

### Programme Specification



<b>1. Programme title</b>	MSc Cooperative Intelligent Transport Systems
<b>2. Awarding institution</b>	Middlesex University
<b>3. Teaching institution</b>	Middlesex University: London
<b>4. Details of accreditation by professional/statutory/regulatory body</b>	
<b>5. Final qualification</b>	MSc Cooperative Intelligent Transport Systems PGDip Cooperative Intelligent Transport Systems PGCert Cooperative Intelligent Transport Systems
<b>6. Year of validation</b>	2019/20
<b>Year of amendment</b>	
<b>7. Language of study</b>	English
<b>8. Mode of study</b>	Full-Time & Part-Time

#### **9. Criteria for admission to the programme**

A minimum of a second-class Honours degree (UK), or an equivalent overseas qualification – in computer science or in a science or engineering related subjects. Candidates with other degrees but with relevant work experience may also be considered and are encouraged to apply.

**International students** whose first language is not English or who have not been taught in the English medium throughout, and whose first degree is not from a British university, must achieve an IELTS score of 6.5 with a minimum score of 6 in each band.

C-ITS is the fusion between communication networks and transport infrastructure allowing the building of this new environment. This course offers a good balance between these two fields. Hence any prior expertise in networking or transport systems

can be applied to this course.

For some modules, experience in programming would be very beneficial. Module Leaders and lab tutors will put on programming sessions if required.

**Note:** University policies supporting students with disabilities apply, as described in the University Regulations, 'Information for Students with Disabilities'.

## 10. Aims of the programme

The programme aims to equip students with:

- Full comprehension of the emergence of Connected and Autonomous Vehicles (CAVs) and how those developments are motivating the building of a Cooperative Intelligent Transport System (C-ITS) network.
- Mastery of all the technologies required to build a C-ITS network.
- Ability to prepare a project budget and implementation strategy appropriate for deploying a C-ITS network.
- Expertise to evaluate how C-ITS would bring economic benefits and new business opportunities to the national or global economy.
- Prowess to evaluate the performance of a C-ITS network using analytical models and simulation tools.
- Aptitude to design and deploy a complete C-ITS network.
- Skill to build new secure applications and services, which would enable better traffic management systems to be deployed.
- Complete understanding of the ethical, legal and environmental issues that needs to be considered for C-ITS

## 11. Programme outcomes

### A. Knowledge and understanding

On completion of this programme the successful student will have knowledge and understanding of:

1. all aspects of current transport systems including the financial and technological benefits of transport systems and the need to build a C-ITS network.
2. mobile communications systems that are used in C-ITS. The theory of basic

### Teaching/learning methods

Students gain knowledge and understanding through

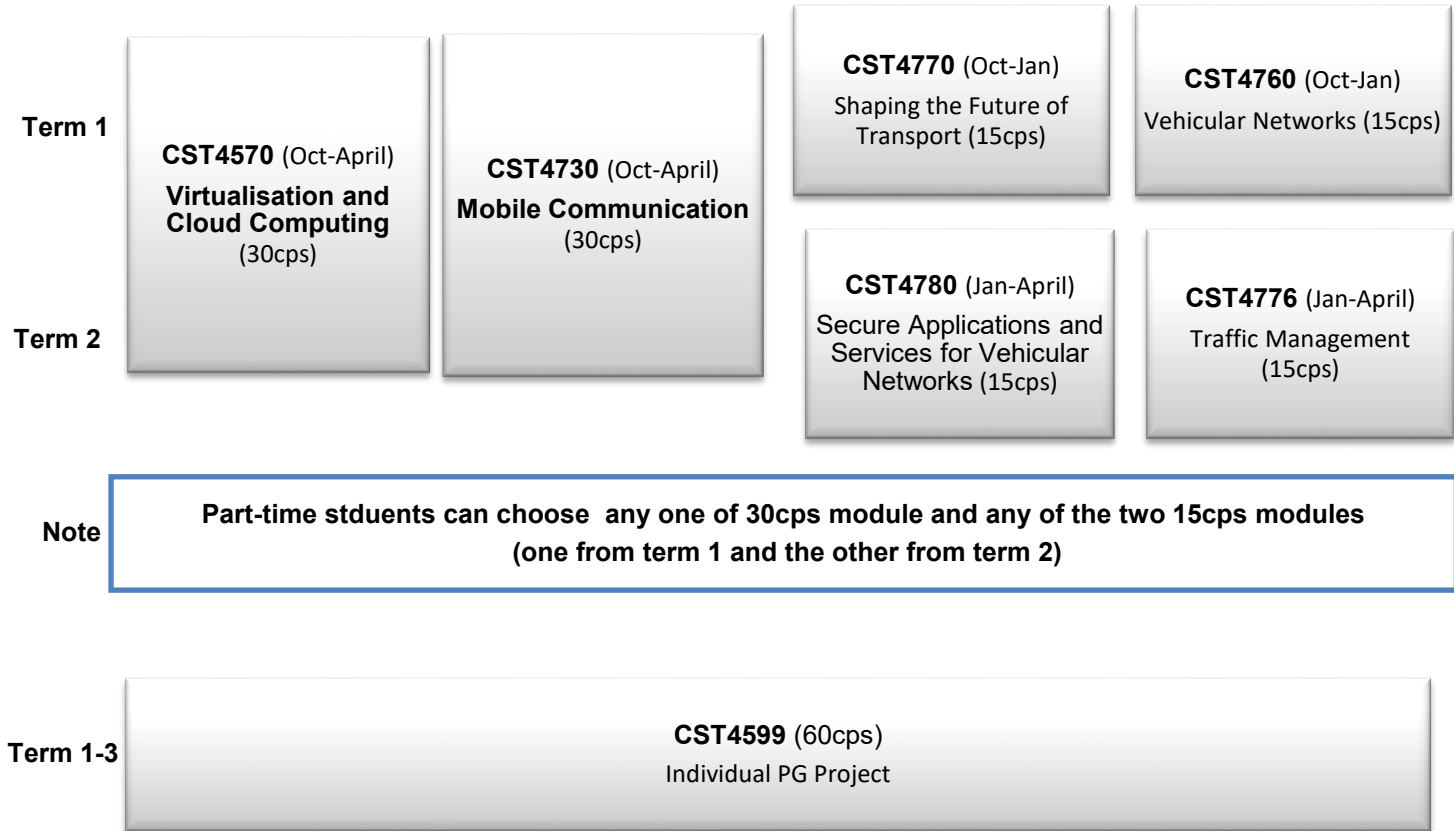
- Traditional lecture delivery (outcomes A1-A8)
- Group and individual research, presentations and written reports (outcomes A4-A5, A7-A8)
- Laboratory sessions (outcome A2-A5, A7-A8)

<p>communication systems as well as different wireless technologies is examined</p> <ol style="list-style-type: none"> <li>3. vehicular networks including the protocols, message formats, deployment and backhaul issues involved in deploying vehicular networks</li> <li>4. the technical aspects of Cloud Systems to store and process data from the vehicular networks</li> <li>5. the algorithms needed to analyse traffic data to determine areas of traffic congestion</li> <li>6. the use and operation of dynamic routing algorithms including the use of machine learning and AI techniques to manage a C-ITS network.</li> <li>7. the deployment of cyber physical security for C-ITS network</li> <li>8. The evaluation of policies developed by transport authorities to deploy a regional or national C-ITS.</li> </ol>	<ul style="list-style-type: none"> <li>• The use of software including the development of servers and applications ranging from operating to applications (outcomes A5-A7)</li> <li>• The individual project Throughout the course, students are encouraged to undertake independent reading both to supplement and consolidate what is being taught / learnt and to broaden their individual knowledge and understanding of the subject (outcomes A1-A8)</li> </ul> <p><b>Assessment methods</b> Students' knowledge and understanding is assessed by:</p> <p>Group and individual coursework, presentations, group and individual reports, and the unseen examination and the project thesis assess students' knowledge and understanding.</p> <ul style="list-style-type: none"> <li>• Outcomes A1-A8 assessed by examination.</li> <li>• Outcomes A2 – A7 are assessed by laboratory sessions and practical assignments</li> </ul> <p>Outcome A1-A8 is assessed by individual essay and final project thesis.</p>
<p><b>B. Skills</b> On completion of this programme the successful student will be able to:</p> <ol style="list-style-type: none"> <li>1. critically analyse different types of transport and how these systems are integrated to provide transport for a given city or region.</li> <li>2. design and implement a new transport policy that will need to use new networking technology</li> <li>3. use simulation and analytic techniques</li> </ol>	<p><b>Teaching/learning methods</b> Students learn cognitive skills through</p> <ul style="list-style-type: none"> <li>• Traditional lecture delivery (outcomes B1-B10)</li> <li>• Group research (outcomes B1-B3, B5, B7-B9)</li> <li>• Presentations and written reports (outcomes B1-B4, B7-B10)</li> <li>• Small group and individual exercises (outcomes B1-B9)</li> </ul>

<p>to design vehicular networks</p> <ol style="list-style-type: none"> <li>4. implement a new vehicular network</li> <li>5. deploy a Cloud System to store and process data from vehicular networks.</li> <li>6. Implement servers and applications to make use of vehicular data for C-ITS networks</li> <li>7. design and deploy new security mechanisms for C-ITS networks</li> <li>8. investigate algorithms for traffic management</li> <li>9. use machine learning and AI algorithms for traffic management</li> <li>10. make presentations on transport initiatives and projects to major companies and corporations</li> </ol>	<ul style="list-style-type: none"> <li>• Laboratory sessions (B2-B3, B5-B9)</li> <li>• The use of various network software to build servers and applications (outcomes B5-B6 and B10)</li> <li>• Individual and group design work (outcomes B2-B9)</li> <li>• The project thesis (outcomes B1–B10 depending on project title)</li> </ul> <p>Analysis, design and problem solving skills are further developed through various design activities as well as case studies, and extensive computer laboratory sessions. Feedback is given to students on all assessed coursework as well as written exams (in the form of exam reports produced each term)</p> <p><b>Assessment Methods</b></p> <p>Students' cognitive skills are assessed by:</p> <ul style="list-style-type: none"> <li>• Group and individual coursework (outcomes B1-B3, B5-B9)</li> <li>• Presentations (outcomes B2-B3)</li> <li>• Laboratory logbooks (outcomes B4-B7)</li> <li>• Reports (outcomes B1, B2, B4-B10)</li> <li>• The unseen examination (outcomes B1-B10)</li> <li>• The project thesis (outcomes B1-B10 depending on project title)</li> </ul>
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## 12. Programme structure (levels, modules, credits and progression requirements)

### 12. 1 Overall structure of the programme Full-Time/ Part-Time



<b>12. Levels and modules</b>	
<b>COMPULSORY (ALL MODULES)</b>	<b>PROGRESSION REQUIREMENTS</b>
<p>Students must take all of the following:</p> <p><b>CST4770:</b> Shaping the Future of Transport</p> <p><b>CST4760</b> Vehicular Networks</p> <p><b>CST4730:</b> Mobile Communication</p> <p><b>CST4570:</b> Virtualisation and Cloud Computing</p> <p><b>CST4776</b> Traffic Management</p> <p><b>CST4780:</b> Secure Applications and Services for Vehicular Networks</p> <p><b>CST4599:</b> Individual PG Project</p>	<p><b>Students must pass all the taught modules and submit a formal proposal before they can progress onto the project.</b></p> <p><b>To pass a module, students must pass all components of assessment (i.e. examinations, coursework)</b></p>

<b>12.3 Non-compensatory modules</b>	
<b>Module level</b>	<b>Module code</b>
7	CST4730 Mobile Communication
7	CST4599 Individual PG Project

<p><b>13. Curriculum map</b></p> <p>See attached.</p>
<p><b>14. Information about Assessment Regulations</b></p> <p>Compulsory modules are those that must be taken; that is, the qualification cannot be made unless these modules have been successfully completed.</p> <p>Each of these modules makes a unique contribution to the learning objectives of the programme.</p> <ul style="list-style-type: none"> <li>Information on how the University formal assessment regulations work, including</li> </ul>

details of how award classifications are determined, can be found in the University Regulations at [www.mdx.ac.uk/regulations/](http://www.mdx.ac.uk/regulations/).

- Modules are assessed in accordance with the Faculty of Science and Technology assessment strategy. Most modules adhere to a standard pattern of final grades being made up of examinations and/or coursework.
- Practical aspects of the programme are often assessed via coursework that may be carried out using specialist software and may include lab tests.
- Theoretical material is normally assessed by a combination of both coursework and examination at level 7.
- Grades are awarded on the standard University scale of 1–20, with Grade 1 (80-100%) being the highest. To pass a module all components, both coursework and examination, must be passed individually with a minimum grade of 16 (40%). Failure in one of the components will result in the failure of the module.
- For additional information on assessment and how learning outcomes are assessed please refer to the individual module narratives for this programme.

### **15. Placement opportunities, requirements and support**

- Industrial placement is an option available for students who wish to work in industry for a maximum period of 12 weeks. During this period students are expected to work on their project, part of which should be relevant to the company where the placement is arranged.
- Industrial placement is conditional on the successful completion of all taught modules. Therefore 120 credits at level 7 need to be successfully completed before embarking on an industrial placement.
- In this programme placements are normally a student-initiated process for which the University will provide support. Where possible, the University will use its extensive industrial links with transport companies to help in this process. Students who are already employed with transport companies should seek to do a relevant project at their place of employment.

### **16. Future careers**

All programmes in the Faculty of Science & Technology – their curricula and learning outcomes – have been designed with an emphasis on currency and the relevance to future employment.

- <https://unihub.mdx.ac.uk/employment> is a website that is used to help graduates of Middlesex University to gain employment.
- The majority of graduates usually gain employment in transport, communication, Cloud Administration and Project management of Transport projects.

- Over 20% of students pursue further postgraduate study or research.
- The Faculty has an Industrial Advisory Group, which meets to advise and inform the department and the faculty about employment trends in industry.

The employer links with the faculty are encouraged and take part in a number of ways:

- by inviting experts from industry as guest speakers in lectures;
- through links with companies where students are employed as part of their Industrial placement and alumni both in the UK and overseas.

### **17. Particular support for learning**

In support of the student learning experience:

- The Faculty's teaching and Learning Strategy is compliant with those of the University, in seeking to develop learner autonomy and resource-based learning. In support of the students learning experience:
- All new students go through an induction programme and some have early diagnostic numeric and literacy testing before starting their programme. The Learning Enhancement Team provides one-to-one tutorials and workshops for those students needing additional support in these areas.
- An electronic copy of the programme handbook is made available to students at enrolment.
- Electronic copies of all module handbooks can also be found on Unihub. Web-based learning materials are provided to further support learning.
- Extensive library facilities are available at the University.
- Students can access advice and support on a wide range of issues using Unihelp.
- High quality specialist laboratories equipped with industry standard software and hardware where appropriate, for formal teaching as well as self-study.
- Tutorial sessions for each module organised for groups of up to 20 students are provided for additional teaching support.
- Formative feedback is given on completion of student coursework
- Past exam papers for all modules (which are assessed by examination) are available for students via Unihub.
- Research activities of academic staff feed into the teaching programme, which can, on some occasions, provide an opportunity for students to work with academics on some aspect of research.

Middlesex University encourages and supports students with disabilities. Some practical aspects of Faculty of Science & Technology programmes may present challenges to students with particular disabilities. You are encouraged to visit our campuses at any time to evaluate facilities and talk in confidence about your needs. If we know your individual needs we'll be able to provide for them more easily. For further information contact the Disability Support Service (email: [disability@mdx.ac.uk](mailto:disability@mdx.ac.uk)).



<b>18. JACS code (or other relevant coding system)</b>	G420
<b>19. Relevant QAA subject benchmark group(s)</b>	Computing

### **20. Reference points**

The following reference points were used in designing and reviewing the programme:

- QAA Framework for Higher Education Qualification in England, Wales and Northern Ireland
- QAA Computing subject benchmarks
- QAA/QAAS guidelines for programme specification
- QAA Code of Practice for the assurance of academic quality and standards in HE
- University Policy, Regulations and guidelines
- British Computer Society (BCS) Guidelines for Exemption and Accreditation
- Middlesex University and Faculty of Science and Technology Teaching, Learning and Assessment Policies and Strategies
- Teaching Learning and Assessment policies and strategies

Please note programme specifications provide a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve if s/he takes full advantage of the learning opportunities that are provided. More detailed information about the programme can be found in the rest of your programme handbook and the university regulations.

## Curriculum map for *MSc Cooperative Intelligent Transport Systems*

This section shows the highest level at which programme outcomes are to be achieved by all graduates, and maps programme learning outcomes against the modules in which they are assessed.

### Programme learning outcomes

<b>Knowledge and understanding</b>	
A1	All aspects of current transport systems including the financial and technological benefits of transport systems and the need to build a C-ITS network.
A2	Vehicular networks including the protocols, message formats, deployment and backhaul issues involved in deploying vehicular networks
A3	Mobile communications systems that are used in C-ITS. The theory of basic communication systems as well as different wireless technologies is examined
A4	The technical aspects of Cloud Systems to store and process data from the vehicular networks
A5	The algorithms needed to analyse traffic data to determine areas of traffic congestion
A6	The use and operation of dynamic routing algorithms including the use of machine learning and AI techniques to manage a C-ITS network.
A7	the deployment of cyber physical security for C-ITS network.
A8	The evaluation of policies developed by transport authorities to deploy a regional or national C-ITS.
<b>Skills</b>	
B1	Critically analyse different types of transport and how these systems are integrated to provide transport for a given city or region.
B2	Design and implement a new transport policy that will need to use new networking technology
B3	Use of simulation and analytical techniques to design vehicular networks
B4	Implement a new vehicular network
B5	Deploy a Cloud System to store and process data from vehicular networks.

B6	Implement servers and applications to make use of vehicular data for C-ITS networks
B7	Design and deploy new security mechanisms for C-ITS networks
B8	Investigate algorithms for traffic management
B9	Use machine learning and AI algorithms for traffic management
B10	Make presentations on transport initiatives and projects to major companies and corporations

Programme outcomes																	
A1	A2	A3	A4	A5	A6	A7	A8	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
Highest level achieved by all graduates																	
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7

Module Title	Module Code by Level	A1	A2	A3	A4	A5	A6	A7	A8	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
		Shaping the Future of Transport	CST4770	✓							✓	✓	✓						
Vehicular Networks	CST4760	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
Mobile Communications	CST4730	✓	✓	✓			✓		✓		✓	✓	✓						✓

Secure Applications and Servers	CST4780	✓			✓	✓		✓	✓		✓			✓	✓	✓			✓
Virtualisation and Cloud Computing	CST4570				✓	✓	✓					✓		✓	✓	✓			✓
Traffic Management	CST4776	✓		✓	✓	✓	✓			✓	✓		✓		✓		✓	✓	✓
Individual PG Project	CST4599	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓