Smart Products, Robotics and Automation V1.0

Syllabus

BCS Foundation Award

bcs
The Chartered Institute for IT

This professional certification is not regulated by the following United Kingdom Regulators – Ofqual, Qualification in Wales CCEA or SQA.

Document Change History

Any changes made to the syllabus shall be clearly documented with a change history log. This shall include the latest version number and the changes made. The purpose is to identify quickly what changes have been made.

Version Number	Changes Made
1.0	Document creation.
1.1	Updated information on module credits.

The Chartered Institute for IT

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Introduction

The BCS Foundation Award in Smart Products, Robotics and Automation is designed for individuals wishing to gain an understanding of the role of robotics and automation in the workplace.

As robots and SMART technology become more common within society and the workplace, it is important to understand how they can be used and maintained appropriately and safely. This award will introduce candidates to the concept of intelligent robots, Deep Learning and the use of Neural Networks. Candidates will also be encouraged to explore the potential use of robots in the future workplace and consider their current limitations.

Qualification Suitability and Overview

There are no specific entry requirements for this award. However, some professional experience in an IT environment may be particularly advantageous.

The BCS Foundation Award in Smart Products, Robotics and Automation has been designed for individuals interested in furthering their understanding of the more technical aspects of AI. This Foundation Award is ideal for those candidates who wish to gain an insight into the interactions between robotic or automated systems and the human element of the workplace, with a view to developing or implementing AI solutions.

This award has been created alongside a selection of other awards in the AI space which offer candidates a clear pathway of progression into other disciplines of IT along with a broader knowledge of AI in the workplace. This makes it ideally suited for those looking for a change in career, an upskilling workforce, sustainable employers, and individuals with a background in science, engineering, knowledge engineering, finance, education or IT services. This list is not exhaustive, and many other roles may benefit.

This award counts towards achieving your Foundation Certificate in AI and/or your Foundation Diploma in AI.

- To receive the Foundation Certificate in AI, you need to achieve four awards - one award from each of the categories listed here (https://www.bcs.org/media/qd5dotas/ai-pathway-24.png)
- To receive the Foundation Diploma in AI, you need to achieve eight awards in total - one or more award from each of the categories listed here (https://www.bcs.org/media/qd5dotas/ai-pathway-24.png)

Once you have achieved this, please contact your training provider or, if you are a self-study candidate, BCS. Your certificate will then be processed.

Candidates can study for this award by attending a training course provided by a BCS accredited Training Provider or through self study.

Total Qualification Time	Guided Learning Hours	Independent Learning	Assessment Qualification Time
50 hours	16 hours	33.5 hours	0.5 hours

*Examples of Independent Learning include reading of articles or books, watching videos, attendance of other types of training or work shadowing.

Trainer Criteria

It is recommended that to effectively deliver this award, trainers should possess:

- BCS Foundation Certificate in Artificial Intelligence or a similar qualification.
- A minimum of 2 years' training experience or a recognised training qualification.

SFIA Levels

This award provides candidates with the level of knowledge highlighted within the table, enabling candidates to develop the skills to operate successfully at the levels of responsibility indicated.

Level	Levels of Knowledge	Levels of Skill and Responsibility (SFIA)
K7		Set strategy, inspire and mobilise
K6	Evaluate	Initiate and influence
K5	Synthesise	Ensure and advise
K4	Analyse	Enable
K3	Apply	**Apply**
K2	**Understand**	**Assist**
K1	**Remember**	**Follow**

SFIA Plus

This syllabus has been linked to the SFIA knowledge skills and behaviours required of an individual at level 3;

KSD43

Methods and techniques for ensuring valid results are obtained by means of sampling.

Further detail around the SFIA Levels can be found at www.bcs.org/levels.

Learning Outcomes

Upon completion of the award, candidates will be able to demonstrate:

1. An understanding of the use of robots and automation in the workplace
2. An understanding of identifying, creating, and maintaining automation
3. An understanding of the role robots will play in the future.

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1. The use of robots and automation in the workplace (40%) (K1/2)

Candidates will be able to:

1.1 Describe what a robot is with reference to examples.

Indicative content

a. Different types of robots:
   - Industrial
   - Personal e.g. personal assistants (Siri, Alexa), personal care (Smart homes)
   - Autonomous (vehicles) – 5 levels (from no automation to fully automated)
   - Nanobots
   - Humanoid robots
   - SWARM – multiple robots doing the same task
   - Defence – smart robotic standards, identifying targets on a battlefield

b. Smart entities/smart products
   - Augmentation – heads up display (HUD) (pilots, surgeons, cars)
   - Smart roads

c. Robotic paradigms (Sensing, Planning, Acting)

d. Agent-based modelling

Guidance

It useful to consider examples of how robots and smart products are used in different industries to understand their purpose or to arrive at a definition. Learners should be able to understand that robots and smart products are designed to replicate movements and functions using sensory data. Agent-based modelling can be used to illustrate how different agents can work together to make this work.

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1. The use of robots and automation in the workplace (40%) (K1/2)

Candidates will be able to:

1.2 Define what an intelligent robot is.

Indicative content

a. Machine learning
   - Neural networks
   - Deep learning

b. Relate intelligent robotics to intelligent agents via deep learning.

Guidance

Introduce learners to the concept of Neural Networks which are an essential element to enabling the robot to "think" and act, making decisions based on the input data and certain "degrees of truth" (fuzzy logic). Through deep learning the multiple intelligent agents (learning agents) within the robot can learn to improve through repetition of task, learning from mistakes and attainment of new data.

Candidates will be able to:

1.3 Outline a brief history of the use of robots within technology.

Indicative content

a. Optimising war strategy
b. Controlling a robot (analogue machines, perceptron and neural networks)
   - Subsumption – delegate controls to a lower subset

c. 4th Industrial revolution > 5th exploring space
   - Extreme environments
   - Food production
   - Surgery – ideal conditions
   - Anthropomorphism

Guidance

Learners should be encouraged to look to the origins of robots to where we are today in terms of robotics, machine learning and smart products. It is useful to consider what the next phase in the development of robotic and smart technology may look like.

Candidates will be able to:

1.4 Describe Intelligent RPA.

Indicative content

a. What is RPA? Typically associated with BPR but making process better
   - Example; Agent Based Modelling and modelling supply chains

b. Digital twins
   - Example; Simulating a product and optimising its performance

c. Learning from experience
   - RPA – Traditionally human does the learning and build the process
   - Machines can now do the learning and build the process

d. Machine Learning
   - Examples; route finding, automated project planning

Guidance

It is useful to consider that Robotic Process Automation (RPA) has evolved since the term was first introduced to describe the use of automation in business process re-engineering and workflow automation.

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1. The use of robots and automation in the workplace (40%) (K1/2)

Candidates will be able to:

1.5 Describe the current needs which are driving new innovations in robotics and smart technologies in the market.

Indicative content

a. Changes in consumer buying behaviour
b. Fashion and trends
c. Health and wellbeing (smart watches, AI toothbrush)
d. Accessibility (personal assistants, barcode readers)
e. Social care – e.g. Japan's aging population
f. Desire for greater access to information (on demand)
g. Education (distance learning, independence)
h. Requirements of different industries

Guidance

Learners should be encouraged to explore the needs of the market and society that are driving innovation in robotics and smart products.

Candidates will be able to:

1.6 Outline the basic ethical principles surrounding the creation of smart products and robotics.

Indicative content

a. Ethical use – what is the impact on humans? e.g. social interaction
b. LAWS – Lethal Autonomous Weapons
    - Responsibility of mechanical engineers to train their systems for good intentions
    - National security
    - Human centric ethical purpose – EU

Guidance

Learners should consider the role of ethics and the responsibility of those designing and implementing smart products and robotics for ensuring they are being developed for the good of society.

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2. Identifying, creating, and maintaining automation (40%) (K2)

Candidates will be able to:

2.1 Describe the challenges of smart product and robotic logic.

Indicative content	Guidance
a. Logic b. Autonomy c. Who controls the logic?	It is useful to consider how robots and smart products use logic to determine how to act. What challenges are created when introducing greater levels of autonomy?

Candidates will be able to:

2.2 Describe how a smart product or robot can be supported.

Indicative content	Guidance
a. Human understanding of use b. Maintenance cycle c. Updates (software, patches)	Learners should be encouraged to consider the reliance robots have on humans for ensuring they are kept "healthy" and that they are implemented, maintained, and utilised in the best way. What skills and training might be required?

Candidates will be able to:

2.3 Describe how smart products and robots are tested.

Indicative content	Guidance
a. Standards and regulation b. EPSRC Robotic Guidelines	It is useful to consider different types of testing such as performance, reliability, acceptance, and operational testing to identify robot or product failures.

3. The future of robots (20%) (K1/2)

Candidates will be able to:

3.1 Describe the requirements for ensuring an environment of continuous innovation for the future development of robots and smart products.

Indicative content

a. A creative thinking culture
b. Willingness to fail and learn
c. Investment
d. Technical understanding and skills
e. Collaboration
f. Competition
g. Market analysis
h. Continuous user feedback
i. Ethics

Guidance

Learners may wish to consider this topic in relation to the particular risks that may impact this environment of continuous innovation.

Candidates will be able to:

3.2 Identify the current limitations in robotic/machine intelligence.

Indicative content

a. Unable to empathise
b. Inability to act using common sense (against what the data tells us in order to achieve a more positive outcome)
c. Susceptibility to bias

Guidance

It is useful to consider human intelligence in relation to this topic and a human's ability to make decisions and act on emotion and feeling rather than on data and logic alone.

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3. The future of robots (20%) (K1/2)

Candidates will be able to:

3.3 Identify examples of where robots, smart products and humans coexist.

Indicative content

a. Human/machine interface – human body can control a robot (organoid)
b. Exoskeleton technology
c. Social care innovation
d. Health care innovation
e. Industrial/production innovation
f. Travel innovation

Guidance

Learners may be encouraged to consider other possibilities and future innovations that have not yet been designed.

Examination Format

This award is assessed through completion of an invigilated online exam which candidates will only be able to access at the date and time they are registered to attend.

Type	12 Multiple Choice questions, 4 Scenario Based Question
Duration	30 minutes
Supervised	Yes
Open Book	No (no materials can be taken into the examination room)
Passmark	13/20 (65%)
Delivery	Digital format only.

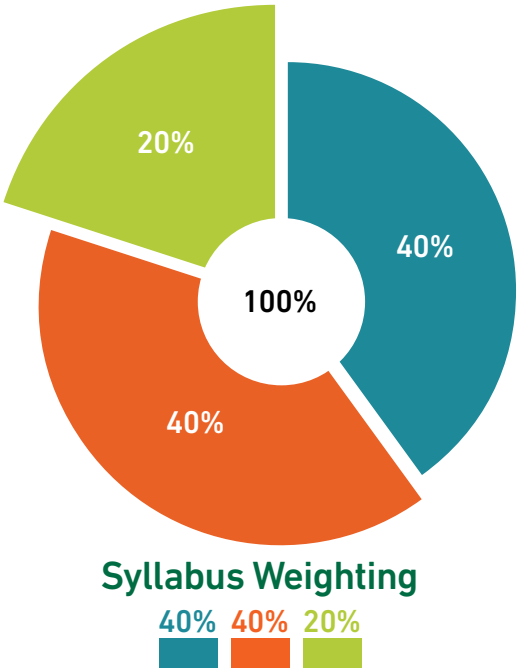
Adjustments and/or additional time can be requested in line with the BCS reasonable adjustments policy for candidates with a disability, or other special considerations including English as a second language.

Question Weighting

Each major subject heading in this syllabus is assigned a percentage weighting. The purpose of this is:

1. Guidance on the proportion of content allocated to each topic area of an accredited course.
2. Guidance on the proportion of questions in the exam.

Syllabus Area	Question type	
1. The use of robots and automation in the workplace	Scenario Based Multiple Choice	**40%**
2. Identifying, creating and maintaining automation	Scenario Based Multiple Choice	**40%**
3. The future of robots	Multiple Choice	**20%**



Recommended Reading

The following titles are suggested reading for anyone undertaking this award. Candidates should be encouraged to explore other available sources.

Title:	The Singularity is Near
Author:	Raymond Kurzweil
Publisher:	Duckworth
Publication Date:	March 2006
ISBN:	07515635611

Title:	Human + Machine: Reimagining Work in the Age of AI
Author:	Paul R. Daugherty and H. James Wilson
Publisher:	Harvard Business Review Press
Publication Date:	March 2018
ISBN:	1633693864

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