- Understand the concepts of Digital Asset Delivery
 - Basic understanding of BIM modelling concepts
 - Understand the Asset Information Requirements (AIR) specified by the owner
 - Prepare details to be added into the Asset Information Model (AIM) for hand over
 - If other, please specify*
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