

## Graduate Certificates, Core and Elective Modules Offered

| Unit  | Module Title   | MCs       | LAB         | Subsidy status |
|---|--|-----------|-------------|----------------|
| <b>Core Modules</b>                                       |  |           |             |                |
|   | <a href="#"><u>IND5001 Introduction to Industry 4.0 and Applications</u></a> | <b>4</b>  | N           | No subsidy     |
|   | <a href="#"><u>IND5002 Digital-Physical Integration in Industry 4.0</u></a>  | <b>4</b>  | N           | No subsidy     |
|   | <a href="#"><u>IND5003 Data Analytics for Sense-making</u></a>               | <b>4</b>  | N           | No subsidy     |
|   | <a href="#"><u>IND5004 Digital Infrastructure and Transformation</u></a>     | <b>4</b>  | N           | No subsidy     |
|   | <a href="#"><u>IND5005 Industry Consulting and Application Project</u></a>   | <b>4</b>  | N           | No subsidy     |
| <b>Elective Modules from Graduate Certificate Courses</b> |  |           |             |                |
| <b>FoE</b>  | <b><a href="#"><u>Additive Manufacturing (Choose 6 modules)</u></a></b>      | <b>12</b> |             |                |
|   | ME5608A Principles and Processes of Additive Manufacturing                   | 2         | Y           | SSG subsidy    |
|   | ME5608B Hybrid Manufacturing   | 2         | Y           | SSG subsidy    |
|   | ME5615A Design and Pre-processing for Additive Manufacturing                 | 2         | Y           | SSG subsidy    |
|   | ME5615B Post-processing for Additive Manufacturing                           | 2         | Y           | SSG subsidy    |
|   | ME5614A Special Project in Additive Manufacturing                            | 2         | Y           | SSG subsidy    |
|   | ME5513A Fatigue Analysis for Additive Manufacturing                          | 2         | Y           | SSG subsidy    |
|   | MLE5301 Metallic & Ceramic Materials in Additive Manufacturing               | 2         | Y           | SSG subsidy    |
|   | MLE5302 Polymer Materials in Additive Manufacturing                          | 2         | Y           | SSG subsidy    |
|   | <b><a href="#"><u>Internet of Things (Choose 5 modules)</u></a></b>          | <b>10</b> |             |                |
|   | EE5020 Data Science for Internet of Things                                   | 2         | Y           | SSG subsidy    |
|   | EE5021 Cloud Based Services for Internet of Things                           | 2         | Y           | SSG subsidy    |
|   | EE5022 Cyber Security for Internet of Things                                 | 2         | Y           | SSG subsidy    |
|   | EE5023 Wireless Networks   | 2         | Y           | SSG subsidy    |
|   | EE5024 Sensor Networks   | 2         | Y           | SSG subsidy    |
|   | EE5025 Intellectual Property: Innovations in IoT                             | 2         | Y           | SSG subsidy    |
|   | EE5026 Machine Learning for Data Analytics                                   | 2         | Y           | SSG subsidy    |
|   | EE5027 Statistical Pattern Recognition                                       | 2         | Y           | SSG subsidy    |
|   | EE5060 Sensors and Instrumentation for Automation                            | 2         | Y           | SSG subsidy    |
| EE5061 Industrial Control and Programming                 | 2  | Y         | SSG subsidy |                |
| <b>FoS</b>  | <b>Data Mining and Interpretation</b>  | <b>8</b>  |             |                |
|   | ST5227 Applied Data Mining   | 4         | N           | SSG subsidy    |
|   | DSA5203 Visual Data Processing and Interpretation                            | 4         | N           | SSG subsidy    |
|   | <b><a href="#"><u>Deep Learning for Industry</u></a></b>                     | <b>8</b>  |             |                |
|   | DSA5102 Foundations of Machine Learning                                      | 4         | N           | SSG subsidy    |
|   | DSA5204 Deep Learning and Applications                                       | 4         | N           | SSG subsidy    |
|   | <b>Quality Assurance and Yield Optimization</b>                              | <b>8</b>  |             |                |
|   | ST5203 Design of Experiments for Product Design and Process Improvements     | 4         | N           | SSG subsidy    |
|   | ST5208 Analytics for Quality Control and Productivity Improvements           | 4         | N           | SSG subsidy    |

| Unit  | Module Title   | MCs | LAB | Subsidy status |
|-------|--|-----|-----|----------------|
| ISS   | <u><a href="#">ISY5002 Pattern Recognition Systems</a></u> <ul style="list-style-type: none"> <li>• Problem Solving Using Pattern Recognition</li> <li>• Pattern Recognition and Machine Learning Systems</li> <li>• Intelligent Sensing and Sense Making</li> <li>• Practice Project</li> </ul> | 13  | Y   | SSG subsidy    |
|       | <u><a href="#">ISY5004 Intelligent Sensing Systems</a></u> <ul style="list-style-type: none"> <li>• Vision Systems Engineering</li> <li>• Spatial Reasoning from Sensor Data</li> <li>• Real time audio-visual sensing and sense making</li> <li>• Practice Project</li> </ul>                   | 10  | Y   | SSG subsidy    |
| SCALE | <u><a href="#">Digital Supply Chain</a></u>  | 12  |     |                |
|       | IND5021 Managing the Digital Supply Chain  | 4   | N   | SSG subsidy    |
|       | IND5022 Data Analytics for Smart Manufacturing   | 4   | N   | SSG subsidy    |
|       | DSC5221A Managing the Financial Supply Chain   | 2   | N   | SSG subsidy    |
|       | IND5024 Strategic Procurement in a Digital World   | 2   | N   | SSG subsidy    |
| SoC   | <u><a href="#">Principles and Practice of Secure Systems (Choose 3 modules)</a></u>  | 12  |     |                |
|       | CS5321 Network Security  | 4   | Y   | SSG subsidy    |
|       | CS5322 Database Security   | 4   | Y   | SSG subsidy    |
|       | CS5332 Biometric Authentication  | 4   | Y   | SSG subsidy    |
|       | CS5331 Web Security  | 4   | Y   | SSG subsidy    |
|       | CS5439 Software Security   | 4   | Y   | SSG subsidy    |
|       | <u><a href="#">Digital Business (Choose 3 modules)</a></u>   | 12  |     |                |
|       | IS5007 Strategising for Global IT-enabled Business Success   | 4   | N   | SSG subsidy    |
|       | IS5116 Digital Entrepreneurship  | 4   | N   | SSG subsidy    |
|       | IS5117 Digital Government  | 4   | N   | SSG subsidy    |
|       | IS5151 Information System Security Policy and Management   | 4   | N   | SSG subsidy    |

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## ***Core Modules offered in the Master of Science (Industry 4.0) Programme***

### **IND5001 Introduction to Industry 4.0 and Applications**

#### **Module Description:**

The 4th Industrial Revolution is characterized by a confluence of different technologies coming together, and massive amounts of data being generated. Companies are incorporating Industry 4.0 technologies into their operations, and creating new business models through digitalizing and transforming their products and services. This has consequences for how companies think about their business.

The course is a core module to understand about business operations and processes, and how the Industry 4.0 technologies can be applied. We will also look innovation frameworks and how these technologies fit into strategic technology transformation roadmaps.

**Pre-requisite(s):** Nil

**Co-requisite(s):** Nil

**Preclusion(s):** Nil

**Cross-listing:** Nil

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### **IND5002 Digital-Physical Integration in Industry 4.0**

#### **Module Description:**

This module introduces the key recent technological developments that enable cyber-physical systems, which in turn will define Industry 4.0. Topics will be organized under additive manufacturing, robotics and automation, and Internet of Things. This is a core module in the MSc in Industry 4.0 and provides a common technology foundation for students in that programme.

**Pre-requisite(s):** Nil

**Co-requisite(s):** Nil

**Preclusion(s):** Nil

**Cross-listing:** Nil

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### **IND5003 Data Analytics for Sense-making**

#### **Module Description:**

Technological advancements such as cyber-physical systems and the Internet of Things are enabling connected machines which collect a tremendous volume of structured and unstructured data. This module covers essential analytics tools and techniques for performing supervised and unsupervised learning on that data. It focuses on applications in such domains as consumer, human resource, manufacturing, medical and retail to identify patterns and insights for process improvements and decision-making. These tools include the Python programming language; the techniques include frequently used time series models and predictive models such as regression, random forests, neural networks and deep learning.

**Pre-requisite(s):** Nil

**Co-requisite(s):** Nil

**Preclusion(s):** Nil

**Cross-listing:** DSA5231 Data Analytics for Sense-making

## **IND5004 Digital Infrastructure and Transformation**

### **Module Description:**

This module brings the students through the journey of digitalization in transforming organizations, include how they operate, manufacture products and deliver services.

This module covers two major aspects, namely:

- strategizing organizations for digital transformation; and
- transforming the organization's digital infrastructure.

The first aspect covers:

- fundamentals of digitisation, digitalization, and digital transformation;
- digital transformation dimensions, approaches, and readiness indices;
- stakeholder analysis and change management;
- digital culture and organizational culture transformation; and
- workforce and skillset upgrading.

The second aspect covers the technology building blocks (e.g., cloud computing) and cybersecurity measures and approaches.

**Pre-requisite(s):** Nil

**Co-requisite(s):** Nil

**Preclusion(s):** IS5002 Digital Transformation

**Cross-listing:** Nil

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## **IND5005 Industry Consulting and Application Project**

### **Module Description:**

This module will be the last core module of the MSc programme to be taken just prior to graduation, with a view to applying learnings in the programme to actual application of one or more Industry 4.0 technology areas in a company, students will form teams of 3 to 4 people to work on a project implementation in a company, under the supervision of one or more faculty with the appropriate expertise for the project. The outcome will be a prototype or minimum viable product, as well as a report and presentation.

**Pre-requisite(s):** Pass at least 16 MCs with two core modules including IND5001

**Co-requisite(s):** Nil

**Preclusion(s):** Nil

**Cross-listing:** Nil

## ***Graduate Certificate in Digital Supply Chain – NUS SCALE***

The Graduate Certificate (GC) in Digital Supply Chain aims to equip students with the skills to analyse the supply chain operational model, and implement process improvement wherever necessary to boost efficiency and output.

Offered by NUS' School of Continuing and Lifelong Education (NUS SCALE), the GC is offered under the NUS Master of Science (MSc) in Industry 4.0.

The logistics and manufacturing industries are undergoing deep transformation as new data-driven business models shake up traditional approaches to business, paving the way for new industries like the sharing economy to grow.

The Supply Chain also forms one of the eight building blocks of the Singapore Smart Industry Readiness Index, which was created by the Singapore Economic Development Board (EDB) after consultation with over 300 companies and stakeholders across various industries.

The modules offered under this GC are:

| <b>Digital Supply Chain</b>                      |
|--|
| IND5021 Managing the Digital Supply Chain        |
| IND5022 Data Analytics for Smart Manufacturing   |
| DSC5221A Managing the Financial Supply Chain     |
| IND5024 Strategic Procurement in a Digital World |