

THE HONG KONG INSTITUTION OF ENGINEERS
SCHEME “A” GRADUATE TRAINING
CONSOLIDATED MODEL TRAINING GUIDE
CONTROL, AUTOMATION & INSTRUMENTATION ENGINEERING

Location where Training will be done	Training Outcomes	Previous Reference	HKIE Competence Ref.	Length of Time (weeks)
	1. Introduction			1
	1.1 Information about the Company			
<i>Location 1</i>	<i>Description 1</i>			
	1.1.1 Own Organisation			
	a) Discuss the size, history and internal culture of the trainee’s own organisation.	<i>CCO</i> <i>1.10</i>	11	
	b) Discuss an overview of the relationship between the trainee’s own organisation, government departments and other organisations.	<i>CCO</i> <i>1.10</i>	11	
	c) Discuss the structure and functions of different units within the trainee’s own organisation.	<i>CCO</i> <i>1.10</i>	11	
	d) Demonstrate the awareness to follow operational procedures and practices as required by the trainee’s own organisation.	<i>CCO</i> <i>1.10</i>	11	
	e) Discuss the objectives, requirements and processes that support the quality assurance system within the trainee’s own organisation.	<i>CCO</i> <i>1.10</i>	11	
	f) Apply the quality assurance system according to the policy of the trainee’s own organisation.	<i>CCO</i> <i>1.10</i>	11	
	1.1.2 Training Programme, Prospects and Career Development			
	a) Discuss an overview of the internal communication systems, training system and career development pathway within the trainee’s own organisation.	<i>CCO</i> <i>1.10</i>	11	

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	<p>b) Demonstrate a commitment to extend and develop up-to-date technical knowledge through reading relevant engineering publications, participating in seminars or conferences, and information searching.</p> <p>c) Demonstrate a commitment to extend and develop up-to-date knowledge of local, regional and international current affairs through reading relevant engineering publications, participating in seminars or conferences, and information searching.</p> <p>d) Demonstrate a commitment to participate in the local organisations or community services for general personal development.</p>	<p><i>CCO 1.2</i></p> <p><i>CCO 1.3</i></p> <p><i>CCO 1.3</i></p>	<p>11</p> <p>11</p> <p>11</p>	
	1.2 Information about the HKIE			
Location 2	Description 2			
	<p>a) Discuss an overview of the HKIE organisation as well as its history and role in society.</p> <p>b) Demonstrate a commitment to participate in relevant activities organised by the HKIE.</p>	<p><i>CCO 1.1</i></p> <p><i>CCO 1.1</i></p>	<p>11</p> <p>11</p>	
	2. Engineer as a Profession			Continuous
	2.1 Professionalism			
Location 3	Description 3			
	<p>a) Discuss the social and ethical responsibilities of engineers in society.</p>	<p><i>CCO 1.2</i></p>	<p>8</p>	

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	<ul style="list-style-type: none"> b) Explain the rules and standard requirements of conducting engineering activities to the HKIE, employers, clients, general public and colleagues in accordance with the HKIE Rules of Conduct. c) Explain the ethical standards and responsibilities of professional engineers as required by the HKIE. d) Demonstrate the awareness to follow the codes of practice of professional engineers. e) Demonstrate the awareness to uphold the dignity, standing and reputation of the engineering profession. f) Demonstrate the awareness to protect the interests of the community including the environment, welfare, health and safety in conducting engineering activities. 	<p><i>CCO 1.2</i></p> <p><i>CCO 1.2</i></p> <p><i>CCO 1.2</i></p> <p><i>CCO 1.2</i></p> <p><i>CCO 1.2</i></p>	<p>8</p> <p>8</p> <p>8</p> <p>8</p> <p>8</p>	
	2.2 Occupational Safety and Health			
Location 4	Description 4			
	<ul style="list-style-type: none"> a) Demonstrate an understanding of the statutory health and safety requirements. b) Demonstrate an understanding of the responsibilities of professional engineers for the health and safety of the employers, employees and general public when engaging in engineering activities. c) Apply the safety management system in accordance with the industry standards and regulatory requirements. 	<p><i>CCO 1.5</i></p> <p><i>CCO 1.5</i></p> <p><i>CCO 1.5</i></p>	<p>9</p> <p>9</p> <p>7</p>	
	2.3 Environment			
Location 5	Description 5			
	<ul style="list-style-type: none"> a) Demonstrate an understanding of the relevant statutory environmental requirements related to the trainee’s discipline. 	<p><i>CCO 1.6</i></p>	<p>9</p>	

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	b) Evaluate the inter-relationship of technology with the environment in the work place.	<i>CCO 1.6</i>	9	
	c) Demonstrate the awareness of the impact of technology on the environment in society.	<i>CCO 1.6</i>	9	
3. CAI Engineering Practice and Applications				51
	3.1 Engineering Practice (Workshop Training)			8
Location 6	Description 6			
	3.1.1 Instrumentation – application and measurement			
	a) Comply the instrumentation application and measurement with the relevant standards and regulatory requirements.	<i>CO 1.6</i>	1	
	b) Comply the instrumentation application and measurement with the relevant standards and regulatory requirements in Hong Kong.	<i>CO 1.6</i>	2	
	c) Evaluate the effectiveness, limitation and uncertainty of instrumentation system and measurement.	<i>CO 1.6</i>	3	
	d) Develop the implantation plan of instrumentation system and measurement.	<i>CO 1.6</i>	4	
	e) Carry out implementation of instrumentation system and measurement.	<i>CO 1.6</i>	6	
	f) Analyse the potential risk from improper instrumentation system and measurement.	<i>CO 1.6</i>	7	
	g) Produce well-structured, clear and concise instrumentation system and measurement documents.	<i>CO 1.6</i>	10	

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Location where Training will be done	Training Outcomes	Previous Reference	HKIE Competence Ref.	Length of Time (weeks)
	<p>h) Select the most appropriate solution from different options of instrumentation application and measurement.</p> <p>i) Appraise computer networking for industrial automation.</p> <p>j) Appraise the use of AI (Artificial Intelligence) and Machine learning in Control and Automation in CAI application.</p> <p>3.1.2 Instrumentation – tooling and configuration</p> <p>a) Comply the tooling and configuration with the relevant standards and regulatory requirements.</p> <p>b) Comply the tooling and configuration with the relevant standards and regulatory requirements in Hong Kong.</p> <p>c) Evaluate the effectiveness and limitation of tooling and configuration.</p> <p>d) Develop the configuration requirements of tooling.</p> <p>e) Carry out tooling configuration.</p> <p>f) Analyse the potential risk from improper tooling and configuration.</p> <p>g) Produce well-structured, clear and concise tooling and configuration documents.</p> <p>h) Select the most appropriate solution from different options of instrumentation tooling and configuration.</p>	<p><i>CO 1.6</i></p> <p><i>New CO</i></p> <p><i>New CO</i></p> <p><i>CO 1.6</i></p> <p><i>CO 1.6</i></p> <p><i>CO 1.6</i></p> <p><i>CO 1.6</i></p> <p><i>CO 1.6</i></p> <p><i>CO 1.6</i></p> <p><i>CO 1.6</i></p>	<p>12</p> <p></p> <p>1</p> <p>2</p> <p>3</p> <p>4</p> <p>6</p> <p>7</p> <p>10</p> <p>12</p>	

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Location where Training will be done	Training Outcomes	Previous Reference	HKIE Competence Ref.	Length of Time (weeks)
	<ul style="list-style-type: none"> b) Assess the technical and functional requirements of automation and control system of CAI system design. c) Develop the detailed design of automation and control of CAI system design. d) Select the most appropriate solution from different options of automation and control of CAI system design. 	<p style="text-align: center;"><i>CO 1.1</i></p> <p style="text-align: center;"><i>CO 1.1</i></p> <p style="text-align: center;"><i>CO 1.1</i></p>	<p>3</p> <p>4</p> <p>12</p>	
	<p>3.2.2 Hardware</p> <p>3.2.2.1 Design</p> <ul style="list-style-type: none"> a) Comply the hardware design with the relevant international standards and regulatory requirements. b) Comply the hardware design with the relevant standards and regulatory requirements in Hong Kong. c) Evaluate the applicability and limitation of hardware design. d) Carry out hardware design. e) Evaluate the environmental, health, sustainability and safety implications from hardware design. 	<p style="text-align: center;"><i>CO 1.2</i></p> <p style="text-align: center;"><i>CO 1.2</i></p> <p style="text-align: center;"><i>CO 1.2</i></p> <p style="text-align: center;"><i>CO 1.2</i></p> <p style="text-align: center;"><i>CO 1.2</i></p>	<p>1</p> <p>2</p> <p>3</p> <p>5</p> <p>9</p>	

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Location where Training will be done	Training Outcomes	Previous Reference	HKIE Competence Ref.	Length of Time (weeks)
	<ul style="list-style-type: none"> f) Produce well-structured, clear and concise hardware design documents. g) Select the most appropriate solution from different options of hardware design. 	<p><i>CO 1.2</i></p> <p><i>CO 1.2</i></p>	<p>10</p> <p>12</p>	
	<p>3.2.2.2 Development and Manufacturing</p> <ul style="list-style-type: none"> a) Appraise the development and manufacturing processes of hardware. b) Carry out implementation of hardware development and manufacturing processes. c) Analyse the potential risk from improper hardware development and manufacturing. d) Evaluate the environmental, health, sustainability and safety implications from hardware development and manufacturing process. e) Produce well-structured, clear and concise documents on hardware development and manufacturing. 	<p><i>CO 1.2</i></p> <p><i>CO 1.2</i></p> <p><i>CO 1.2</i></p> <p><i>CO 1.2</i></p> <p><i>CO 1.2</i></p>	<p>1</p> <p>6</p> <p>7</p> <p>9</p> <p>10</p>	
	<p>3.2.2.3 Maintenance</p> <ul style="list-style-type: none"> a) Appraise the requirements of hardware maintenance. 	<p><i>CO 1.2</i></p>	<p>1</p>	

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Location where Training will be done	Training Outcomes	Previous Reference	HKIE Competence Ref.	Length of Time (weeks)
	<ul style="list-style-type: none"> b) Evaluate the applications and limitations of different maintenance approaches. c) Apply appropriate diagnostic techniques to analyse equipment failures and maintenance problems. 	<p><i>CO 1.2</i></p> <p><i>CO 1.2</i></p>	<p>3</p> <p>6</p>	
	<p>3.2.3 Software</p> <p>3.2.3.1 Design</p> <ul style="list-style-type: none"> a) Comply the software design with the relevant international standards and regulatory requirements. b) Comply the software design with the relevant standards and regulatory requirements in Hong Kong. c) Evaluate the applicability and limitation of software design. d) Carry out software design. e) Produce well-structured, clear and concise software design documents. <p>3.2.3.2 Development and Maintenance</p> <ul style="list-style-type: none"> a) Appraise the development and/or maintenance processes of software. b) Carry out implementation of software development and/or maintenance process. 	<p><i>CO 1.3</i></p> <p><i>CO 1.3</i></p> <p><i>CO 1.3</i></p> <p><i>CO 1.3</i></p> <p><i>CO 1.3</i></p> <p><i>CO 1.3</i></p> <p><i>CO 1.3</i></p> <p><i>CO 1.3</i></p> <p><i>CO 1.3</i></p>	<p>1</p> <p>2</p> <p>3</p> <p>5</p> <p>10</p> <p>1</p> <p>5</p>	

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Location where Training will be done	Training Outcomes	Previous Reference	HKIE Competence Ref.	Length of Time (weeks)
	<ul style="list-style-type: none"> c) Produce well-structured, clear and concise software development and/or maintenance documentations. d) Carry out verification of software design. 	<i>CO 1.3</i>	10	
	<p>3.2.4 SCADA System</p> <p>3.2.4.1 Working Principles</p> <ul style="list-style-type: none"> a) Appraise the working principles of Supervisory Control and Data Acquisition (SCADA) System. b) Carry out the implementation of SCADA system in accordance with appropriate working principles. c) Evaluate the reliability and safety impacts from SCADA system implementation. 	<i>CO 1.3</i>	12	
	<p>3.2.4.2 System Configuration</p> <ul style="list-style-type: none"> a) Evaluate the appropriateness of SCADA system configuration. b) Develop the configuration requirements of SCADA system. c) Select the most appropriate SCADA system configuration. 	<i>CO 1.4</i>	1	
		<i>CO 1.4</i>	5	
		<i>CO 1.4</i>	9	
		<i>CO 1.4</i>	3	
		<i>CO 1.4</i>	4	
		<i>CO 1.4</i>	5	

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	3.2.4.3 Design and Application a) Evaluate the applications and limitations of SCADA system. b) Develop the implementation plan of SCADA system. c) Produce well-structured, clear and concise SCADA system design and/or application documents. d) Select the most appropriate SCADA system design and/or application.	<i>CO 1.4</i> <i>CO 1.4</i> <i>CO 1.4</i> <i>CO 1.4</i>	3 4 10 12	
	4. Engineering Administration and Management Techniques			26
	4.1 Interpretation, preparation and communication of requirement, specifications and drawings; report and manual compilation			8
Location 8	Description 8			
	a) Prepare technical drawings and reports to illustrate the engineering design. b) Review engineering drawings, report and manuals submitted by a third party. c) Compile technical manual to facilitate test and commissioning as well as future O&M.	<i>CO 1.5</i> <i>CO 1.5</i> <i>CO 1.5</i>	6 6 6	
	4.2 Cost estimate and comparison, analysis and evaluation			4
Location 9	Description 9			
	4.2.1 Project Cost Control a) Derive the cost estimates of engineering project including capital cost, operational and maintenance costs, and life cycle cost as appropriate. b) Analyse potential risks on cost overrun.	<i>CO 1.5</i> <i>CO 1.5</i>	6 7	

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	4.3 Procurement procedures, tender document preparation and evaluation, pre-qualification of supplier, commercial terms, delivery schedules and monitoring, quality control, stock keeping.			8
Location 10	Description 10			
	a) Implement the procurement procedures and quality control requirements, e.g., ISO9001.	<i>CO1.5</i>	6	
	b) Conduct market searches and tender prequalification assessment.	<i>CO1.5</i>	6	
	c) Review commercial terms, delivery schedules and spare parts requirement	<i>CO1.5</i>	6	
	d) Produce tender specification with due considerations of the items mentioned above.	<i>CO1.5</i>	6	
	4.4 Project Management			6
Location 11	Description 11			
	4.4.1 Integrated Project Lifecycle			
	a) Develop the project plan such as any critical path analysis.	<i>CO 1.5</i>	5	
	b) Carry out project management by integrating the project life cycle concept.	<i>CO 1.5</i>	6	
	c) Produce well-structured, clear and concise project management documents.	<i>CO 1.5</i>	10	
	4.4.2 Project Programme Monitoring			
	a) Develop corrective actions to recover project progress problems.	<i>CO 1.5</i>	4	
	b) Examine the project progress against the schedule.	<i>CO 1.5</i>	5	

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	5. Objective Training			26
	<i>This section covers any activities related to Control, Automation and Instrumentation Engineering. It should aim to develop skills and knowledge relating to personal qualities, communication, human resources management and business operational sense in addition to the technical, commercial and engineering knowledge acquired by the trainees during earlier parts of their training. Latest developments in the discipline should be included. All Training Outcomes, if not yet achieved in earlier parts of training, should be completed here.</i>			
	6. Other Common Core Outcomes for Continuous Development			Continu ous
	6.1 Leadership and Management			
Location 12	Description 12			
	a) Discuss the various leadership qualities required of a leader including accountability, conflict management and resources management etc.	<i>CCO 1.9</i>	6	
	b) Explain the importance of accountability and responsibility required by a leader for making decisions on engineering activities.	<i>CCO 1.9</i>	6	
	c) Apply various management skills in engineering projects.	<i>CCO 1.9</i>	6	
	d) Distinguish the relationship between good leadership and good management skills.	<i>CCO 1.9</i>	6	
	e) Demonstrate an understanding of the importance of teamwork and partnering skills in engineering projects.	<i>CCO 1.9</i>	6	
	6.2 Development of Personal Qualities			
Location 13	Description 13			
	a) Identify appropriate innovative approach and/or tools for professional development.	<i>CCO 1.4</i>	11	
	b) Demonstrate interpersonal skills for professional development.	<i>CCO 1.4</i>	10	
	c) Demonstrate negotiating skills required for various engineering activities.	<i>CCO 1.4</i>	10	

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	d) Demonstrate sound time management skills for professional development.	<i>CCO 1.4</i>	11	
	e) Demonstrate a commitment to continuous development and enhancement.	<i>CCO 1.4</i>	11	
	6.3 Communication			
Location 14	Description 14			
	a) Communicate ideas orally in an accurate and clear manner under various situations (including presentations and meetings).	<i>CCO 1.7</i>	10	
	b) Formulate an oral presentation of complicated data and information in an effective and persuasive manner.	<i>CCO 1.7</i>	10	
	c) Produce grammatically correct, clear and concise documents (including memos, letters, instructions, reports, resumes and technical papers) which meet the business objectives.	<i>CCO 1.7</i>	10	
	d) Evaluate the needs of the intended readers to design appropriate technical contents for communication.	<i>CCO 1.7</i>	10	
	6.4 Human Resources Management			
Location 15	Description 15			
	a) Demonstrate the awareness of the duties and employment criteria for different job positions in an engineering project.	<i>CCO 1.8</i>	6	
	b) Demonstrate an understanding of the relevant legal requirements and regulatory issues of labour employment and management.	<i>CCO 1.8</i>	6	
	c) Discuss the appropriate staff training and development programmes in the organisation.	<i>CCO 1.8</i>	6	
	6.5 Business Operations			
Location 16	Description 16			
	a) Recognise the importance of intellectual property to business operations.	<i>CCO 1.11</i>	11	

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	b) Describe the legal requirements in Hong Kong relevant to intellectual property rights.	<i>CCO 1.11</i>	11	
	c) Identify appropriate tools and method to measure and improve the productivity of business operations.	<i>CCO 1.11</i>	11	
	d) Identify appropriate information technology applications to manage business information and to facilitate business operations.	<i>CCO 1.11</i>	11	
	e) Recognise the importance of research and development towards business operations.	<i>CCO 1.11</i>	11	
	f) Demonstrate the awareness of financial considerations in operation business.	<i>CCO 1.11</i>	11	
	g) Recognise the importance of business development in business operations.	<i>CCO 1.11</i>	11	

N.B.

1. The training period must not be less than 104 weeks (24 months).
2. The programme set out is for guidance only but substantial departure should not be made. Employers should endeavour to provide training to their trainees in as many areas as possible as is appropriate to the sector of employment.
3. This guide should be read in conjunction with Section 3 of the M3 Routes to Membership.
4. During the training, each trainee is required to maintain a Graduate Training Log Book, Record of Continuing Professional Development and Record of Training Outcomes.

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Additional Notes for 3.2 Engineering Applications:

1. Engineering Applications

The training for Engineering Applications should include critical study and evaluation, OR procurement, installation and commissioning, OR design and development of typical control, automation OR instrumentation components, subsystems, products, equipment and engineering projects in accordance with requirements and specifications. A balanced combination of (a), (b) or (c) below without unnecessary overlap is acceptable.

- (a) For design oriented activities, coverage should extend to design analysis, computer aided modeling or prototyping, critical analysis and objective evaluations of system reliability, stability and integrity; maintainability, ergonomics, safety, health and environmental considerations, standards and regulations.
- (b) For process or production oriented activities, the training should include applications of CAI in large scale production process. Typical aspects may include data capture, acquisition and monitoring; real time process control; selection of control actuators; selection, evaluation or design of testing and automation equipment or system; application of CAD / CAM / CIM / mechatronics / artificial intelligence to production automation, testing, diagnosis, fault analysis/and quality control.
- (c) For project handling activities, the project should include system design, installation, commission, operation and maintenance of plant and associated equipment. Typical coverage may include general familiarisation of industrial design practices and standard codes of instrumentation; critical analysis and understanding of system specification and performance under responsibility; in-depth knowledge of technique, procedure and rationale in inspection, testing and evaluation of the overall system and subsystem operation, robustness and integrity. Trainees should also gain exposures in the preparation and compilation of plant operating procedures; design of maintenance schedules; involvement in emergency and major repairs, industrial safety and environmental consideration.