Course Specification

Course Summary Information		
1	**Course Title**	MSc Smart Manufacturing
2	**Course Code**	PT1548
3	**Awarding Institution**	Birmingham City University
4	**Teaching Institution(s)** (if different from point 3)	
5	**Professional Statutory or Regulatory Body (PSRB) accreditation** (if applicable)	

6	**Course Description**
	Do you want to develop your digital skills and become an Industry 4.0 specialist? This MSc Smart Manufacturing course will prepare you to apply digital skills into a dynamic and highly in demand sector, putting you ahead in the graduate job market. Smart Manufacturing is the convergence of Operational Technologies and Information Technologies, to support the operations of the factory of the future. Also known as Industry 4.0 the convergence of manufacturing's physical aspects and processes with data, sensors, artificial intelligence, cybersecurity and computer networks enables an increase in efficiency across the value chain of the manufacturing sector. On this course, you will focus solely on the computing aspects of Industry 4.0, to enable your professional development by filling the skill gap required to understand how data and digital technology transforms and augments the physical aspects of manufacturing and its related areas. As a conversion course centred on the digital-led aspects of the smart manufacturing sector, we consider that all students are starting with no experience in the computing and mathematical aspects of the technologies involved in the course. This MSc is designed to train graduates in courses related to Engineering, Computing and Management or with a background in these areas, to allow them to actively progress into the highly demanded market of the digitally-enabled transformation of the manufacturing sector. This course brings together cutting-edge digital technology by starting with a solid foundation of principles of computing, networking, sensing technologies, security and the digitally enabled value chain that support the development and operation of Industry 4.0. Some of the core concepts of Industry 4.0 that will be taught are: • **Industrial Internet of Things (IIoT)** The infrastructure behind the factories of the future, the IIoT enables the development of intelligent systems to automate manufacturing processes with high levels of efficiency, accuracy and visibility. You will learn industry standard sensors and platforms and techniques for their implementation.

	• **Cybersecurity** As industrial processes move to the digital realm, there is a requirement for the adopting cyber security measures for the adequate protection of valuable information assets to ensure organisations' operations. You will learn the skills and techniques to identify security gaps, evaluate business risks, and recommend mitigations strategies. • **Artificial intelligence (AI) and Machine Learning (ML)** AI is a core component of modern computing systems which involve the development intelligent agents that mimic human's cognitive capability in learning, reasoning and problem solving. As a student of this MSc, you will develop an in-depth understanding of the potential and scope of applying and evaluating the different forms of ML techniques. The course is complemented by the study of how digital technologies are impacting the manufacturing value networks and how to best manage these technologies, including: novel visualisation techniques such as Augmented and Virtual Reality; digital ledgers (blockchain); and Digital Twins that link physical systems into the cyber world. Through a practice-led approach, our course teaches you the underlying digital technologies, tools and techniques supporting the digital evolution of the manufacturing sector into Industry 4.0, by making use of state-of-the-art software and computing hardware tools. Our research, staff and lab facilities on Smart Systems, High Performance Computing, Future Networks and Machine Learning Cluster will enable your journey to become a highly sought-after specialist on Smart Manufacturing at the forefront of the digitally-driven field.

7	**Course Awards**		
7a	**Name of Final Award**	**Level**	**Credits Awarded**
	Master of Science Smart Manufacturing	7	180
	Master of Science Smart Manufacturing with Professional Placement	7	240
7b	**Exit Awards and Credits Awarded**		
	Postgraduate Certificate Smart Manufacturing Studies	7	60
	Postgraduate Diploma Smart Manufacturing	7	120

8	**Derogation from the University Regulations**
	1. A maximum volume of 20 credits per course in a Master's degree (other than an integrated Master's degree) can be compensated. 2. No condonement of modules at Levels 4-7 is permitted.

9	**Delivery Patterns**		
Mode(s) of Study	**Location(s) of Study**	**Duration of Study**	**Code(s)**
Full-time	City Centre	1 year	PT1548
Part-time	City Centre	2 years	PT1549
With Professional Placement (full-time)	City Centre	18 months	PT1550

10	Entry Requirements	
	Home:	At the point of application, you must have GCSE at Grade C or above in English language and Mathematics. A first Degree (2:2+) related to Smart Manufacturing (including Engineering, Computing, and Business, with an interest in the digital approach to Smart Manufacturing.)
	EU:	As above plus IELTS 6.0 overall with 5.5 minimum in all bands
	International:	As above plus IELTS 6.0 overall with 5.5 minimum in all bands
	Access:	N/A

11	Course Aims
	This MSc course will prepare you to become an employable graduate by evaluating and managing the Industry 4.0 sector. You will learn all of the practical skills and theoretical knowledge required for professionals working in this industry, enabled by the digital-driven Cyber Physical Systems (CPS) technologies and techniques such as sensors, networks, data analytics and machine learning, security, digital ledgers (blockchain) and augmented reality. This course will provide you with industry standard skills on the data and digitally enabled processes for the highly demanded Smart Manufacturing field. As such, the course aims for learners*:* • To develop skills of analysis, synthesis, critical appraisal and the ability to solve complex problems through the underlying Industry 4.0 technologies and processes to deliver value, sustain innovation and business growth in the global economy. • Allow you to apply aspects of Cyber Physical Systems and Industry 4.0 to different manufacturing sectors and its related areas. • Promote engagement with multidisciplinary professional partners to foster innovation and enable you to gain an in-depth knowledge of Industry 4.0 tools and techniques for solving complex organisational challenges. • Facilitate the transfer of knowledge and experience to address the emerging opportunities and challenges of Industry 4.0 across international communities.

12	**Course Learning Outcomes**
	Knowledge and Understanding
1	Critically analyse key concepts, theories, approaches, techniques, and principles related to the design and development of cyber physical systems applied to manufacturing (digital-led smart manufacturing solutions).
2	Identify and justify the use of different evaluation and analytical approaches to determine the effectiveness of a variety of digital-led smart manufacturing solutions.
3	Assess emerging trends in the field of smart manufacturing and consider their potential for organisational and societal impact.
4	Examine and appraise key ethical, social, and commercial considerations around the implementation of cyber physical systems applied to manufacturing.
5	Understand and interpret the roles and responsibilities of a professional working in the user digital-led smart manufacturing field.
	Skills and Other Attributes
6	Design and create cyber physical systems solutions for manufacturing (Industry 4.0), through the application of industry standard principles across a range of platforms, tools and technologies.
7	Critically assess the effectiveness of platforms and frameworks commonly used for developing cyber physical systems with and application to manufacturing.
8	Collect, interpret, and analyse research data (utilising multiple techniques) to evaluate the effectiveness of digital-led solutions for the manufacturing sector.
9	Demonstrate leadership and collaborate within multi-disciplinary teams to manage workload, prioritise project activities, complete shared tasks, to produced digital-led smart manufacturing solutions.
10	Communicate complex concepts effectively in oral presentations, demonstrations, and written reports by ensuring their adequate delivery for different target audiences.
11	Demonstrate systematic understanding of knowledge, critical awareness and evaluation of relevant complex issues and produce evidence of original application of knowledge towards an independent project.

13	**Level Learning Outcomes**

Postgraduate Certificate (PG Cert) Smart Manufacturing Studies

To obtain the PG Cert Smart Manufacturing Studies, you will need to complete 60 credits (a combination of any three modules), through which you will need to partially meet at least seven of the course learning outcomes.

Example Scenario:

MODULES	Course Learning Outcomes										
Level 7 Core Modules	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
CMP7231 - Industrial Internet of Things	X	X	X		X	X	X			X	
CMP72XX - Digital Supply Chain	X	X	X	X	X	x	X		X	X	
CMP72XX - Information Security Governance	X		X	X							
CMP72XX - Applied Machine Learning	X	X	X	X				X			
CMP7220 – Advanced and Immersive Technologies	X	X				X	X	X	X	X	
CMP7158 - Research Methods and Project Management			X	X			X	X		X	
CMP7200 - Individual Masters Project		X				X	X	X			X

Postgraduate Diploma (PG Dip) Smart Manufacturing

To obtain the PG Dip Smart Manufacturing, you will need to complete 120 credits (all 6 taught modules), through which you will need to fully meet LO1, LO3-5, LO9-10 and partially meet LO2 and LO9-10 of the course learning outcomes.

MSc Smart Manufacturing

In order to achieve the MSc Smart Manufacturing, you must successfully complete the Individual Masters Project module in addition to the requirements for the PG Dip Smart Manufacturing and meet all 11 learning outcomes of the course. The Masters project is a research dissertation which must be focused at investigating a relevant significant Smart Manufacturing challenge and adopt a structured research-informed approach to conduct the study.

The Masters dissertation enables you to gain experience of managing a significant task within Cyber Physical Systems applications in smart manufacturing, and apply technical, research, and project management skills. It will also help you prepare for managing similar tasks in industrial settings as well as enabling you to gain research experience which will be beneficial for further studies such as a PhD.

14	Course Learning, Teaching and Assessment Strategy
	The timeframe for course delivery period consists of two semesters plus the summer, 180 credits in 12 months and 24 months for part-time students. Students will have two attempts at assessment under BCU academic regulations. Knowledge and understanding are acquired through a variety of methods, including formal lectures, tutorials and directed independent learning activities and reinforced by laboratory tasks and seminars. Learning resources are made available through the Moodle virtual learning environment to allow flexibility in engagement with the materials. Analytical skills are developed through coursework tasks that encourage creativity and problem solving using a range of systems and computing technologies relevant to Industry 4.0 and the smart factory. Practical applications are a key feature of the course and are emphasised in course design and delivery. Small-group tutorial and practical work comprise up to 50% of timetabled sessions. Learners are assessed both formatively and summatively by a number of methods, the criteria for each module being published within each specified module guide and assignment briefs. Formative assessment occurs in various ways throughout the programme and may involve feedback from peers, tutors and individual reflection, seminars, coursework, exercises and presentations. Summative assessment may include coursework exercises, examinations (seen and unseen, open- and closed- book), presentations, and practical assignments. Intellectual skills, particularly analytical and problem-solving skills, are developed using a range of case-studies and problem / task-based learning scenarios. Assessment of such activities includes practical simulation and design exercises and individual and group projects, in addition to the methods mentioned above. The acquisition of appropriate practical skills is central to the learning strategy of the programme. All technical themes provide weekly timetabled practical laboratory or PC based sessions supported by lecturing or other technically qualified staff. The content of these sessions evolves as the student progresses through the course. This ranges from guided tasks to developing practical skills in the use of Internet of Things platforms and devices, Cybersecurity Risk analysis, AI tools, AR/VR tools, using exercises to reinforce the understanding of their fundamental principles and techniques, to open-ended mini-projects to give experience of practical implementation of Smart Industrial applications. Assessment methods include laboratory and design reports, presentations and in-class demonstrations of working hardware and software or simulated platforms. Transferable/key skills are core to the learning and assessment strategy of the programme. They are pervasive and are incorporated into modules and assessments as appropriate, e.g. team-working skills are fostered and assessed via group task-based practical projects. Learners are encouraged to plan their own work schedules and are required to meet deadlines. Reflection and self-awareness are fostered by keeping logbooks of laboratory and design activity and attending tutor interviews in support of personal performance.

15	**Course Requirements**
15a	**Level 7:** ***In order to complete this course a student must successfully complete all the following CORE modules (totalling 180 credits):***

Module Code	Module Name	Credit Value
CMP7231	Industrial Internet of Things	20
CMP7242	Digital Supply Networks	20
CMP7170	Information Security Governance	20
CMP7239	Applied Machine Learning	20
CMP7220	Advanced and Immersive Technologies	20
CMP7158	Research Methods and Project Management	20
CMP7200	Individual Master's Project	60

Level 6:

In order to qualify for the award of MSc Smart Manufacturing with Professional Placement, a student must successfully complete all of the Level 7 modules listed above as well as the following Level 6 module:

Module Code	Module Name	Credit Value
PLA6004	Professional Placement	60

15b	Structure Diagram

Level 7 – Full Time

SEMESTER 1	SEMESTER 2	SEMESTER 3
CMP7231 Industrial Internet of Things (20 credits) CMP7242 Digital Supply Networks (20 credits) CMP7170 Information Security Governance (20 credits)	CMP7239 Applied Machine Learning (20 credits) CMP7220 Advanced and Immersive Technologies (20 credits) CMP7158 Research Methods and Project Management (20 credits)	CMP7200 Individual Master's Project (60 credits)

Level 7 – Part Time

Year 1 - SEMESTER 1	Year 1 - SEMESTER 2	Year 1 – SEMESTER 3
CMP7231 Industrial Internet of Things (20 credits) CMP7242 Digital Supply Networks (20 credits)	CMP7239 Applied Machine Learning (20 credits) CMP7220 Advanced and Immersive Technologies (20 credits)	
Year 2 - SEMESTER 1	**Year 2 - SEMESTER 2**	**Year 2 – SEMESTER 3**
CMP7170 Information Security Governance (20 credits)	CMP7158 Research Methods and Project Management (20 credits)	CMP7200 Individual Master's Project (60 credits)

Level 7 – Full time Professional Placement

Year 1 SEMESTER 1	**Year 1 SEMESTER 2**	**Year 1 SEMESTER 3**
CMP7231 Industrial Internet of Things (20 credits) CMP7242 Digital Supply Networks (20 credits) CMP7170 Information Security Governance (20 credits)	CMP7239 Applied Machine Learning (20 credits) CMP7220 Advanced and Immersive Technologies (20 credits) CMP7158 Research Methods and Project Management (20 credits)	CMP7200 Individual Master's Project (60 credits)
Year 2 SEMESTER 1	**Year 2 SEMESTER 2**	**Year 2 SEMESTER 3**
Professional Placement **(60 Credits)**		

16 Overall Student Workload and Balance of Assessment

Overall student *workload* consists of class contact hours, independent learning and assessment activity, with each credit taken equating to a total study time of around 10 hours. While actual contact hours may depend on the optional modules selected, the following information gives an indication of how much time students will need to allocate to different activities at each level of the course.

- *Scheduled Learning* includes lectures, practical classes and workshops, contact time specified in timetable
- *Directed Learning* includes placements, work-based learning, external visits, on-line activity, Graduate+, peer learning
- *Private Study* includes preparation for exams

The *balance of assessment* by mode of assessment (e.g. coursework, exam and in-person) depends to some extent on the optional modules chosen by students. The approximate percentage of the course assessed by coursework, exam and in-person is shown below.

Level 7

Workload

17% time spent in timetabled teaching and learning activity

Activity	Number of Hours
Scheduled Learning	306
Directed Learning	418
Private Study	1076
Total Hours	1800

Balance of Assessment

Assessment Mode	Percentage
Coursework	71%
Exam	
In-Person	29%