



UNIVERSITY OF  
CAMBRIDGE

Department of Engineering

**Institute for Manufacturing**

METIIA Course  
Handbook 2025-26

# Disclaimer








We have endeavoured to ensure that the information contained in this handbook is as accurate as possible. However, it is likely that minor changes and updates may need to be made to some sections during the course of the year.












We will ensure that all updates are communicated to you by email and/or posted on the MET IIA Moodle site.





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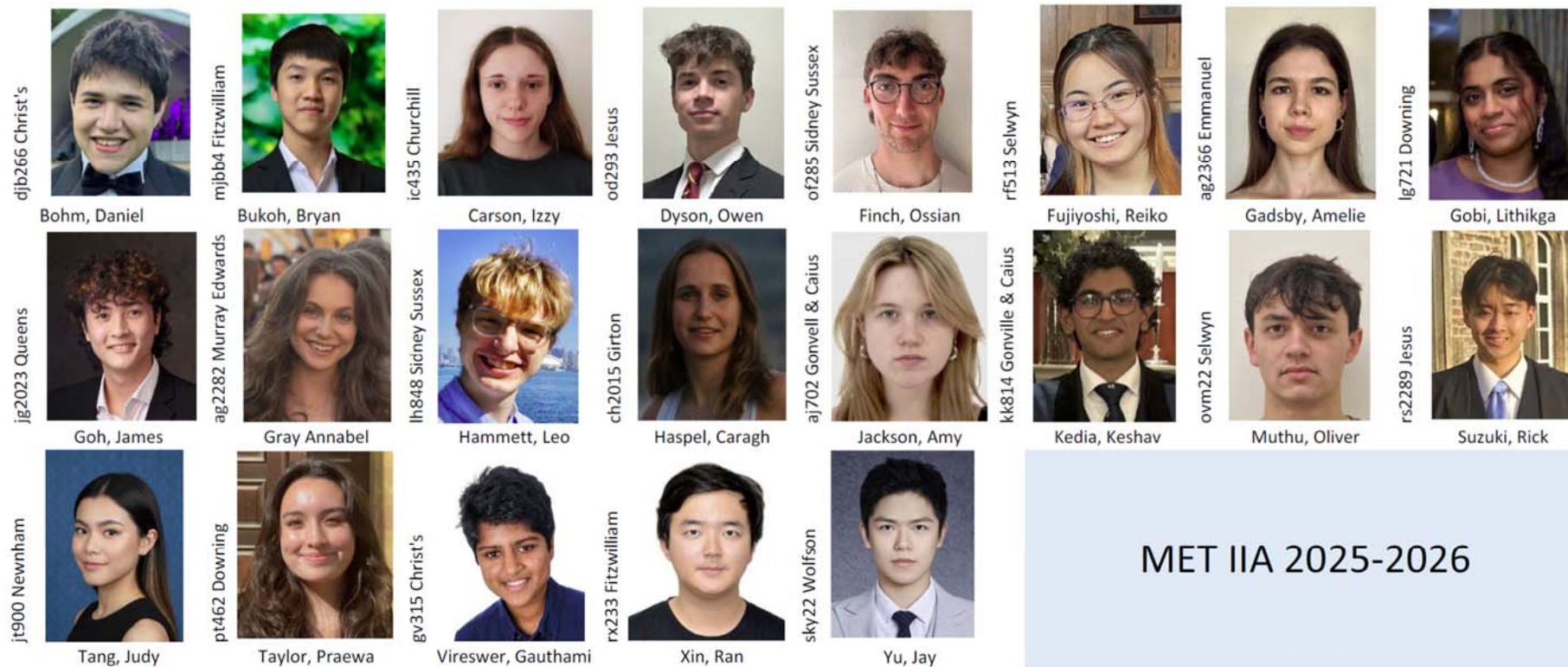
# MET Ila People

|  |   |   |   |
|--|---|---|---|
| <b>Course Directors</b>  | <br>Prof Aexandra Brintrup<br>(IIa)              | <br>Dr Letizia Mortara (IIb)     |   |
| <b>Teaching office</b>   | <br>Shane Strawson<br>(MET Admin)                | <br>Hannah Smith<br>(ISMM Admin) | Arlene Metcalfe<br>(Teaching Office Admin)  |
| <b>3P1 Materials into Products (Mich)</b>                                  | <br>Dr Matteo Seita<br>(module leader)           | <br>Dr Claire Barlow             |   |
| <b>3P2 Operation and Control of Production Machines and Systems (Mich)</b> | <br>Prof Bill O'Neill<br>(module leader)       | <br>Dr Karel Kruger            |   |
| <b>3P3 Product Design (Mich)</b>   | <br>Prof James Moultrie<br>(module leader)     | <br>Prof Michael De Volder     | <br>Dr Sebastian Pattinson |
| <b>3P4 Operations Management (Lent)</b>                                    | <br>Prof Alexandra Brintrup<br>(module leader) |   |   |
| <b>3P5 Industrial Engineering (Lent)</b>                                   | <br>Prof Ajith Parlikad<br>(module leader)     |   |   |

|   |   |   |   |   |
|---|---|---|---|---|
| <b>3P6<br/>Organisational<br/>Behaviour (Mich)</b>                              |    |   |   |   |
|   | Dr Mukesh Kumar<br>(module leader)  |   |   |   |
| <b>3P7 Managing<br/>Business and<br/>People (Lent)</b>                          |    |   |   |   |
|   | Dr Mukesh Kumar<br>(module leader)  |   |   |   |
| <b>3P8 Financial<br/>and<br/>Management<br/>Accounting<br/>(Mich)</b>           |    |   |   |   |
|   | Prof Chander Velu<br>(module leader)  |   |   |   |
| <b>3P9 Industrial<br/>Economics,<br/>Strategy and<br/>Governance<br/>(Lent)</b> |   |   |   |   |
|   | Prof Chander Velu<br>(module leader)  |   |   |   |
| <b>3P10<br/>Contemporary<br/>Issues in<br/>Manufacturing<br/>(Mich)</b>         |  |  |   |   |
|   | Prof Ronan Daly<br>(module leader)  | Dr Nathaniel Cooper   |   |   |
| <b>Major Project</b>  |  |  |  |  |
|   | Prof James Moutlrie   | Prof Michael De Volder  | Dr Sebastian Pattinson  | Prof Chander Velu   |
| <b>Industrial Visits<br/>and Workshops</b>                                      |  |   |   |   |
|   | Dr Karel Kruger   |   |   |   |

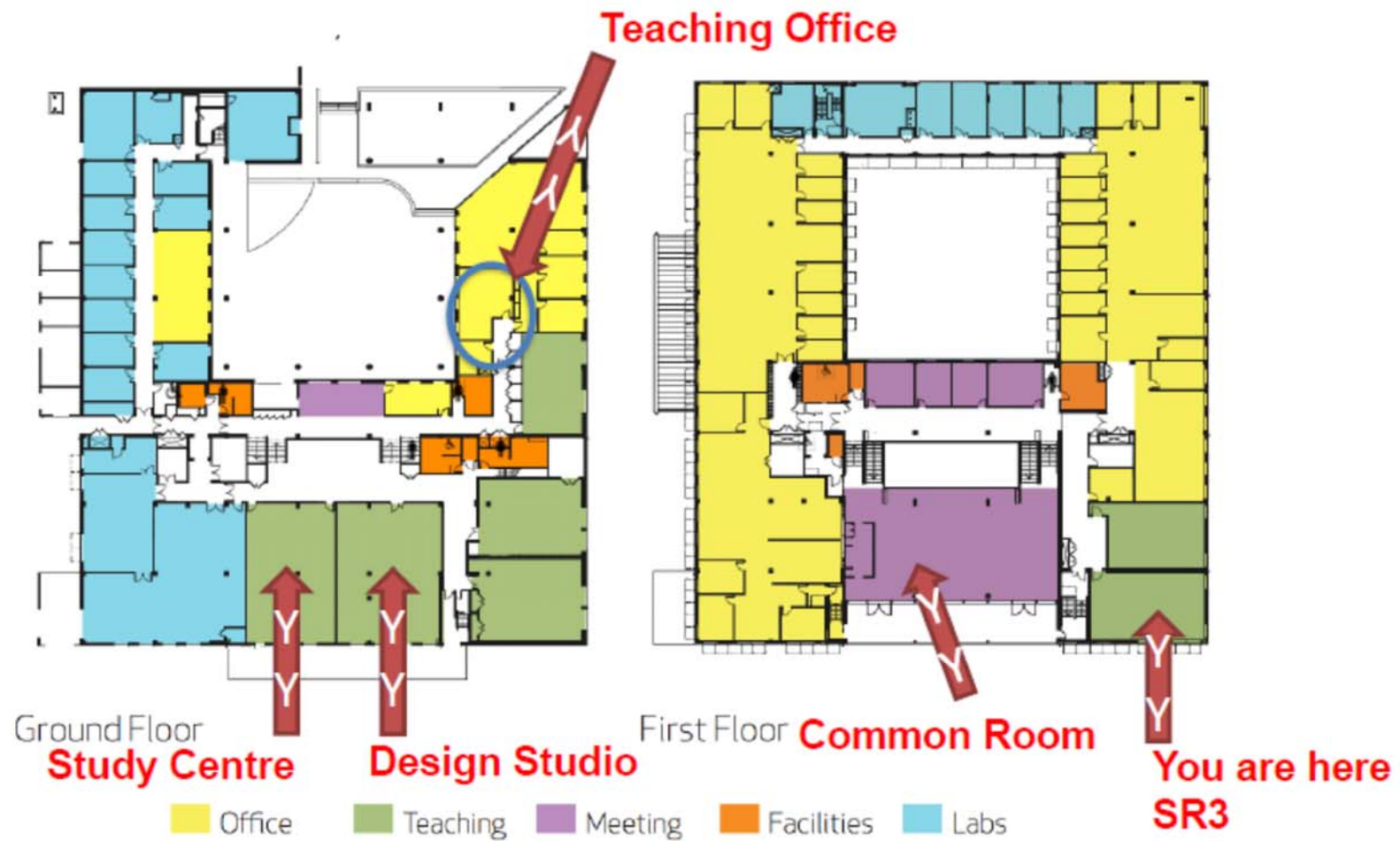
|                                     |   |   |   |
|-------------------------------------|---|---|---|
| <b>CADCAM</b>                       | <br>Alan Thorne (Technical officer)                  |   |   |
| <b>Production Game</b>              | <br>Prof Alexandra Brintrup                          |   |   |
| <b>IT Support</b>                   | <br>Lewis Grantham (Heads the IT team)               | <br>Giles Hainsworth (Senior Computing Technician)     |   |
| <b>Workshop / Technical support</b> | <br>Alan Thorne (Technical officer)                 | <br>Chris Jennings (Workshop technician, mechanical) | <br>Simon Sennitt (Workshop technician, electrical) |
| <b>Others who you should know</b>   | <br>Maggie Harriss<br>IfM Divisional Administrator |   |   |

## 2025-26 Year Group





# IfM Floor Plan





# Course overview and timetables

## **Project, Coursework and Examination Credit for Part IIA of the Manufacturing Engineering Tripos**

The Examiners for Part IIA of the Manufacturing Engineering Tripos in 2025 will take account of work produced by candidates. The Faculty Board have determined that this shall consist of work with the requirements and total marks available set out below.

Major project - 140 marks

CAD/CAM exercise - 30 marks

Production game - 30 marks

Visits programme - 40 marks

9 examined modules - 60 marks each

1 module assessed by coursework - 60 marks

Students are expected to undertake all the coursework as specified above. Students should refer to the MET Extensions & Penalty policy, which is included in the MET student handbook. Work submitted for marking must be that of the student who submits it, as defined in the [plagiarism, cooperating and cheating guidelines](#).

## Summary of Taught Modules

| Module number | Module Title                                  | Module Scope   | Assessment       | Term       |
|---------------|---|--|------------------|------------|
| 3P1           | Materials into Products                       | From microstructure to mechanical property: manufacturing process optimisation for all classes of solids             | 100% Examination | Michaelmas |
| 3P2           | Production Machines and Systems               | The specification, operation and management of production machines and systems                                       | 100% Examination | Michaelmas |
| 3P3           | Design  | Integrating engineering and industrial design in the creation of new products  | 100% Coursework  | Michaelmas |
| 3P4           | Operations Management                         | The management of material and information flow in the factory and in the supply chain                               | 100% Examination | Lent       |
| 3P5           | Industrial Engineering                        | The design of production flows and operations in manufacturing   | 100% Examination | Lent       |
| 3P6           | Organisational Behaviour                      | An introduction to the theory of organisational behaviour  | 100% Examination | Michaelmas |
| 3P7           | Managing Business and People                  | An introduction to the processes involved in starting and running a business   | 100% Examination | Lent       |
| 3P8           | Financial and Management Accounting           | An introduction to the principles and practice of financial and management accounting                                | 100% Examination | Michaelmas |
| 3P9           | Industrial Economics, Strategy and Governance | An introduction to the principles and practice of industrial economics, strategy and corporate governance            | 100% Examination | Lent       |
| 3P10          | Contemporary Issues in Manufacturing          | (a) Integrative industrial visits to study modern manufacturing practice<br>(b) Lectures to introduce current topics | 100% Examination | Michaelmas |

## Examinations and Coursework Structure

| Name               | Descriptor  | Contents   | Marks      |
|--------------------|---|--|------------|
| Paper 1            | Single module<br>paper: 90 minutes<br>Common with 3C1 | Module 3P1, Materials into Products  | 60         |
| Paper 2            | Single module<br>paper: 90 minutes                    | Module 3P2, Production Machines and Systems  | 60         |
| Paper 3            | Double module<br>paper: 3 hours                       | Module 3P4, Operations Management<br>Module 3P5, Industrial Engineering                                      | 120        |
| Paper 4            | Double module<br>paper: 3 hours                       | Module 3P6, Organisational Behaviour<br>Module 3P7, Managing Business and People                             | 120        |
| Paper 5            | Double module<br>paper: 3 hours                       | Module 3P8, Financial and Management Accounting<br>Module 3P9, Industrial Economics, Strategy and Governance | 120        |
| Paper 6            | Single module<br>paper: 90 minutes                    | Module 3P10, Contemporary Issues in Manufacturing  | 60         |
| 3P3 Product Design | Single module<br>assessed coursework                  |  | 60         |
| Major Project      | Coursework  |  | 140        |
| CAD/CAM exercise   | Coursework  |  | 30         |
| Production Game    | Coursework  |  | 30         |
| Visits             | Coursework  |  | 40         |
| <b>TOTAL</b>       |   |  | <b>840</b> |

Michaelmas Timetable: **Note, these timetables are provisional and are subject to change**

| weeks |        | 9-10                    |  | 10-11 |  | 11-12 |   | 12-1 |  | 1-2 |  | 2-3 |   | 3-4 |   | 4-5 |  | 5-6 |  |  |  |  |                    |  |  |  |
|-------|--------|-------------------------|--|-------|--|-------|---|------|--|-----|--|-----|---|-----|---|-----|--|-----|--|--|--|--|--------------------|--|--|--|
| 0     | 06-Oct | Monday                  |  |       | Induction [0], BRINTRUP, SR3   |       |   |      |  |     |  |     | Induction [0], BRINTRUP, SR3                            |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 1     | 13-Oct |                         | 3P10: Contemp issues in manuf. [1-4], DALY / COOPER, SR3                           |       |  |       |   |      |  |     | 3P6: Organisational Behaviour [1-8], KUMAR SR3       |     |   |     |   |     |  |     | Rapid Prototype Workshop 2 (group of 10 students)    |  |  |  |                    |  |  |  |
| 2     | 20-Oct |                         |  |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     | 1.30pm - 5.30pm Workshop (4) - (Group of 4 students) |  |  |  |                    |  |  |  |
| 3     | 27-Oct |                         |  |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 4     | 03-Nov |                         |  |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 5     | 10-Nov |                         |  |       | 3P10: Contemp issues in manuf. [5-8] DALY SR3                        |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 6     | 17-Nov |                         |  |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 7     | 24-Nov |                         |  |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 8     | 01-Dec |                         |  |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 0     | 07-Oct | Tuesday                 | Induction [0], BRINTRUP, SR3   |       |  |       |   |      |  |     |  |     | Induction [0], BRINTRUP, SR3                            |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 1     | 14-Oct |                         |  |       |  |       |   |      |  |     |  |     | 1.30pm - 5.30pm Workshop (1) - (Group of 4 students)    |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 2     | 21-Oct |                         | Introduction to Visits SR3   |       |  |       | Skills workshop SR3                                   |      |  |     |  |     | 1.30pm - 5.30pm Workshop (5) - (Group of 4 students)    |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 3     | 28-Oct |                         | Industrial Visit: scheduled all day but may finish earlier depending upon location |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 4     | 04-Nov |                         | Visit Debrief SR3  |       |  |       | Skills workshop SR3                                   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 5     | 11-Nov |                         | Industrial Visit: scheduled all day but may finish earlier depending upon location |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 6     | 18-Nov |                         | Visit Debrief SR3  |       |  |       | Skills workshop SR3                                   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 7     | 25-Nov |                         | Industrial Visit: scheduled all day but may finish earlier depending upon location |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 8     | 02-Dec | Wednesday               | Visit Debrief SR3  |       |  |       | Skills workshop SR3                                   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 0     | 08-Oct |                         | Induction [0], BRINTRUP, I/M, SR3  |       |  |       |   |      |  |     |  |     | 3P8: Financial & management accounting, [1-8], VELU SR3 |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 1     | 15-Oct |                         | 3P1: Materials into products [1-8], SEITA / BARLOW, LR6                            |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 2     | 22-Oct |                         |  |       |  |       |   |      |  |     | 1.30pm - 5.30pm Workshop (2) - (Group of 4 students) |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 3     | 29-Oct |                         |  |       |  |       |   |      |  |     | 1.30pm - 5.30pm Workshop (6) - (Group of 4 students) |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 4     | 05-Nov |                         |  |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 5     | 12-Nov |                         |  |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 6     | 19-Nov |                         |  |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 7     | 26-Nov |                         |  |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 8     | 03-Dec |                         |  |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 1     | 09-Oct | Thursday                | L1: Process & prototyping (JM)   |       |  |       | L2: Machine systems design (MFLD)                     |      |  |     | Coursework and Design task briefing                  |     |   |     | Introduction to Solidworks, THORNE<br>SOLID CAM: Milling, Briefing of CAD/CAM coursework, THORNE<br>SOLID CAM: Turning, THORNE<br>Coursework<br>Coursework<br>Group Work / Coursework<br>Group Work / Coursework<br>3P3 Submission via Moodle |     |  |     |  |  |  |  |                    |  |  |  |
| 2     | 16-Oct |                         | Design challenge competition and debrief   |       |  |       | L3 Tolerances (JM)                                    |      |  |     | L4 Actuators (MFLD)                                  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 3     | 23-Oct |                         | L5 Bearings (MFLD)   |       |  |       | L6 Mechanisms (MFLD)                                  |      |  |     | Coursework Q&A (JM)                                  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 4     | 30-Oct |                         | L7 Design for Assembly (JM)  |       |  |       | Dfa Exercise  |      |  |     | Dfa Debrief  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 5     | 06-Nov |                         | L8 Design for Manufacture (MFLD)   |       |  |       | L9 Design for Injection Moulding (MFLD)               |      |  |     | L10 Design for AM (JM)                               |     |   |     |   |     |  |     |  |  |  |  | Portfolio Workshop |  |  |  |
| 6     | 13-Nov |                         | L11 Design History JM  |       |  |       | L12 Product Form (JM)                                 |      |  |     | L13: Ergonomics (JM)                                 |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 7     | 20-Nov |                         | Major Project Briefing   |       |  |       | Major Project Group Work (Team Partnership agreement) |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 8     | 27-Nov |                         | Group Work / Coursework  |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 9     | 04-Dec | Group Work / Coursework |  |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 1     | 10-Oct | Friday                  | 3P1: Materials into products [1-8], SEITA / BARLOW, LR6                            |       | 3P2: Production machines & systems [1-4], O'NEILL, [5-8], KRUGER SR3 |       |   |      |  |     |  |     |   |     | Rapid Prototype Workshop 1 (group of 10 students)   |     |  |     |  |  |  |  |                    |  |  |  |
| 2     | 17-Oct |                         |  |       |  |       |   |      |  |     |  |     |   |     | 1.30pm - 5.30pm Workshop (3) - (Group of 4 students)  |     |  |     |  |  |  |  |                    |  |  |  |
| 3     | 24-Oct |                         |  |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 4     | 31-Oct |                         |  |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 5     | 07-Nov |                         |  |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 6     | 14-Nov |                         |  |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 7     | 21-Nov |                         |  |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 8     | 28-Nov |                         |  |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |
| 9     | 05-Dec |                         |  |       |  |       |   |      |  |     |  |     |   |     |   |     |  |     |  |  |  |  |                    |  |  |  |

Lent timetable: **Note, these timetables are provisional and are subject to change**

| weeks |        | 9-10      | 10-11  | 11-12   | 12-1 | 1-2                                     | 2-3                       | 3-4 | 4-5 | 5-6 |  |
|-------|--------|-----------|--|---|------|---|---------------------------|-----|-----|-----|--|
| 0     | 19-Jan | Monday    |  |   |      | Lunch                                   |                           |     |     |     |  |
| 1     | 26-Jan |           |  |   |      |   |                           |     |     |     |  |
| 2     | 02-Feb |           |  |   |      |   |                           |     |     |     |  |
| 3     | 09-Feb |           |  |   |      |   |                           |     |     |     |  |
| 4     | 16-Feb |           | 3P5: Industrial Engineering [1-8], PARLIKAD SR3                                    |   |      |   |                           |     |     |     |  |
| 5     | 23-Feb |           |  |   |      |   |                           |     |     |     |  |
| 6     | 02-Mar |           |  |   |      |   |                           |     |     |     |  |
| 7     | 09-Mar |           |  |   |      |   |                           |     |     |     |  |
| 8     | 16-Mar |           |  |   |      |   |                           |     |     |     |  |
| 0     | 20-Jan | Tuesday   |  |   |      |   |                           |     |     |     |  |
| 1     | 27-Jan |           | Industrial Visit: scheduled all day but may finish earlier depending upon location |   |      |   |                           |     |     |     |  |
| 2     | 03-Feb |           | Visit Debrief SR3  | Skills workshop SR3                               |      |   |                           |     |     |     |  |
| 3     | 10-Feb |           | Industrial Visit: scheduled all day but may finish earlier depending upon location |   |      |   |                           |     |     |     |  |
| 4     | 17-Feb |           | Visit Debrief SR3  | Skills workshop SR3                               |      |   |                           |     |     |     |  |
| 5     | 24-Feb |           | Industrial Visit: scheduled all day but may finish earlier depending upon location |   |      |   |                           |     |     |     |  |
| 6     | 03-Mar |           | Visit Debrief SR3  | Skills workshop SR3                               |      |   |                           |     |     |     |  |
| 7     | 10-Mar |           | Visit Final Presentations LT2  |   |      |   |                           |     |     |     |  |
| 8     | 17-Mar |           |  |   |      |   |                           |     |     |     |  |
| 0     | 21-Jan | Wednesday |  |   |      | Lunch                                   |                           |     |     |     |  |
| 1     | 28-Jan |           |  |   |      |   |                           |     |     |     |  |
| 2     | 04-Feb |           |  |   |      |   |                           |     |     |     |  |
| 3     | 11-Feb |           |  |   |      |   |                           |     |     |     |  |
| 4     | 18-Feb |           | 3P9: Industrial Economics [1-8], VELU SR3  | 3P4: Operations Management, [1-8] BRINTRUP/?? SR3 |      |   |                           |     |     |     |  |
| 5     | 25-Feb |           |  |   |      |   |                           |     |     |     |  |
| 6     | 04-Mar |           |  |   |      |   |                           |     |     |     |  |
| 7     | 11-Mar |           |  |   |      |   |                           |     |     |     |  |
| 8     | 18-Mar |           |  |   |      |   |                           |     |     |     |  |
| 1     | 22-Jan | Thursday  | Major Project: Project proposal presentation                                       |   |      | Lunch                                   | Major Project: Group Work |     |     |     |  |
| 2     | 29-Jan |           | Major Project: Project group consultations   |   |      |   | Major Project: Group Work |     |     |     |  |
| 3     | 05-Feb |           | Major Project: Project group consultations   |   |      |   | Major Project: Group Work |     |     |     |  |
| 4     | 12-Feb |           | Major Project: Design review 1   |   |      |   | Major Project: Group Work |     |     |     |  |
| 5     | 19-Feb |           | Major Project: Project group consultations   |   |      |   | Major Project: Group Work |     |     |     |  |
| 6     | 26-Feb |           | Major Project: Project group consultations   |   |      |   | Major Project: Group Work |     |     |     |  |
| 7     | 05-Mar |           | Major Project: Design review 2   |   |      |   | Major Project: Group Work |     |     |     |  |
| 8     | 12-Mar |           |  |   |      |   |                           |     |     |     |  |
| 9     | 19-Mar |           |  |   |      |   |                           |     |     |     |  |
| 1     | 23-Jan | Friday    |  |   |      | Lunch                                   |                           |     |     |     |  |
| 2     | 30-Jan |           |  |   |      |   |                           |     |     |     |  |
| 3     | 06-Feb |           |  |   |      |   |                           |     |     |     |  |
| 4     | 13-Feb |           | 3P7: Managing Business and People [1-8], KUMAR, SR3                                |   |      |   |                           |     |     |     |  |
| 5     | 20-Feb |           |  |   |      |   |                           |     |     |     |  |
| 6     | 27-Feb |           |  |   |      |   |                           |     |     |     |  |
| 7     | 06-Mar |           |  |   |      |   |                           |     |     |     |  |
| 8     | 13-Mar |           |  |   |      | Production Game [8] (commencing at 1pm) |                           |     |     |     |  |
| 9     | 20-Mar |           |  |   |      |   |                           |     |     |     |  |

Easter timetable: ***Note, these timetables are provisional and are subject to change***

| weeks    |           | 9-10   | 10-11 | 11-12 | 12-1 | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 |
|----------|-----------|--|-------|-------|------|-----|-----|-----|-----|-----|
| 0 27-Apr | Monday    | Exam period  |       |       |      |     |     |     |     |     |
| 1 04-May |           | Exam period  |       |       |      |     |     |     |     |     |
| 2 11-May |           | Major Project Period   |       |       |      |     |     |     |     |     |
| 3 18-May |           |  |       |       |      |     |     |     |     |     |
| 4 25-May |           |  |       |       |      |     |     |     |     |     |
| 5 01-Jun |           | Major Project: Hand in portfolio, Business plan                            |       |       |      |     |     |     |     |     |
| 6 08-Jun |           |  |       |       |      |     |     |     |     |     |
| 7 15-Jun |           |  |       |       |      |     |     |     |     |     |
| 8 22-Jun |           |  |       |       |      |     |     |     |     |     |
| 0 28-Apr | Tuesday   | Exam period  |       |       |      |     |     |     |     |     |
| 1 05-May |           | Exam period  |       |       |      |     |     |     |     |     |
| 2 12-May |           | Major Project period   |       |       |      |     |     |     |     |     |
| 3 19-May |           |  |       |       |      |     |     |     |     |     |
| 4 26-May |           |  |       |       |      |     |     |     |     |     |
| 5 02-Jun |           |  |       |       |      |     |     |     |     |     |
| 6 09-Jun |           |  |       |       |      |     |     |     |     |     |
| 7 16-Jun |           |  |       |       |      |     |     |     |     |     |
| 8 23-Jun |           |  |       |       |      |     |     |     |     |     |
| 0 29-Apr | Wednesday | Exam period  |       |       |      |     |     |     |     |     |
| 1 06-May |           | Exam period  |       |       |      |     |     |     |     |     |
| 2 13-May |           | Major Project period   |       |       |      |     |     |     |     |     |
| 3 20-May |           |  |       |       |      |     |     |     |     |     |
| 4 27-May |           |  |       |       |      |     |     |     |     |     |
| 5 03-Jun |           | MAJOR PROJECT FINAL PRESENTATIONS (Poster Display and evening Design Show) |       |       |      |     |     |     |     |     |
| 6 10-Jun |           |  |       |       |      |     |     |     |     |     |
| 7 17-Jun |           |  |       |       |      |     |     |     |     |     |
| 8 24-Jun |           |  |       |       |      |     |     |     |     |     |
| 1 30-Apr | Thursday  | Exam period  |       |       |      |     |     |     |     |     |
| 2 07-May |           | Exam period  |       |       |      |     |     |     |     |     |
| 3 14-May |           | Major Project Supervisions   |       |       |      |     |     |     |     |     |
| 4 21-May |           | Project Team Consultations   |       |       |      |     |     |     |     |     |
| 5 28-May |           | Project Team Consultations   |       |       |      |     |     |     |     |     |
| 6 04-Jun |           | Project Team Consultations   |       |       |      |     |     |     |     |     |
| 7 11-Jun |           | Take down Design Show and clear up Design Studio                           |       |       |      |     |     |     |     |     |
| 8 18-Jun |           |  |       |       |      |     |     |     |     |     |
| 1 01-May | Friday    | Exam period  |       |       |      |     |     |     |     |     |
| 2 08-May |           | Exam period  |       |       |      |     |     |     |     |     |
| 3 15-May |           | Major Project Period   |       |       |      |     |     |     |     |     |
| 4 22-May |           |  |       |       |      |     |     |     |     |     |
| 5 29-May |           |  |       |       |      |     |     |     |     |     |
| 6 05-Jun |           |  |       |       |      |     |     |     |     |     |
| 7 12-Jun |           |  |       |       |      |     |     |     |     |     |
| 8 19-Jun |           |  |       |       |      |     |     |     |     |     |

# Induction

## Aims

- **To provide information about the course** including: the content and structure of the taught modules; the opportunity presented by the course work to demonstrate an integrative approach; the process and administration of the Company Visits; tablet based teaching; the methods of examination; timetable and locations.
- **To ensure operating procedures and administration are understood:** including the different ethos from Part 1 of Engineering; the role of the IfM teaching office; the use of Moodle for providing information and taught content; access to admin and teaching staff; layout of the Alan Reece Building and the use of its facilities.
- **To start the skills development programme.** The induction programme includes sessions on communications, including presentation skills which are required early in the course. The remainder of the skills development programme takes place on alternate Tuesdays during Michaelmas and Lent terms.
- **To facilitate group bonding** which is essential for the successful operation of the course. Students will meet academic and teaching staff, and the style of the course will be interactive with taught inputs interspersed with small group activities.
- **To provide a brief introduction to Manufacturing** to emphasise the integrated nature of Manufacturing and to explain the importance of retaining this perspective even though the subject is deconstructed into modules for the purposes of teaching.

## Teaching style

To meet these aims the induction programme will necessarily contain some taught input but will include substantial periods of interactive learning through group work and exercises.

## Location

The induction programme is based in the Alan Reece Building, Seminar Room 3. Some components, highlighted in the timetable will be delivered remotely and additional resources will be available online.



## Induction programme

| <b>Mon 6 October</b>  |  |  |
|-----------------------|--|--|
| 10:00 – 10:30         | Welcome and overview of induction programme<br>Discussion: your hopes from MET                     | Tim Minshall<br>Alexandra Brintrup                 |
| 10:45 – 11:15         | Course overview and administration   | Alexandra Brintrup                                 |
| 11:15 – 11:30         | <i>Break</i>   |  |
| 11:30 – 12:30         | Manufacturing awareness  | Sebastian Pattinson<br>/ Ronan Daly                |
| <b>12:30 – 14:00</b>  | <b>Buffet lunch with ISMM, MET and Staff</b>   | <b>ALL</b>   |
| 14:00 – 14:45         | Company visits: aims, visits process, themes and topics, assessment, safety                        | Letizia Mortara                                    |
| 15:00-16:00           | Facilities tours   | Alan Thorne /<br>Simon Sennitt /<br>Chris Jennings |
| <b>Tues 7 October</b> |  |  |
| 09:30 – 10:00         | Introduction Library Facilities  | Emily Bamber                                       |
| 10:00 – 10:30         | Retail shop exercise: Briefing   | Alexandra Brintrup                                 |
| 11:00 – 14:00         | Retail shop exercise:<br>Store Observation and Presentation Preparation<br>Lunch: Own arrangements | Alexandra Brintrup                                 |
| 14:00-16:00           | Retail shop exercise:<br>Group Presentation and Feedback   | Alexandra Brintrup                                 |
| <b>Wed 8 October</b>  |  |  |
| 10:00 – 10:15         | IfM Health & Safety  | Sebastian Pattinson                                |
| 10:15 – 10:45         | Introduction to workshop training  | Alan Thorne  |
| 11:00 – 11:45         | Workshop Health & Safety lecture   | Alan Thorne<br>/Simon Sennitt /<br>Chris Jennings  |

# Industrial Visits and Skills Workshops

Programme Leader: Dr Karel Kruger

## Programme

The module consists of industrial visits and skills development workshops. These are delivered during the Michaelmas and Lent terms to allow maximum opportunity for observing real manufacturing environments and for testing and practicing a variety of managerial and practical skills as the MET IIA course progresses.

Industrial visits occur on Tuesdays, and typically are organised every other week (see programme)<sup>1</sup>. In the intervening week, on the Tuesdays the programme comprises debriefing sessions and skills workshops. The debriefing sessions and workshops are scheduled throughout Michaelmas and Lent terms.

All the elements of this module require attendance. The coursework is expected to be delivered by teams and it is of the utmost importance that students will work collegially to produce the required outputs.

## Industrial visits and Debriefing

### Visits

**It is important that the students' calendar remains completely free on Tuesdays for the whole day, to facilitate our organisation of visits.**

Punctuality is expected. Companies will be informed of those attending. The coaches will be leaving on time and will not wait for any late student. Any absence from visit or presentation needs to be communicated by emailing the IfM Teaching office ([met-admin@eng.cam.ac.uk](mailto:met-admin@eng.cam.ac.uk)) so your case can be considered.

If you will be out of Cambridge over lunchtime, then either the company will provide lunch, or you will have to bring your own lunch. Unless otherwise informed on the Visit Brief, the students are expected to bring their own lunch.

### Dress Code












When visiting companies you are representing Cambridge University and the Institute for Manufacturing, and you are expected to maintain the high standards for which we are known. You should always behave in a responsible and professional manner, and you should be smartly turned-out and appropriately dressed. This means in compliance with the requests of the companies (which will be listed on the briefing provided ahead of each visit). You should always wear sensible shoes and **not** trainers on factory visits (no high heels or sandals). **Safety footwear will be required on most visits.** Other requirements and restrictions (e.g. photography) may be specified by the company and must be adhered to. All rules visit by visit will be advised on the Visit Brief (which will be made available on Moodle).

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<sup>1</sup> The programme might be changed during the year – for the most up to date version, consult the Industrial Visits Moodle folder

## Company visits and presentations

The visit and debriefing rota will follow a schematic, like the **example** below.

|  Debriefing presenting responsibility<br>* Responsibility for taking notes during industrial visits and contributing to debriefing team<br><br><b>Group 1   Group 2</b> |         | Debriefing presentations  |   |   |   |   |   | Final presentation                 |
|--|---------|---|---|---|---|---|---|------------------------------------|
|  |         | Sector 1<br>Primary Processes   | Sector 2<br>Electro-mechanical  | Sector 3<br>Fast moving consumer goods (FMCG)   | Sector 4<br>Vehicles  | Sector 5<br>Logistics   | Sector 6<br>Sustainability  | Review of practices across sectors |
|  |         |   |   |   |   |   |   |                                    |
| Team 1A  | Team 2A | *Materials Prod process   | *Ops Mgt  | *Industrial Eng   |  *Design Mgt | *HR + CSR   |  *Industrial Eng         | Industrial Eng                     |
| Team 1B  | Team 2B | *Ops Mgt  | *Industrial Eng   |  *Design Mgt | *HR + CSR   | *Materials Prod process   |  *Design Mgt             | Design Mgt                         |
| Team 1C  | Team 2C | *Industrial Eng   |  *Design Mgt | *HR + CSR   | *Materials Prod process   | *Ops Mgt  |  *HR + CSR               | HR + CSR                           |
| Team 1D  | Team 2D |  *Design Mgt | *HR + CSR   | *Materials Prod process   | *Ops Mgt  | *Industrial Eng   |  *Materials Prod process | Materials Prod process             |
| Team 1E  | Team 2E | *HR + CSR   | *Materials Prod process   | *Ops mgt  | *Industrial Eng   |  *Design Mgt |  *Ops mgt              | Ops mgt                            |

The class is divided into groups (1 and 2), with each group attending a different visit in parallel.

Within each group, students will be assigned to teams (E.g., Team 1D). Each team will focus on a different business or technical aspect during the visit (e.g. Materials and Production processes). The aspects will be rotated between the teams so that each team focuses on a different aspect for each visit (see example of table above). For all visits except the final visit, one team (indicated by the highlighted smiley icon in the example table) will be responsible for collating the input from all the teams in their group and preparing a debriefing presentation for the following Tuesday. This responsibility is rotated between the teams as assigned on the visit rota. The debriefing presentation after the final visit will take on a different format, with all teams giving a short presentation, in preparation for the final presentations.

The programme is assessed and so attendance is expected at all events. Any absence from any industrial visits needs to be approved by the Module Leader and the IfM Teaching Office by emailing [met-admin@eng.cam.ac.uk](mailto:met-admin@eng.cam.ac.uk)

For the debriefing and final presentations, the following approach is suggested:

- i. Teams (e.g. 1A, 1B, 1C, etc) collect information on their designated aspect during the visit. It is important that the team doing the subsequent debriefing presentation (usually the team focusing on the “design management” aspect) instructs the other teams on how to gather information (e.g. “please remember to ask this question; please remember to look for this”). A good time to do this is during the travels to reach the companies.
- ii. Teams structure their information and provide it to the presenter team. This should be started on the return coach trip while the details are still fresh. Additionally, summary presentation slides should be given to the presenter team by the Thursday following the visit.
- iii. The presenter team prepares a 25 minute presentation incorporating information from all the teams. The presentation should be structured and edited to ensure an integrated overview of the company and the analysis, and all members of the presenter team should participate.
- iv. The formal debrief normally takes place on the Tuesday following the visit. At these debriefing sessions, students from both visit groups come together, with their visit supervisors and the visits programme Module Leader.
- v. The debriefing presentations are evaluated by the Module Leader and the accompanying supervisors (contributing 15/40 marks). The debriefing presentations are evaluated as a team (i.e. all students presenting will receive the same mark).
- vi. Debriefing process: The first visit group make their presentation, followed by discussion and questions, principally from the other group. All members of the first group will be encouraged to participate in the discussion. The process is repeated for the second visit group. There is a round up discussion about each of the aspects in turn, drawing out comparisons between the companies.
- vii. The presenter team annotates their presentation slides with comments and update them following the discussion. The annotated slides need to be sent to the teaching office after the presentations and are made available to all students on Moodle for reference and revision in preparation of the final presentation.
- viii. The final presentation will be assessed, constituting the remainder of the module marks (25/40). The process is as follows:
  - a. Teams from the two groups will jointly present on one aspect, reviewing and discussing the observations/information from all visits and identifying the key learnings (e.g., according to the example table, Team 1D and Team 2D will do a joint presentation on the “Material and production processes” aspect, drawing on observations from all visits). All members are expected to contribute to the development and presentation of the material.
  - b. On the final presentation day, 15 minutes (exactly) will be allocated to presentations on the different aspects, followed by 10 minutes for questions from the module leader and assessors. As such, the overall final presentation day will last approximately 4 hours.
  - c. After the presentation, presenters should update their slides to record the discussion and send their material to the Teaching office.

## Industry contexts and business and technical aspects

During visits, students should aim to understand the context wherein the different companies operate and how this context shapes the companies' strategies and operations. The table below describes some key factors that influence industry and company level context.

| Context                | Details  |
|------------------------|--|
| Industry level context | <ul style="list-style-type: none"> <li>• <i>History</i> - how has the industry developed: what technical and structural changes have occurred.</li> <li>• <i>Markets</i> - where are the major markets – how is this forecast to change; what are the current market conditions; what are the major trends affecting the industry.</li> <li>• <i>Competition</i> - who are the major players; what market shares.</li> </ul>   |
| Company level context  | <ul style="list-style-type: none"> <li>• <i>History</i> – what is the history of the company; has the ownership structure changed; is there a specific culture, ethos, or set of values.</li> <li>• <i>Scale</i> - key metrics for this site – turnover, employees, products</li> <li>• <i>Structure</i> – how is the company structured; how does it fit into the whole organisation.</li> <li>• <i>Market</i> - where does the company position itself in the market; who is the competition; who are the customers; where are they.</li> <li>• <i>Products</i> - what is the range of products - to what extent are products customised</li> <li>• <i>Strategy</i> - what is the business model – how does the company make money; how does the company compete – price, quality delivery, responsiveness, others; what is the impact of low cost economies.</li> </ul> |

During visits, teams will be tasked to gather insights into specific business and technical aspects of a company – some guiding questions are given in the table below.

| Aspects  | Details   |
|--|---|
| Materials, production processes and technology   | <ul style="list-style-type: none"> <li>• <i>Materials</i> - what range of materials is used – why; where are they sourced?</li> <li>• <i>Production processes</i> - what production processes are employed; are there any areas of special expertise; which processes are outsourced – why and where to; what level of automation is in evidence – are there further opportunities; is the operation labour intensive or capital intensive?</li> <li>• <i>Technology</i> - how does the company stay abreast of technical developments; how is new equipment selected and justified?</li> </ul> |
| Operations management - organisation and control | <ul style="list-style-type: none"> <li>• How many product variants are there – how does uncertainty affect the business and manufacturing operations?</li> <li>• What are the key challenges in matching supply and demand?</li> <li>• What is the typical time from order to delivery?</li> <li>• How is production configured - cell, line, functional etc – and why?</li> <li>• What cost reduction techniques are used?</li> <li>• How are lean processes applied?</li> <li>• What are the systems for controlling production flow e.g. MRP, JIT, Kanban etc?</li> </ul>                    |

|  |  |
|--|--|
| Industrial engineering and quality   | <ul style="list-style-type: none"> <li>• <i>Industrial engineering</i> - how are work study methods applied; how is work place layout determined; how are task times determined; what performance measures are used?</li> <li>• <i>Quality</i> - what quality control systems are in place; is there evidence of statistical approaches; what continuous improvement techniques are used e.g. quality circles, kaizan projects, suggestion schemes?</li> </ul>   |
| Design management  | <ul style="list-style-type: none"> <li>• How is the brand positioned in the market?</li> <li>• What is the customer journey: what are the range of 'touch points' (e.g. web, brochures, people, stores, telephone calls, etc.) that define the customers interface with the company. How are these designed and who is responsible for ensuring consistency?</li> <li>• What is the company's design strategy; how are industrial and engineering design linked?</li> </ul>  |
| Human Resources + Corporate Social Responsibility; Health & Safety, Environment and Sustainability | <ul style="list-style-type: none"> <li>• <i>Recruitment and training</i> - how are employees recruited and trained; what are the critical skills; how are they developed; how are they forecast to change?</li> <li>• <i>Remuneration</i> - what pay systems are in place – e.g. piece work, salary, bonus; what non-pay reward systems are in place?</li> <li>• <i>Employee relations</i> - are any unions recognised; what structures are in place to work with them; how are communications with employees handled?</li> <li>• <i>Health &amp; Safety</i> – which standards are adhered to; how is safety managed?</li> <li>• <i>Environment</i> - why is the operation based in this locality – what advantages, disadvantages; what is the impact of the operation on the local environment and community; what measures are in place to reduce any negative impact; in what ways does the company engage with the community?</li> <li>• <i>Sustainability</i> - what regulations impinge on the business – are they getting tougher; are alternative technologies being developed to reduce the environmental impact – are there cost implications; how are sustainability issues affecting the business – markets, products, operations?</li> </ul> |

## Skills workshops

The skills workshops are designed to develop some of the personal skills critical for success in industry and related employment. The skills are introduced in the workshop series and are practiced and developed during the two years of the MET programme.

The skills considered in the workshop series are related to<sup>2</sup>:

- **Process improvement:** bringing improvements to manufacturing processes form a fundamental part of the skillset that any manufacturing engineer must possess. These sessions focus on using structured approaches to understand a manufacturing process and to improve its performance.
- **Industrial strategy and technology:** understanding the fundamental strategies and technologies that are applied in industry to drive competitiveness and sustainability.

<sup>2</sup> The skills workshops list will be updated at the start of the year and possibly before the Lent term. Please refer to Moodle for the up to date timetable.

- **Communication:** essential both in academic settings and when engaging with industry, good communication skills will benefit you throughout your career.
- **Academic success:** giving guidance on examinations and examination preparation skills.

**NOTE: Please check email and MOODLE for updated schedule. All debriefing and workshop sessions will be held at the IfM, Alan Reece Building, SR3**

**Example timetable (this is indicative, the visits and debriefing days can change. See Moodle for up to date schedule)**

| <b>Michaelmas</b>  | <b>Morning</b>                   | <b>Afternoon</b> |
|--------------------|----------------------------------|------------------|
| <b>14 October</b>  | Free                             |                  |
| <b>21 October</b>  | Introduction and Skills workshop |                  |
| <b>28 October</b>  | Visits                           |                  |
| <b>4 November</b>  | Debriefing and Skills workshop   |                  |
| <b>11 November</b> | Visits                           |                  |
| <b>18 November</b> | Debriefing and Skills workshop   |                  |
| <b>25 November</b> | Visits                           |                  |
| <b>2 December</b>  | Debriefing and Skills workshop   |                  |
| <b>Lent</b>        | <b>Morning</b>                   | <b>Afternoon</b> |
| <b>27 January</b>  | Visits                           |                  |
| <b>3 February</b>  | Debriefing and Skills workshop   |                  |
| <b>10 February</b> | Visits                           |                  |
| <b>17 February</b> | Debriefing and Skills workshop   |                  |
| <b>24 February</b> | Visits                           |                  |
| <b>3 March</b>     | Debriefing and Skills workshop   |                  |
| <b>10 March</b>    | Final Presentations              |                  |

## Marking scheme

The programme is assessed and a total of 40 marks are available (15 marks for the debriefing presentations and 25 for the final presentation). Presentations are evaluated as a group (all students in the presenting team will receive the same marks).

Attendance is expected at all events. Any absence from any assessed part (i.e. de-briefing presentations and final year presentation), and from the visits, should be discussed with the Module Leader and the IfM Teaching Office by emailing [met-admin@eng.cam.ac.uk](mailto:met-admin@eng.cam.ac.uk) Please note that the debriefing presentations and final presentations cannot be rearranged (see the Extension Policy in Appendix 2).



**The assessment will consider:**

- **Structure:** is the presentation structured in a logical way? Are all the necessary parts covered?
- **Content:** Has the presentation given an exhaustive account of the visit and demonstrates further research into the themes?
- **Analysis:** Have the team reflected on the issues and identified key take aways from the visit? Has this been done across all the themes?
- **Clarity:** is the presentation clearly delivered (professional language, clear slides, well referenced content, good time keeping) etc?

**Reading list:**

Goodson, R. E., "Read a Plant -Fast", Harvard Business Review, May, 2002

Upton, M.U., Macadam, S.E., "Why (and How) to Take a Plant Tour", Harvard Business Review, May-June, 1997.

# Module Specifications

## 3P1: Materials into products

|  |  |
|--|--|
| <b>Module summary</b>                        | From microstructure to final properties: manufacturing process optimisation for all classes of materials.  |
| <b>Taught by</b>                             | Dr M Seita (module leader) Dr C Barlow   |
| <b>Supporting activities</b>                 | Artefacts workshops - TBA  |
| <b>Assessment</b>                            | 100% by examination. Paper 1, single module paper common with Engineering Part IIA 3C1   |
| <b>Supervision</b>                           | 4 supervisions (1 per examples paper, plus revision class), using a combination of groups of 4-5 and larger classes  |
| <b>Links to other elements of the course</b> | Complementary materials know-how for aspects of 3P2 (processes), 3P3 (design) and Major Projects. Directly relevant to visits to industrial materials processing operations. |

### Module Learning Outcomes

By the end of the course, students should:

- Have a broad appreciation of the different materials processing methods used for metals, ceramics and polymers.
- Understand the main interactions between process and material in design and process selection, for each of the main classes of material.
- Understand the factors which control the microstructure of shaped castings, and their consequences for final properties and design of castings.
- Know the main deformation processes for wrought alloys, and be able to conduct simple upper bound analysis of plastic deformation.
- Know the microstructural characteristics of wrought alloys, and the reasons for alloying and heat treatment, with examples from Al alloys and steels.
- Understand hardenability of steels, using CCT diagrams to select steels and heat treatments for a given component specification.
- Know the main classes of polymers and composites, and understand the processing and design considerations in selecting these for a given component.
- Understand the processes and issues in the manufacture of powder metallurgy and ceramic products, and in additive manufacturing.
- Understand the importance of surface treatments and joining technologies, and know the main factors to consider in process selection.
- Be able to apply their knowledge of materials processing, microstructure evolution, and the mechanisms of material degradation to analyse and predict failures and to improve product design.

## Syllabus

| Lecture  | Syllabus  | On completion students should be able to....  |
|--|---|---|
| 1<br>Introduction and<br>Process Selection   | Classification of manufacturing processes.<br>Coupled problems in design and manufacturing: the interaction between material, process and design parameters.  | Take a structured approach to choosing and interpreting viable material-process combinations for making components.   |
| 2<br>Heat Treatment<br>of Steels   | Revision of phase transformations and TTT diagrams.<br>CCT diagrams and hardenability for steels.   | Predict microstructure and mechanical properties in steel components following a given heat treatment.  |
| 3 – 4<br>Casting of Metals   | Ingot and shaped casting.<br>Revision of phase diagrams and transformations applied to solidification: segregation, constitutional supercooling, casting alloys and microstructures.<br>Casting defects and design of shaped castings.<br><i>Examples paper 1</i> | Describe the factors involved in optimising casting processes, alloys and design to achieve required quality and mechanical properties for a component.   |
| 5 – 8<br>Deformation<br>Processing of<br>Wrought Alloys,<br>Heat treatment.        | Wrought alloy processing and microstructure evolution.<br>Simple modelling of plastic forming processes (upper bound method).<br>Application to rolling, forging, extrusion, machining of metals.<br><i>Examples paper 2</i>                                      | Describe the factors involved in optimising wrought processes, alloys and design to achieve required physical and mechanical properties for a component.<br>Estimate load, power, and temperature rise for shaping processes involving plastic deformation of metals.   |
| 9 – 10<br>Processing of<br>Polymers and<br>Composites                              | Polymer and composite processing technology.<br><br>Design, material and process selection for polymers and composites.   | Select polymer and process to achieve required shape and properties for a component.<br>Select manufacturing process to achieve required shape and mechanical properties in fibre-reinforced polymer composites.  |
| 11 – 13<br>Powder<br>Processing,<br>Welding and<br>Joining, Surface<br>Engineering | Sintering, HIPing and other powder methods for metals and ceramics.<br>Additive manufacturing.<br>Welding technologies and other joining processes, and design considerations.<br>Surface engineering processes and their applications.                           | Describe the factors that govern the choice of powder and additive manufacturing routes instead of conventional processes.<br>Make recommendations for suitability of joining technologies for different materials and applications.<br>Select surface treatments to achieve required physical and mechanical properties. |

|                         |   |   |
|-------------------------|---|---|
| 14 - 16                 | Processing as the origin of defects and failures (microstructure, damage, residual stress). | Identify likely sources of failure for components made from all classes of materials. |
| Design against Failure. | Environmental factors in failure of materials.  | Propose ways in which such failures can be avoided.                                   |
|                         | Analysis and case studies of failures.  |   |
|                         | <i>Examples paper 3</i>   |   |

## Reading List

|                                      |   |        |
|--------------------------------------|---|--------|
| *ASHBY, M.F.                         | MATERIALS SELECTION IN MECHANICAL DESIGN Butterworth-Heinemann 4th edition 2010, 3rd edition available as an ebook at:<br><a href="http://www.myilibrary.com?id=75447">http://www.myilibrary.com?id=75447</a>   | JA.208 |
| *ASHBY, M.F. & JONES, D.R.H.         | ENGINEERING MATERIALS 2 Butterworth-Heinemann 3rd edition 2006 (mainly revision) Available as an ebook at:<br><a href="http://www.myilibrary.com?id=75451">http://www.myilibrary.com?id=75451</a>   | JA 191 |
| ASHBY, M., SHERCLIFF, H. & CEBON, D. | MATERIALS: ENGINEERING, SCIENCE, PROCESSING AND DESIGN Butterworth-Heinemann 4 <sup>th</sup> edition 2019, 3 <sup>rd</sup> edition 2014, 2nd edition 2010<br>2nd edition available as an ebook at:<br><a href="https://www.dawsonera.com/guard/protected/dawson.jsp?name=https://shib.raven.cam.ac.uk/shibboleth&amp;dest=http://www.dawsonera.com/depp/reader/protected/external/AbstractView/S9780080961552">https://www.dawsonera.com/guard/protected/dawson.jsp?name=https://shib.raven.cam.ac.uk/shibboleth&amp;dest=http://www.dawsonera.com/depp/reader/protected/external/AbstractView/S9780080961552</a> | JA.209 |
| CALLADINE, C.R.                      | PLASTICITY FOR ENGINEERS Ellis Horwood 1985   | FA 127 |
| *CAMPBELL, J.                        | CASTINGS Butterworth-Heinemann 1991 = Author's Castings principles, 2nd ed available as an ebook at:<br><a href="https://www.dawsonera.com/guard/protected/dawson.jsp?name=https://shib.raven.cam.ac.uk/shibboleth&amp;dest=http://www.dawsonera.com/depp/reader/protected/external/AbstractView/S9780080488448">https://www.dawsonera.com/guard/protected/dawson.jsp?name=https://shib.raven.cam.ac.uk/shibboleth&amp;dest=http://www.dawsonera.com/depp/reader/protected/external/AbstractView/S9780080488448</a>   | JO 41  |
| *EDWARDS, L. & ENDEAN, M.            | MANUFACTURING WITH MATERIALS Open University 1990   | JA 146 |
| JONES, D.R.H.                        | ENGINEERING MATERIALS III Pergamon 1993   | JJ 308 |
| *KALPAKJIAN, S. & SCHMID, S.R.       | MANUFACTURING PROCESSES FOR ENGINEERING MATERIALS Pearson/Prentice Hall 5th edition SI units 2008   | JN 67  |
| LLEWELLYN, D.T. & HUDD, R.C.         | STEELS: METALLURGY & APPLICATIONS Butterworth-Heinemann 3rd edition 1998  | JD 64  |

|  |   |        |
|--|---|--------|
| MILLS, N.J.  | PLASTICS Butterworth Heinemann 3rd edition 2005 Available as e-book at <a href="http://www.mylibrary.com/?id=101358">http://www.mylibrary.com/?id=101358</a>  | JG 216 |
| *POLMEAR, I.   | LIGHT ALLOYS Butterworth-Heinemann 4th edition 2006<br>Available as an ebook at:<br><a href="https://www.dawsonera.com/guard/protected/dawson.jsp?name=https://shib.raven.cam.ac.uk/shibboleth&amp;dest=http://www.dawsonera.com/depp/reader/protected/external/AbstractView/S9780080496108">https://www.dawsonera.com/guard/protected/dawson.jsp?name=https://shib.raven.cam.ac.uk/shibboleth&amp;dest=http://www.dawsonera.com/depp/reader/protected/external/AbstractView/S9780080496108</a> | JB 73  |
| ROWE, G.W.   | ELEMENTS OF METAL WORKING THEORY Arnold 1979  | JN 39  |
| STRONG, A.B.   | PLASTICS – MATERIALS AND PROCESSING Pearson Prentice Hall 3rd edition 2006  | JG 219 |
| TEMPELMAN, E.,<br>SHERCLIFF H.R. &<br>NINABER<br>VAN EYBEN, B. | MANUFACTURING AND DESIGN Butterworth-Heinemann 1 <sup>st</sup> edition 2014   | AP343  |
| WATERS, T.F.   | FUNDAMENTALS OF MANUFACTURING FOR ENGINEERS UCL Press 1996  | BN 204 |

## 3P2: Operation and Control of Production Machines and Systems

|  |   |
|--|---|
| <b>Module summary</b>                        | The specification, operation and management of production machines and systems  |
| <b>Course leader</b>                         | Prof Bill O'Neill (module leader), Dr Karel Kruger  |
| <b>Courses</b>                               | a. Operation of production machines, 4 x 2hr lectures, Michaelmas Term (Prof B O'Neill)<br>b. Control of production machines and systems, 4 x 2hr lectures, Michaelmas Term (Dr Karel Kruger) |
| <b>Supporting activities</b>                 | Integrated coursework – CAD/CAM exercise  |
| <b>Assessment</b>                            | 100% by examination. Paper 2 - single module paper.   |
| <b>Supervision</b>                           | The course will be supported by two examples papers, for each of which one supervision will be arranged.  |
| <b>Timetable</b>                             | Lectures are given in 2 hour blocks on Fridays in Michaelmas term   |
| <b>Links to other elements of the course</b> | Links to 3P1, 3P4, 3P5, and industrial visits.  |

### Module Learning Outcomes

On completion of the module students should be able to:

1. Know the operational aspects of the main categories of machining processes
2. Know the operational aspects of the main categories of metal based additive manufacturing processes
3. Understand the types of interaction between components and process tooling
4. Understand the factors that affect the accuracy and precision of machining, grinding operations, and additive manufacturing processes
5. Understand the various control strategies used to mitigate the sources of error in machining processes and the manner in such which machines are automated
6. Understand the systems, requirements and challenges in cell-level automation and,
7. Be able to model cell operations using Finite State Machines (FSMs), Petri Nets and Ladder Logic
8. Know the means by which machining cells are integrated into factory wide operations using modern communications and computing systems
9. Develop an appreciation for recent developments in industrial automation



## Syllabus: Operation of Production Machines

| Lecture  | Syllabus  | On completion students should be able to ...  |
|--|---|---|
| 1<br>Introduction to machine tools               | History and development of machine tools, and metal based additive manufacturing systems. Concept and definition of machining and machine tools. Classification and specification of machine tools. Basic constructional features, advanced system designs.   | Know the history of machine tool developments.<br>Know elements of machine tool design and their configurations.<br>Know their manufacturing and operational capabilities.<br>Know the applications domain and range of materials processed by modern machine tools.  |
| 2<br>Basics of machining and chip formation      | Tool geometry, mechanism of chip formation, mechanics of machining, cutting temperature: causes, effects, estimation, measurement and control. Operations of single and multi-point tooling. Classification of machining processes. Basic machining operations - turning, shaping, planing, drilling, milling processes | Understand the basic physics of cutting-tool/material interactions. Understand the influence that parametric variables have on cutting performance (tool tip condition, cutting fluid flow, temperature, force, feed etc).<br>Know the range of cutting tool materials and cutting tip geometries.<br>Know the range of machining methodologies employed in modern machining operations.  |
| 3<br>Cutting tools and machinability             | Failure modes, wear mechanisms, and life of cutting tools. Cutting tool materials, influence of geometrical, process and cutting fluid parameters on machinability and surface roughness, economics of cutting tool operations  | Know the conditions necessary to deliver accurate machining processes.<br>Understand the causes of wear and process strategies to reduce it.<br>Know the techniques applied to characterize machining performance.<br>Understand roughness classifications and measurement techniques.<br>Understand Taylor's tool life equation and be able to apply it to make informed decisions on tool choice for a range of materials.<br>Determine cost and times of machining operations. |
| 4<br>Metal Additive Manufacturing Processes (AM) | System architectures, processing configurations. AM materials, process performance and applications, economics of additive manufacturing operations.  | Know the conditions necessary to deliver accurate AM processes.<br>Understand the causes of process variation and process strategies to reduce it.<br>Understand the benefits and limitations of current processes.   |

|                               |  |  |
|-------------------------------|--|--|
| 5-6<br>Process<br>Variability | Factors affecting the accuracy and precision of processes, static and dynamic effects, sources of uncertainties: inputs, process interactions, process degradation. Response to uncertainties: design of production equipment and tooling, online inspection, corrective processes | Understand the factors that affect the accuracy and precision of machining and grinding operations.<br>Know the sources of variation in machining.<br>Understand the various strategies used to mitigate the sources of error in machining processes.                      |
| 7 - 8<br>Quality<br>Control   | Testing and inspection points in machining operations.<br>Statistical process control-control charts, process improvement techniques, causes of variation, control chart patterns, control chart applications.   | Understand quality control techniques in machining operations.<br>Know how to measure and minimize process variation using statistical process control (SPC).<br>Understand the various SPC strategies used to implement quality control measures in machining operations. |

### Syllabus: Control of Production Machines and Systems

| Lecture  | Syllabus  | On completion students should be able to ...   |
|--|---|--|
| 9 – 10<br>Machine<br>automation and<br>control                       | Issues in automation of machines, CNC control, Open loop and closed-loop control of m/c tools, adaptive control, sensing and actuation, robotic control | Discuss the benefits and downsides of automation<br>Design a feedback control loop to compensate for machine tool deflection during operation<br>Describe how sensing and actuation is achieved to implement control<br>Describe how machine tools are automated<br>Articulate challenges in robotic control |
| 11 – 12<br>Cell Control<br>Using PLC<br>Programming                  | Issues in cell-level control, Programmable Logic Controllers, Ladder Logic Diagrams, modeling of cell operations using FSMs                             | Understand requirements for cell automation<br>Develop Ladder Logic code to automate the operations of a manufacturing cell<br>Learn how to develop FSM process representations<br>Use Finite State Machines to develop Ladder Logic Code  |
| 13 – 14<br>Petri Net Based<br>Automation<br>Modelling and<br>Control | Introduction to Petri Nets, modeling of cell operations using petri nets, conversion of Petri Nets to Ladder Logic                                      | Know the rationale for selecting different discrete event models for automated systems<br>Understand how to develop Petri Net models<br>Develop a cell management scheme using a Petri Net approach<br>Convert Petri Nets to equivalent Ladder Logic code  |
| 15-16<br>Factory<br>Automation &<br>Comms                            | Automation options in factory wide operations.<br>Communication systems.<br>Future automation developments  | Understand automation requirements across the factory<br>Learn different options for communications at different levels in the factory<br>Be aware of modern automation and communications developments and how they will impact on modern manufacturing   |

## Reading List: Operation of Production Machines

- \*Kalpakjian, Serope & Schmid, Steven R     MANUFACTURING PROCESSES FOR ENGINEERING MATERIALS, PRENTICE HALL, Edition: 0005, August 2007 (ISBN10: 0132272717, ISBN13: 9780132272711)
- \*Winston A. Knight, Geoffrey Boothroyd     FUNDAMENTALS OF METAL MACHINING AND MACHINE TOOLS, Third Edition. 2005 by CRC Press (ISBN 9781574446593)
- Helmi A Youssef, & Hassan El-Hofy     [MACHINING TECHNOLOGY](#), Taylor & Francis Ltd CRC Press Inc, 2008 (ISBN10: 1420043390 , ISBN13: 9781420043396)
- \*Ian Gibson, David Rosen, Brent Stucker     Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Edition 2, Springer, Nov 26 2014, (ISBN 9781493921133)

## Reading List: Control of Production Machines and Systems

- \*BOUCHER, T.O.     COMPUTING AUTOMATION IN MANUFACTURING: AN INTRODUCTION Chapman & Hall 1996
- \*KALPAKJIAN, S. & SCHMID, S.R.     MANUFACTURING ENGINEERING AND TECHNOLOGY Prentice Hall 5th edition 2004
- BOLTON, W.     INSTRUMENTATION AND CONTROL SYSTEMS Newnes 2004
- BOLTON, W.     PROGRAMMABLE LOGIC CONTROLLERS, Newnes 4<sup>TH</sup> Edition 2006

Links to online copies of this Reading List can be found here -

[https://cam.alma.exlibrisgroup.com/leganto/public/44CAM\\_INST/lists/14624245830003606?auth=SAML](https://cam.alma.exlibrisgroup.com/leganto/public/44CAM_INST/lists/14624245830003606?auth=SAML)

## 3P3: Product Design

|  |   |
|--|---|
| <b>Module summary</b>                        | Integrating engineering and industrial design in the creation of new products   |
| <b>Taught by</b>                             | Prof J Moultrie (Module Leader), Prof Michael De Volder   |
| <b>Assessment</b>                            | Coursework  |
| <b>Supervision</b>                           | A Q&A session for the coursework will be timetabled   |
| <b>Links to other elements of the course</b> | <p>3P1: Links to content on production processes, relevant to design for manufacture (L8-10), including design for injection moulding and additive manufacturing</p> <p>3P2: Links to content on machining processes and accuracy/precision relevant to lecture on tolerancing (L3) and design for assembly &amp; standardisation (L7).</p> <p>3P4: Very loose link to operational complexity when considering assembly simplification in design for assembly.</p> <p>CAD/CAM Exercise: requires the application of content from the lecture on Engineering Drawing and tolerancing (L3).</p> <p>IIA Major Project: Aims to put 3P3 lectures content (L1-13) into practice.</p> |

### Module Learning Outcomes

On completion of the module students should be able to:

1. Understand the iterative nature of the design process.
2. Understand and apply dimensional tolerances to engineering drawings.
3. Understand and apply the principles of machine design to the design of products.
4. Be able to select appropriate manufacturing processes for a new design and understand how production volume and cost influences the design.
5. Be able to assess and improve the design for assembly of an existing design. Be able to apply these ideas to a new design.
6. Understand why products are designed as they are and be able to explore a product's form.
7. Understand and be able to apply basic ergonomic principles.
8. Develop skills in sketching, conceptual design and detailed design.

## Syllabus

| Session                               | Syllabus  | On completion students should be able to ...  |
|---------------------------------------|---|---|
| 1 The design process & Prototyping    | Introduction to the module & overview of the design process. Discussion on design competence. Overview of the role of prototypes. | Understand the difference between a theoretical and real design processes.<br>Be aware of the differences in competence between novice and experienced designers.<br>Understand the importance of prototyping in the design process and the role of different types of prototype. |
| 2 Machine systems                     | Machine frames and force loops. Frame construction, joining techniques and design practices.                                      | Application and understanding of kinematic design, force loops, flexure hinges, etc.  |
| 3 Engineering Drawing and Tolerancing | Basics of component dimensioning and drawing conventions. Limits and fits.  | Produce and read engineering drawings<br>Apply engineering tolerances.  |
| 4 Actuators                           | Introduction to different types of linear and rotating actuation principles.  | Understand that different types of actuators serve different needs.   |
| 5 Design for Assembly                 | A brief history of standardisation. DfA heuristics. DfA structured method.  | Be able to apply principles of design for assembly in order to simplify and reduce the cost/complexity of an assembly.  |
| 6 Bearings                            | Introduction techniques to guide the generated motion using bearings.   | Understand the need for bearings, and be able to select the appropriate type of bearings in a design.   |
| 7 Mechanisms                          | Gears and gear boxes. Linkages, cams and other mechanisms.  | Understanding of the opportunities and limitations of mechanisms and how to calculate or simulate their operation.  |
| 8 Design for manufacture              | Unit costs. Process selection.  | Understand the importance of understanding costs and volumes in designing a new product and the impact this has on the selection of production methods and how this influences the design.  |
| 9 Design for injection moulding       | Overview of principles of design for injection moulding   | Be able to apply design rules for manufacture, with emphasis on machining, injection moulding and 3D printing.  |
| 10 Design for Additive Manufacturing  | Overview of principles of design for AM   | Be able to apply design rules for manufacture, with emphasis on machining, injection moulding and 3D printing.  |
| 11 Design history                     | Design history from the industrial revolution to the present day  | Understand how industrial design developed and evolved since the start of the industrial revolution. Be aware of key design movements and their associated forms, materials, technologies and designers as well as the technological, social and economic                         |

|                                    |   |   |
|------------------------------------|---|---|
|                                    |   | context influencing this. Reflect on current trends and drivers in design.  |
| 12 Product form                    | How to 'read' a product and using sources of inspiration.                   | Understand how designers create a product's form. Be able to apply some basic principles to create a product's form.                                    |
| 13 Physical & cognitive ergonomics | Introduction to anthropometrics and basic principles to improve ease of use | Understand how to apply principles of design for use. Understand how we physically interact with products and how we relate to and understand products. |

## Workshop activities

To support the lecture course, there will be a number of supporting activities:

1. Sketching skills session: to develop sketching confidence.
2. Design for assembly exercise: to put theory into practice in preparation for the coursework.
3. Portfolio workshop to explore good and bad aspects of previous design portfolios

## Assessment

The coursework will take the form of a product redesign. All students will be given a product to use as a starting point. This will be theirs to take apart to analyse the product's strengths and weaknesses, specifically in relation to design for manufacture and assembly. They will fully redesign this product to both:

- 1 improve its design for manufacture and assembly;
- 2 change the product form to make it suitable for a specific brand.

Work will be submitted in the form of a design portfolio which in addition to documenting the design work will include an overall assembly drawing. All work will be submitted and assessed anonymously. A detailed briefing for the coursework will be provided separately.

## Reading List

|                                |   |        |
|--------------------------------|---|--------|
| *BAXTER, M.R.                  | PRODUCT DESIGN: A PRACTICAL GUIDE TO THE SYSTEMATIC METHODS OF NEW PRODUCTS DEVELOPMENT <u>Nelson Thornes</u> 1995 (2002 reprint) | AP 308 |
| *ULRICH, K.T. & EPPINGER, S.D. | PRODUCT DESIGN AND DEVELOPMENT <u>McGraw-Hill/Irwin</u> 3rd edition 2004  | BN 220 |
| SLOCUM A H                     | PRECISION MACHINE DESIGN, 1991  | AP 323 |

Links to online copies of this Reading List can be found here -

<https://cam.alma.exlibrisgroup.com/leganto/readinglist/lists/14624300620003606?institute=44CAMINST&auth=SAML>

## 3P4: Operations Management

|  |  |
|--|--|
| <b>Module summary</b>                        | The management of material and information flow in factory systems and the supply chain  |
| <b>Taught by</b>                             | Prof Alexandra Brintrup (Module Leader), TBC   |
| <b>Assessment</b>                            | 100% by examination. Paper 3, double paper with 3P5  |
| <b>Supervision</b>                           | The course will be supported by three examples papers, for each of which one supervision will be arranged. Typically Lent week 2, 4 and 8.   |
| <b>Links to other elements of the course</b> | Production Game to simulate the operations of a manufacturing company, where students trial elements of the 3P4 module in a live setting. 3P4 has links to the 3P5 module particularly when students learn Lean and Just-In-Time manufacturing principles. 3P2 links to 3P4 as motivator for manufacturing process scheduling. |

### Module Learning Outcomes

On completion of the module students should be able to:

1. Understand the ways in which manufacturing processes are managed in order to achieve the right quality of product, manufactured to meet the customer requirements and delivered on time, and making the most efficient use of the resources available.
2. Understand the role of inventory in manufacturing systems, and apply basic ordering, replenishment, and forecasting techniques
3. Describe the major influences on the efficient flow of work through a factory, apply MRP techniques to scheduling, describe the implications of different co-ordination structures on job design, describe how improvement processes relate to co-ordination strategies
4. Understand how manufacturing operations are integrated with other aspects of the business; how operations are managed across supply networks; and the role of different information systems in supporting operations across the supply chain



## Syllabus and Lecture Learning Outcomes

| Lecture                               | Syllabus  | On completion students should be able to ...   |
|---------------------------------------|---|--|
| 1 - 2<br>Introduction                 | Course introduction,<br>Operations management levers,<br>Volume vs Variety,<br>Process Principles,<br>Operations Trade-offs | Discuss the key issues in manufacturing and service operations and the key levers available to managers to tackle them.<br>Discuss the importance of the volume-variety choice in process design<br>Understand the importance of process theory<br>Identify the objectives involved in operations management, the costs, and the trade-offs                                |
| 3 - 4<br>Capacity Management          | Capacity planning,<br>Queuing Systems   | Discuss reasons why actual capacity will be lower than theoretical capacity and how changing demand and product mix influence capacity<br>Assess capacity/demand trade-offs and understand different options for a manager to cope with variations in demand and capacity<br>Understand how queues and capacity are related and analyse the components of a queuing system |
| 5 - 6<br>Inventory management         | Role of Inventory,<br>Parts classification,<br>Independent and Dependent demand,<br>Forecasting                             | Discuss the role of inventory in a production system<br>Understand the differences between independent and dependent demand for goods<br>Appreciate the need for forecasting of independent demand<br>Calculate independent demand forecasts using different forecasting methods (Moving Average & Exponential Smoothing)  |
| 7 - 8<br>Inventory Management II      | EOQ and other inventory models<br>Sustainability and Inventory Management   | Derive the expression for and calculate the Economic Order Quantity (EOQ)<br>Understand different order fulfilment strategies and and batch sizing decisions<br>Articulate green inventory practices   |
| 9 - 10<br>Scheduling                  | Line balancing, EDD, SPT, FIFO scheduling rules   | Balance a production line<br>Implement different production scheduling rules   |
| 11 – 12<br>Procurement                | Materials Requirements Planning, JIT  | Generate MRP records for a product and its components, given market demand and other process parameters. Discuss the differences between “push” and “pull” manufacturing approaches  |
| 13 – 14<br>Logistics & transportation | Transportation model, warehousing and distribution  | Solve simple transportation problems for allocating product flows between supply chain locations<br>Determine the optimal factory/warehouse location for a given demand distribution   |

|         |   |   |
|---------|---|---|
| 15 - 16 | SC Dynamics, ERP/SCM systems, CPFR, VMI | Discuss the implications of dynamics in supply chains<br>Discuss the role of the information systems in improving supply chain operations<br>Discuss various mechanisms used by organizations to coordinate product and information flows within a supply chain |
|---------|---|---|

## Reading List

### **Course Text:**

Slack, N., Brandon-Jones, A. and Burgess N. (2022) Operations Management. 10th ed. Harlow, England: Pearson

- Printed book at: TS155.S52 2022

Or

Slack, N. and Brandon-Jones, A. (2019) Operations Management. 9th ed. Harlow, England: Pearson

- Printed book at: TS155.S52 2022
- E-Book available via: iDiscover [Link here](#)

### **Additional Reading:**

Womack, J.P., Jones D.T. & Roos, D. , The Machine That Changed The World: The Triumph Of Lean Production Rawson Associates 1990

Goldratt, E.M. & Cox, J., The Goal: A Process Of Ongoing Improvement Gower 3rd Edition 2004

Holweg, M., Davies, J., De Meyer, A., Lawson, B. & Schmenner, R. (2018). Process Theory: The Principles of Operations Management, Oxford University Press.

- Printed book at: TS155.H64 2017
- E-book via iDiscover [Link here](#)

**Links to online copies of this Reading List can be found here -**

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## 3P5: Industrial Engineering

|  |   |
|--|---|
| <b>Module summary</b>                        | The design of production flows and operations in manufacturing  |
| <b>Taught by</b>                             | Prof A. Parlikad (Module leader)  |
| <b>Assessment</b>                            | 100% by examination, consisting of 2 questions. Students will attempt all questions. Paper 3 is a double paper with 3P4.  |
| <b>Supervision</b>                           | The module is supported by 3 supervisions: EP 1 – Lectures 1-6; EP 2 – Lectures 7-10; EP 3 – Lectures 11-16.  |
| <b>Links to other elements of the course</b> | Production Game to simulate the operations of a card-manufacturing company where students trial elements of 3P4 and 3P5. Particular links between 3P4 and 3P5 exist in the application of the Just-in-time manufacturing principles. Links to the industrial visits and the major project particularly on the JIT, 5S, work measurements tools and layout planning. |

### Syllabus and Lecture Learning Outcomes

| Lecture                              | Syllabus   | On completion students should be able to ...  |
|--------------------------------------|--|---|
| 1-2<br>Introduction and Method Study | Introduction to Industrial Engineering; objectives of Method Study.<br>Method Study procedure: Select, Record, Examine, Develop, Define, Install, Maintain.            | Understand and be able to apply the traditional techniques of method study.   |
| 3-4<br>Ergonomics                    | Ergonomics, principles of Motion Economy. Job Design, use of the Human Body. Arrangement of the Workplace. Design of Tools and Equipment                               | Understand the factors that affect the ergonomic design of jobs, tools and equipment, and the workplace.  |
| 5-6<br>Lean Production Techniques    | Toyota Production System: JIT, 5S and Kaizen.  | Understand the principles of Lean production, and be able to relate these to traditional work study.  |
| 7-8<br>Work Measurement 1            | The Need for Time Standards. Establishing Time Standards: Activity Sampling, Time Study, Rating, Learning Curves, Allowances, Basic time, Work Content, Standard time. | Understand the roles of time standards in manufacturing.<br>Know the different ways in which time standards can be determined and the advantages and disadvantages of each method.<br>Understand the basic principles behind learning and be able to manipulate a simple learning model to predict the effect of learning on the cycle time of repetitive work. |

|  |   |   |
|--|---|---|
| 9-10<br>Work<br>Measurement 2                      | Predetermined Time Standards: MTM-1; Standard Data Systems; Activity Sampling.  | Know the basic motion elements and how these are used in predetermined motion time systems.<br>Know how standard data systems are developed.<br>Understand work sampling is used for measuring proportion of time spent in different activities.                      |
| 11-12<br>Process<br>Organisation &<br>Plant Layout | Project, jobbing, batch, line, continuous flow; cellular production; group technology Factory, Department and Workplace layout; Systematic Layout Planning. | Understand the different types of process layout and the advantages and disadvantages of each.<br>Appreciate the factors that affect the layout of a factory.<br>Group technology.<br>Understand and be able to apply the techniques used in planning factory layouts |
| 13-14<br>Reliability<br>Engineering                | Failure detection and prevention in factory equipment. Reliability modelling.   | Discuss the basics of machine tool reliability, and explain the implications of the “bathtub curve”.<br>Understand how to calculate reliability of complex engineering systems.   |
| 15-16<br>Maintenance<br>Management                 | Maintenance strategies Preventive maintenance planning.   | Explain various maintenance strategies, their advantages and disadvantages.<br>Understand how to develop an optimal maintenance schedule for equipment.   |

## Reading List

- \*GROOVER, M.P. WORK SYSTEMS: THE METHODS, MEASUREMENT, AND MANAGEMENT OF WORK Pearson 2014
- \*MUHLEMANN, A., OAKLAND, J. & LOCKYER, K PRODUCTION AND OPERATIONS MANAGEMENT Pitman 6th edition 1992
- \*BICHENO J. & HOLWEG M. THE LEAN TOOLBOX, 6<sup>th</sup> Edition, PICSIE Books, 2024
- \*WOMACK JP, JONES DT, ROOS D. THE MACHINE THAT CHANGED THE WORLD, Rawson Associates, 1990
- \*IMAI M KAIZEN, Random House, 1986
- HELANDER, M. A GUIDE TO THE ERGONOMICS OF MANUFACTURING, Taylor and Francis, 1995
- CHASE R, AQUILANO N. & JACOBS PRODUCTION AND OPERATIONS MANAGEMENT, 8<sup>th</sup> Ed, McGraw Hill, 1998
- SLACK, N., CHAMBERS, S. & JOHNSTON. R. OPERATIONS MANAGEMENT FT/Prentice Hall 5th edition 2007 4th edition (2004) available as e-book at: <http://ul-newton.lib.cam.ac.uk/cgi-bin/Pwebrecon.cgi?BBID=4508815>

Links to online copies of this Reading List can be found here -

<https://cam.alma.exlibrisgroup.com/leganto/readinglist/lists/15419780400003606?institute=44CAMINST&auth=SAML>

## Online resources

- \*GROOVER, M.P. Book: WORK SYSTEMS: THE METHODS, MEASUREMENT, AND MANAGEMENT OF WORK Pearson 2014. \*\*\*Online book\*\*\*  
[http://idiscover.lib.cam.ac.uk/permalink/f/1ii55o6/44CAM\\_ALMA51606969690003606](http://idiscover.lib.cam.ac.uk/permalink/f/1ii55o6/44CAM_ALMA51606969690003606)
- Ergonomics Video: Five steps for ergonomic workstation.  
<https://www.youtube.com/watch?v=dVFtAEDlnRA>
- Toyota production system Sugimori Y., Kusunoki K., Cho F. and Uchikawa S. (1977) Toyota production system and Kanban system Materialization of just-in-time and respect-for-human system, International Journal of Production Research, 15:6, 553-564, DOI: 10.1080/00207547708943149  
<https://www.tandfonline.com/doi/pdf/10.1080/00207547708943149>  
 Spear S. and Bowen K. 1992. Decoding the DNA of the Toyota production system. Harvard Busienss Review. Sept-Oct. pp. 96-106  
<https://i9y8y5w2.stackpathcdn.com/wp-content/uploads/2015/12/Decoding-DNA-Spear-Bowen.pdf>  
 Video: 5S Methodology and tips  
[https://www.youtube.com/watch?v=8gKJ3\\_Hm3dM](https://www.youtube.com/watch?v=8gKJ3_Hm3dM)  
 Video: Lean 5S in MSICU - Implementaiton in practice the before and after  
<https://www.youtube.com/watch?v=aMkXICM1-98>
- Time study in work measurement Article: Preparing to measure process work with a time study  
<https://www.isixsigma.com/methodology/business-process-management-bpm/preparing-measure-process-work-time-study/>
- Preditermed time standards Research article: Heungjae Cho, Sungkun Lee & Jaeil Park (2014) Time estimation method for manual assembly using MODAPTS technique in the product design stage, International Journal of Production Research, 52:12, 3595-3613, DOI: 10.1080/00207543.2013.878480  
 Research Article: Todd H.C., Chyatte S. G. and Decker R.S. 1979. Preditermed time standards: their application in workhshop settings. Archives of physical medicine and rehabilitation. 60(5): 222-226  
<https://europepmc.org/article/med/156528>
- Plant Layout Video: Celullar manufacturing  
<https://www.youtube.com/watch?v=Ynhp8Wi2qwM>  
 Video: Plant layout  
[https://www.youtube.com/watch?v=6FYvNrl\\_JVw](https://www.youtube.com/watch?v=6FYvNrl_JVw)
- Predictive maintenance Video: predictive maintenance explained.  
<https://www.reliableplant.com/Read/12495/preventive-predictive-maintenance>
- \*GROOVER, M.P. WORK SYSTEMS: THE METHODS, MEASUREMENT, AND MANAGEMENT OF WORK Pearson 2014  
 \*\*\* Online book\*\*\*.  
[http://idiscover.lib.cam.ac.uk/permalink/f/1ii55o6/44CAM\\_ALMA51606969690003606](http://idiscover.lib.cam.ac.uk/permalink/f/1ii55o6/44CAM_ALMA51606969690003606)  
 Also:\*\*\*ONLINE CHAPTERS\*\*\*  
 Chapters 6, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 21, 22, 23, and 24.  
Note: chapters available in the Engineering Department Library.

## 3P6: Organisational Behaviour

|  |   |
|--|---|
| <b>Module summary</b>                        | An introduction to theories of organisational behaviour   |
| <b>Taught by</b>                             | Dr M Kumar (Module leader)  |
| <b>Assessment</b>                            | 100% by examination. Paper 4, double module paper combined with 3P7   |
| <b>Supervision</b>                           | There will be three supervisions on Organisational Behaviour in the Michaelmas term, typically week 4, 6 and 8.   |
| <b>Links to other elements of the course</b> | <p>This module complements the following modules and course activities:</p> <p><b>MET IIA:</b> Industrial Visits (Corporate Social Responsibility and Sustainability); Skill Workshops (Change Management and Team Building); 3P7 (Nurturing Talent and Change Management); 3P10 (Industrial Sustainability)</p> <p><b>MET IIB:</b> MET IIB-6 (Leadership and Managing people); MET-IIB-8 (Sustainable Manufacturing)</p> |

### Syllabus and Learning Outcomes

| Lecture   | Syllabus  | On completion students should be able to ...   |
|---|---|--|
| 1<br>Introduction   | Introducing<br><i>Organisational Behaviour</i>  | Understand some of the central issues in work organizations<br>Define organisational behaviour   |
| 2<br>Corporate Social Responsibility, and Business Ethics | Free Market<br>Business Ethics<br>Sustainability and Corporate Social Responsibility          | Explain ethical dilemma in the workplace<br>Describe key principles of corporate social responsibility, business ethics and sustainability   |
| 3<br>Culture  | Levels of Organizational Culture<br>Cultural Typology<br>Cultural Change                      | Understand advantages of managing people through culture<br>Distinguish between Schein's three levels of organizational culture<br>Explain how managers try to change culture              |
| 4<br>Personality and Individual Differences               | Nomothetic Approach<br>Personality Testing<br>Ideographic Approach<br>Social-radical Approach | Understand key approaches to study personality<br>Explain how personality is measured in organisational settings   |
| 5<br>Communication  | Organizational Communication<br>Noise<br>Information, Communication, and Technology           | Describe theories and processes of communication in organisations<br>Explain how technology mediates communication, producing a trade-off between efficiency and richness of communication |
| 6   | Hawthorne Studies<br>Human Relations  | Describe the power of the informal organisation  |

|   |  |  |
|---|--|--|
| Social Organisation                       |  | Explain how the Hawthorne studies lead to the foundations of organisational behaviour  |
| 7<br>Motivation                           | Extrinsic Motivators<br>Intrinsic Motivators<br>Behavioural, Content, Process and Social Theories                            | Understand what motivates people to work<br>Use theories to identify motivational problems in organizations and recommend solutions  |
| 8<br>Groups and Teams                     | Definitions of Groups and Teams<br>Types of teams and loafing<br>Groupthink<br>Social Identity Theory                        | Understand the differences between groups and teams<br>Explain the link between teamwork and productivity<br>Analyse the factors needed to produce an effective team<br>Explain how groupthink can have negative implications on teams |
| 9<br>Work Design                          | Rational Work design<br>Rational Production<br>Capitalist Working Relationship   | Describe the principles behind Taylorist and Fordist rational work design<br>Analyse the effect that Taylorism and Fordism are said to have upon workers   |
| 10<br>Changing the Organisation           | Force-field analysis<br>Approaches to change<br>Three-Step Model   | Describe approaches to the management of change<br>Explain how change can be messy, causing conflict and resistance  |
| 11<br>Organization Design and Bureaucracy | Bureaucracy<br>Rational Organisation Design<br>Iron Cage Bureaucracy   | State the main characteristics of a bureaucratic organization structure as specified by Max Weber<br>Explain how bureaucracy is a form of rational organisational design   |
| 12<br>Leadership                          | Behaviourism<br>Contingency theory<br>Post-heroic  | Describe the key leadership theories<br>Explain the differences between leadership and management<br>Analyse whether there is too much emphasis on the individual leader   |
| 13<br>Perception and Decision Making      | Attribution Theory<br>Drawback in judgments<br>Link between perception and decision making<br>Organizational Decision-making | Understand perception and explain the factors that influence it<br>Identify the shortcuts Individuals use in making judgement about others<br>Describe the common Decision Biases or errors  |
| 14<br>Power and Politics                  | Office politics<br>Emancipation<br>False Consciousness<br>Empowerment  | Describe the power as property view<br>Explain why power and politics exist within organisations<br>Analyse the different underlying assumptions   |
| 15 & 16<br>Review /Summary                | Challenges of Organisations<br>Changing Nature of OB<br>Predicting Future trends   | Explain the importance of connecting organisational behaviour theories<br>Describe some of the changes that have occurred in organisations over the last forty years   |

## Reading List

\* HUCZYNSKI, A.A. & BUCHANAN, D. ORGANIZATIONAL BEHAVIOUR, Pearson, 8th edition 2013. Several university departments and colleges have copies of this text. You can purchase it at a 20% discount via <http://www.pearson-books.com/cam> using the voucher code ZP031F. The sixth and seventh editions are also acceptable.

ROBBINS, STEPHEN P. ORGANIZATIONAL BEHAVIOUR: CONCEPTS, CONTROVERSIES AND APPLICATIONS. Prentice Hall, 1991

KING, DANIEL, AND SCOTT LAWLEY ORGANIZATIONAL BEHAVIOUR. Oxford University Press, 2016

Links to online copies of this Reading List can be found here –

[https://cam.alma.exlibrisgroup.com/leganto/public/44CAM\\_INST/lists/14624311000003606?auth=SAML](https://cam.alma.exlibrisgroup.com/leganto/public/44CAM_INST/lists/14624311000003606?auth=SAML)



## 3P7: Managing Business and People

|  |   |
|--|---|
| <b>Module summary</b>                        | An introduction to the processes involved in starting and running a business.   |
| <b>Taught by</b>                             | Dr Mukesh Kumar (Module leader)   |
| <b>Assessment</b>                            | 100% by examination. Double module paper combined with 3P6 Organisational Behaviour.<br><br>Students will be required to answer one question from Managing Business and one from Managing People.   |
| <b>Supervision</b>                           | There will be two hours of supervisions. Typically Lent week 5 and 8.   |
| <b>Links to other elements of the course</b> | This module complements the following modules and course activities:<br><br><b>MET IIA:</b> Industrial Visits ( Company Level Context, Human Resources); 3P7 (Group, Team, Motivation); 3P9 ( Firm Boundaries, Competitive Analysis, Resouces and Capabilities, Strategic Marketing, Business Models)<br><br><b>MET IIB:</b> MET-IIB-2 (Performance Mesurement, Business Strategy, Strategic Marketing); MET-IIB-6 (Leadership and Managing people) |

### Module Learning Outcomes

On completion of the module students should be able to:

1. Explain the core processes involved in starting and running a business
2. Demonstrate the importance of integrating management and business practices with the firm's strategic objectives
3. Evaluate HR practices and the importance of making the best use of people

### Syllabus

| Lecture           | Syllabus  | On completion students should be able to ...   |
|-------------------|---|--|
| 1<br>Introduction | The key integrating frameworks for understanding a manufacturing business<br>Module overview<br>Key areas of activity of a manufacturing business<br>External factors that influence a manufacturing business<br>Frameworks to show linkages between internal and external activities of a manufacturing business | Describe and apply a framework for management of a manufacturing business and the context within which it operates |

|                                |   |   |
|--------------------------------|---|---|
| 2<br>Entrepreneurship          | <p>Starting and growing a business</p> <p>The role of entrepreneurship in an economy</p> <p>Defining entrepreneurship: Resource-based versus opportunity based activities</p> <p>How a firm grows: Typical growth trajectories and common management challenges</p> | Describe entrepreneurial activity and its place in the economy, and to outline the most significant challenges faced by those managing a young firm |
| 3<br>Staying competitive       | <p>Guiding and managing an established business</p> <p>Managing steady state c.f. managing change</p> <p>Tools for planning</p> <p>Managing Innovation (product, process, business model, organisational, etc)</p>  | Explain the challenges faced in managing an established business, and some of the tools available to assist in planning and implementing change     |
| 4<br>Marketing                 | <p>Identifying future business opportunities</p> <p>The business planning cycle</p> <p>Identifying customer needs and opportunity areas</p> <p>Designing business models to address new needs</p>   | Outline the marketing function and its contribution to the business   |
| 5<br>Sales                     | <p>Accessing customers (PBH)</p> <p>The links between business models and routes to market</p> <p>The key tools and techniques for sales</p> <p>Integrating sales with other business activities</p>  | Describe the sales process, its role in the business, and a selection of key tools and techniques   |
| 6<br>Case study                | Integrating example   | Discuss how the principles covered in lectures 1 to 5 might be applied practice   |
| 7<br>Introduction to HRM       | <p>Managing people to deliver business objectives</p> <p>People as a resource</p> <p>The principles of HRM (and contrasts with earlier models)</p> <p>The application of HRM (Hard &amp; Soft; integrated, devolved, outsourced)</p> <p>Strategic HRM</p>           | Describe the core principles of HRM and discuss its practical application   |
| 8<br>Recruitment and Selection | Establishing the need for recruitment; establishing processes to attract good employees to the organisation; and identifying the best mechanism for selection.  | Understand the supply-side factors that influence recruitment and describe the main components of the employee recruitment process.                 |

|   |   |  |
|---|---|--|
| 9<br>Performance management                 | Goals of performance measurement<br>Performance appraisals<br>Potential biases in appraisals<br>Stack ranking<br>360 degree appraisals<br>Appropriate employee compensation and different means of achieving it                   | Describe how employee performance is measured and managed.   |
| 10<br>Nurturing talent                      | Models of learning<br>Training/learning methods<br>Segmenting talent<br>Employee retention  | Discuss the process of employee learning and different methods of training employees<br>Describe how employee talent should be recognised and managed effectively to deliver value to the organisation |
| 11<br>Change Management                     | Types of change in organisations<br>Resistance to change and overcoming resistance<br>Satir Model of change<br>Kotter's 8 steps for successful change management  | Discuss why change is an issue for organisations<br>Describe the implications of change for the management of people   |
| 12<br>Legislation and regulation            | Managing within the legal framework<br>Employment law (hiring, firing, equal opportunities etc)<br>Workplace legislation<br>Employee participation and consultation   | Describe the main features of the regulatory and legal framework for employment  |
| 13<br>Dispute Resolution and Governance     | Managing people within a framework<br>Dispute resolution<br>Governance and ethics in HRM (inc objective-subjective perspectives)  | Outline the main features of the frameworks within which employees are managed, and explain modern approaches to dispute resolution.   |
| 14<br>International practices/Globalisation | Addressing diversity - Cultural and regulatory variations; Pan-national influences<br>Universalist and contextualist paradigms<br>Convergence and divergence<br>Cultural and institutional explanations<br>Variations in practice | Explain, with examples, how cultural and national norms influence the nature and practice of HRM   |
| 15<br>Current trends                        | including globalisation, new technology, demographics, flexible working, outsourcing (People management)<br>Technology in HRM<br>Dynamic organisations  | Demonstrate awareness of current trends and developments in HRM and in the management of people  |
| 16<br>Review/Summary                        | Integrating people, management practices, and business strategy   | Explain and illustrate how strategic, operations and human resource management practices interact in the process of starting and running a business  |

## Reading List

|                                  |  |            |
|----------------------------------|--|------------|
| *MOORE, G                        | CROSSING THE CHASM, New York: <u>Harper Business</u> 1991  |            |
| *MULLINS, J. W                   | THE NEW BUSINESS ROAD TEST: WHAT ENTREPRENEURS AND EXECUTIVES SHOULD DO BEFORE WRITING A BUSINESS PLAN. London, FT <u>Prentice Hall</u> . 2003 |            |
| *STOREY, J. (ed)                 | HUMAN RESOURCE MANAGEMENT: A CRITICAL TEXT<br><u>Thomson Learning</u> 3rd edition 2007   | 1844806154 |
| *TIMMONS, J. A.<br>& SPINELLI, S | NEW VENTURE CREATION: ENTREPRENEURSHIP FOR THE 21 <sup>ST</sup> CENTURY <u>McGraw-Hill</u> 8 <sup>th</sup> edition, 2008                       | 0071276327 |
| *BEARDWELL, J.,<br>& CLAYDON, T. | HUMAN RESOURCE MANAGEMENT: A CONTEMPORARY APPROACH <u>Financial Times/Prentice Hall</u> 5 <sup>th</sup> edition 2007                           | 0273707639 |
| *LEGGE, K                        | HUMAN RESOURCE MANAGEMENT: RHETORICS AND REALITIES, <u>Palgrave Macmillan</u> , 2005   | 1403936005 |

Links to online copies of this Reading List can be found here -

[https://cam.alma.exlibrisgroup.com/leganto/public/44CAM\\_INST/lists/15467921380003606?auth=SAML](https://cam.alma.exlibrisgroup.com/leganto/public/44CAM_INST/lists/15467921380003606?auth=SAML)

## 3P8: Financial and Management Accounting

|  |   |
|--|---|
| <b>Module summary</b>                        | An introduction to the principles and practice of financial & management accounting and finance   |
| <b>Taught by</b>                             | Prof Chander Velu (Module leader)   |
| <b>Supporting activities</b>                 | The module content is used in the production of business plans for the major project  |
| <b>Assessment</b>                            | 100% by examination, Paper 5 combined with 3P9 Economics of Industry and Strategy   |
| <b>Supervision</b>                           | Four supervisions will be offered in support of this module, typically weeks 3, 5, 7 and 8.   |
| <b>Links to other elements of the course</b> | There are some links to 3P4, Operations Management, in particular inventory management. There are also links to 3P9, Industrial Economics, Strategy and Governance. This work also supports capabilities needed within the Major Project. |

### Aims

The course is designed to situate management and shareholders' decision making in their financial context. The course aims to develop students' understanding of the financial processes affecting corporate life - in particular, their understanding of the factors impinging upon corporate decisions and of the financial aspects of organisations.

### Syllabus: Financial Accounting

| Lecture | Syllabus   | On completion students should be able to ...   |
|---------|--|--|
| 1-2     | Overall framework of financial reporting   | Understand the importance of financial accounting.<br>Understand the principles, conventions and regulatory framework of financial accounting.   |
| 3-4     | The mechanics of accounting<br>Balance Sheet, Profit and Loss Account/Income                 | Understand the principles of double entry bookkeeping.<br>Understanding the principles of preparing of company financial statements such as the Profit and Loss Accounts and the Balance Sheet                                   |
| 5-6     | Asset valuation methods, cash flow statements  | Understand different methods of asset valuation and the purpose and creation of cash flow statements   |
| 7-8     | Performance ratios<br>Analysing and interpreting financial statements<br>Creative accounting | Understand and be able to use firm performance ratios.<br>Be familiar with company reports and their analysis, be able to compare performance of firms.<br>Awareness of creative accounting and possible management of earnings. |

## Syllabus: Management Accounting and Finance

| Lecture | Syllabus   | On completion students should be able to ...  |
|---------|--|---|
| 9-10    | Cost concepts and cost behaviour<br>Product costing systems and activity based costing | Understand the classification of different costs<br>Understand and be able to apply different costing methods and to apply different methods for dealing with overhead costs  |
| 11-12   | Building a budget<br>Budgeting and variance analysis/cash flow management              | Understand budgeting methods and processes.<br>Understand and be able to apply variance analysis, and manage the cash in a business.  |
| 13-16   | Investment Appraisal<br>Financing decisions  | Understanding the approaches to compare the financial viability of different projects <ul style="list-style-type: none"> <li>- payback calculations</li> <li>- capital budgeting decisions (opportunity cost of capital, investment rules such as net present value and real options)</li> <li>- time value of money and risk versus return;</li> <li>- financing decisions (debt versus equity).</li> </ul> Understand financing decisions (debt versus equity) and the capital markets. |

### Reading List

|  |   |
|--|---|
| ATRILL, P. & McLANEY, E.J.                   | ACCOUNTING AND FINANCE FOR NON-SPECIALISTS <u>Pearson</u> 11th edition 2018                                   |
| ATRILL, P. & McLANEY, E.J.                   | FINANCIAL ACCOUNTING FOR DECISION MAKERS <u>Pearson</u> 9th edition 2019                                      |
| ATRILL, P. & McLANEY, E.J.                   | MANAGEMENT ACCOUNTING FOR DECISION MAKERS <u>Pearson</u> 9th edition 2019                                     |
| BARKER, R.                                   | SHORT INTRODUCTION TO ACCOUNTING, <u>Cambridge University Press</u> , 2011                                    |
| ATKINSON, A.A., <i>et al.</i>                | MANAGEMENT ACCOUNTING: INFORMATION FOR DECISION MAKERS AND STRATEGY EXECUTION <u>Pearson</u> 6th edition 2011 |
| ROSS, S.A., WESTERFIELD, R.W. & JORDAN, B.D. | FUNDAMENTALS OF CORPORATE FINANCE. McGraw-Hill Irwin. 13th ed. 2022.  |

Links to online copies of this Reading List can be found here -

[https://cam.alma.exlibrisgroup.com/leganto/public/44CAM\\_INST/lists/14624323120003606?auth=SAML](https://cam.alma.exlibrisgroup.com/leganto/public/44CAM_INST/lists/14624323120003606?auth=SAML)

## 3P9: Industrial Economics, Strategy and Governance

|  |   |
|--|---|
| <b>Module summary</b>                        | An introduction to the principles and practice of economics in order to understand the structure of industries and corporate strategy |
| <b>Taught by</b>                             | Prof Chander Velu (Module leader)   |
| <b>Assessment</b>                            | 100% by examination, Paper 5, combined with 3P8 Financial and Management Accounting   |
| <b>Supervision</b>                           | Four supervisions will be offered in support of this course   |
| <b>Links to other elements of the course</b> | There are links to 3P8, Financial and Management Accounting. This work also supports capabilities needed within the Major Project.    |

### Aims

The course is designed to situate firm practices and decisions in their wider economic context. The course aims to develop student understanding of the global economy and the evolving structure of industries and firms. It explores the key aspects of strategy formulation and the management of firms that shape the development of business.

### Syllabus: Industrial Economics

| Lecture | Syllabus  | On completion students should be able to ...  |
|---------|---|---|
| 1-2     | The Global Economy, markets and industries<br>The importance of manufacturing<br>The rise of the service economy<br>The role of strategy and strategic planning | Understand the global economy and the changing structure of markets and industries.<br>Understand the development of the manufacturing and service industries.<br>Appreciate of different views of strategic planning                                   |
| 3-4     | Firm boundaries   | Understand the theory of the firm<br>Understand the horizontal and vertical boundaries of the firm  |
| 5-6     | Competitive analysis  | Appreciate the analytical framework of standard microeconomics.<br>Understand the principles of models of perfect competition, monopoly and oligopoly.<br>Understand the economics of entry and exit<br>Understanding dynamics of competing across time |
| 7-8     | Industry and strategic positioning  | Appreciate the main issues affecting the macro environment<br>Understand the benefits of coopetition<br>Analyse how firms may respond strategically to its changing environment.<br>Understand strategic positioning and competitive advantage          |

|       |                                |   |
|-------|--------------------------------|---|
| 9-10  | Resources and capabilities     | Appreciation of positioning versus resource base view<br>Sustaining competitive advantage   |
| 13-14 | Strategic marketing            | Understand the role of marketing in the execution of strategy<br>Appreciation of marketing objectives and strategies<br>Understand product and pricing<br>Understand distribution and promotion |
| 11-12 | Business models and innovation | Understand the relationship between strategy, business models and tactics and its relationship to innovation  |
| 15-16 | Strategy and governance        | Appreciate departmentalisation, coordination and control<br>Appreciate of organizational structures<br>Understanding efficient information processing   |

### Reading List

BESANKO, D., DRANOVE, D., SHANLEY, M. & SCHAEFER, S. ECONOMICS OF STRATEGY, 6<sup>th</sup> edition, Wiley. 2013

KOTLER, P., KELLER, K.L. & BRADY, M. MARKETING MANAGEMENT. Prentice-Hall/Pearson Education Global edition 2015

GRANT, R. CONTEMPORARY STRATEGY ANALYSIS: Text and Cases, 8<sup>TH</sup> edition, Wiley, 2013

Links to online copies of this Reading List can be found here -

[https://cam.alma.exlibrisgroup.com/leganto/public/44CAM\\_INST/lists/15532598300003606?auth=SAML](https://cam.alma.exlibrisgroup.com/leganto/public/44CAM_INST/lists/15532598300003606?auth=SAML)



## 3P10: Contemporary Issues in Manufacturing.

|  |  |
|--|--|
| <b>Module summary</b>                        | <p>a. Lectures to introduce a selection of current topics and challenges facing manufacturing industries</p> <p>b. Information to support the study and analysis of modern industrial practice during the industrial visits module.</p>  |
| <b>Taught by</b>                             | Prof. Ronan Daly (module leader), Dr Nathaniel Cooper  |
| <b>Supporting activities</b>                 | The module is linked with the industrial visits, which will enhance understanding of all lecture modules and provide examples of their application in modern manufacturing companies.  |
| <b>Assessment</b>                            | 100% by examination. There will be a 90 minute examination in which students will be required to answer one question from each of the three sections – (i) industrial sustainability, (ii) bio engineering and medical device manufacturing and (iii) scaling up to manufacturing  |
| <b>Supervision</b>                           | <p>a. Industrial Sustainability - One review and discussion class for the whole group (1.0h)</p> <p>b. Bioengineering &amp; Medical Device Manufacturing - One examples paper and class for whole group (1.0h)</p> <p>c. Scaling up to Manufacturing – One examples paper and class for whole group (1.0h)</p>   |
| <b>Links to other elements of the course</b> | <p>METIIA 3P1: We look at materials used specifically for medical technologies.</p> <p>METIIA 3P3: There are specific design for manufacturing challenges for medical technologies</p> <p>METIIA: Industrial Visits Programme</p> <p>METIIB-3 Technology and Innovation Management (New product innovation)</p> <p>METIIB -6 Production Technologies and Materials (Sustainable materials, materials analysis for QC)</p> <p>METIIB-7 Sustainability Manufacturing</p> |

### Syllabus: Bioengineering & Medical Device Manufacturing

| Lecture | Syllabus   | On completion students should be able to ...  |
|---------|--|---|
| 1       | Introduction to medical devices, materials, required properties and tissue engineering | <p>Understand the breadth of the medical device industry and the classification of devices.</p> <p>Display familiarity with the range of synthetic and biomaterials used to form medical devices.</p> |
| 2       | Selected key challenges in manufacturing of medical devices.                           | Explain the specific challenges faced in manufacturing of medical devices, e.g. sterilisation, biocompatibility.  |

|   |   |   |
|---|---|---|
| 3 | The medical device industry<br>Sector analysis in UK and international context<br>Regulatory bodies and their influence on manufacturing<br>Bioethics | Explain the essential features of the medical device industry.<br>Show an understanding of the regulatory procedures that are followed.<br>Understand the development of bioethics as a field and the key principles of bioethics |
| 4 | Future trends in medical devices and potential impact on manufacturing.<br>E.g. Nanomanufacturing, personalised medicine, sustainability              | Show awareness of trends in the industry and identify the challenges they pose to manufacturing.  |

### Syllabus: Scaling up to Manufacturing

| Lecture | Syllabus   | On completion students should be able to ...   |
|---------|--|--|
| 1       | Introduction to multiple dimensions of scale-up and links to other modules<br>Case-studies of scale-up challenges                                      | Understand the multidimensional nature of scale-up in manufacturing<br>Systematically think through the scale-up challenges for an emerging technology<br>Understand the use of frameworks to support scale-up |
| 2       | Introduce risks leading to the Valley of Death<br>Techniques for risk management   | Assess combination of risk factors when scaling up<br>Understand and describe a range of management tools for scale-up<br>Understand the industrial innovation infrastructure needed to address risks          |
| 3       | Challenges of scale-up can be addressed through contributions from science, engineering, industry and policy<br>Innovation infrastructure for scale-up | Understand the importance of supporting generic and infra technologies<br>Understand the international approaches to addressing scale-up risks   |

### Syllabus: Industrial sustainability

| Lecture                   | Syllabus   | On completion students should be able to ...  |
|---------------------------|--|---|
| 1<br>The big picture      | The industry landscape: The eco-impact of industrial activity. Energy and resource usage and security. "Triple bottom line"  | Assess the contribution of industry to carbon emissions<br>Discuss major resource implications relevant to manufacturing industry   |
| 2<br>The detailed picture | Measurement and legislation<br>How do we assess the eco-impact of industry? What can we measure and how can we compare different environmental stressors? ISO, LCA., 'LCA Light' | Explain where the eco-impact of industry arises, including the role of supply chains and the implications of the product lifecycle<br>Know what the legislation is<br>Discuss the strengths and weaknesses of different metrics |

|                             |  |  |
|-----------------------------|--|--|
| 3                           | How can eco-efficiency be improved?                          | Choose materials and processes to minimise eco-impact                                |
| Mitigation measures         | Design for sustainability                                    | Discuss the role and limitations of recycling  |
|                             | Optimising materials and process selection                   | Identify sources of waste and suggest how waste may be reduced                       |
|                             | The role and limitations of recycling                        | Be aware of radically different ways of meeting materials needs of society           |
|                             | Waste reduction measures                                     |  |
|                             | Paradigm shifts: Product service systems; zero waste systems |  |
| 4                           | How and why do companies 'go green'?                         | Assess the eco-impact of a company and make reasoned proposals for how to reduce it. |
| Effecting industrial change | Case studies   |  |

### Reading list – Industrial Sustainability

- ALLWOOD, J.M., CULLEN, J. *Sustainable materials – with both eyes open*  
Available as download from the web <http://www.uit.co.uk/B-SMWBEO/>
- ASHBY, M.F. *Materials and the environment*, Butterworth-Heinemann 2009, ISBN 978-1-85617-608-8
- VON WEISZACKER E, LOVINS A.B., LOVINS L.H. *Factor Four: doubling wealth, halving resource use*. Earthscan publications, 1997,
- MACKAY, DJC *Sustainable energy – without the hot air*, [www.withouthotair.com](http://www.withouthotair.com), 2008

### Reading List – Bioengineering & Medical Device Manufacturing

- RATNER, Buddy D. *Biomaterials science an introduction to materials in medicine*, Elsevier Academic Press, 2004 (specific references to sections will be provided in class).
- SINGER, P.A., VIENS, A.M. *Cambridge Textbook of Bioethics*, Cambridge University Press, 2008 (specific references to sections will be provided in class).
- WORLD HEALTH ORGANISATION *Medical Device Regulations- Global overview and guiding principles*, Geneva, 2003, ISBN 92 4 154618 2. (specific references to sections will be provided in class).

Links to online copies of this Reading List can be found here -

[https://cam.alma.exlibrisgroup.com/leganto/public/44CAM\\_INST/lists/14624337100003606?auth=SAML](https://cam.alma.exlibrisgroup.com/leganto/public/44CAM_INST/lists/14624337100003606?auth=SAML)

# Coursework

## CAD/CAM Exercise

|  |   |
|--|---|
| <b>Coursework summary</b>                    | Aims to develop and test the student's ability to produce engineering drawings using CAD, turn the CAD drawings into programmes to produce the components on a machine tool.  |
| <b>Taught by</b>                             | Alan Thorne, Prof James Moultrie  |
| <b>Assessment</b>                            | Coursework  |
| <b>Links to other elements of the course</b> | From -MET IIB - 3P2 (Tools, Feeds & Speeds - B. O'Neill)<br>From -MET IIA – Workshop Practical (Machining – A. Thorne)<br>From -MET IIA – Drawing / Tolerancing Lectures (J. Moultrie)<br>To -MET IIB - MSE (Robot Lab - A. Thorne / D. McFarlane)<br>To -MET IIA - 3P3 (Major Design Project - J. Moultrie / M. De Volder) |

### Overview

The CAD/CAM coursework aims to develop and test the student's ability to produce engineering drawings using CAD, turn the CAD drawings into programmes for the production of the components. The coursework contributes 30 marks.

The CAD exercise is to be completed using SolidWorks. The CAM work is to be produced using SolidCam. There will be classroom support early in Michaelmas term in the use of both software packages.

Students will work in pairs and be assessed as a pair.

### Deliverables

Students will be provided with a simple assembly of 3 parts, 2 of which will have an engineering drawing. Each pair will be required to:

- produce a complete engineering drawing of the 3<sup>rd</sup> component in the assembly. The drawing must depict all features of the component. This must be approved before any CAM programming can begin;
- produce a CAM programme to be loaded onto the machine tool, to allow the correct production of the component.

### Electronic Submission (via Moodle)

The CAD drawings must be electronically submitted on or before **17:00 Friday 31<sup>st</sup> October**

**Your drawing must include your candidate numbers.** A pdf file of your engineering drawing is to be electronically submitted via Moodle submissions, using the following file name structure, where you replace the numbers with your own: **1234n\_5678x\_CAD\_date.pdf**

The CAM programmes must be submitted electronically on or before **17:00 Thursday 4 December** via Moodle submissions. To hand in the CAM component of coursework, please create a zip file, named using the following convention: **1234n\_5678x\_CAM\_date.zip**

## **Assessment**

The coursework is worth 30 marks in total.

- CAD drawing: 50% marks, awarded for completeness, clarity, precision and presentation. Individual drawing will be 'marked-up' with suggested changes, much as would be done in industry by a senior engineer.
- CAM programme: 50% marks, awarded for the functionality of the program, correct use of reference locations, appropriate configuration of chuck jaws, tooling and cutting operations required to produce the different component features.

# Production Game

## Introduction

The Production Game is a simulation of a manufacturing operation. Small companies (teams) are required to manufacture simple paper-based products (greeting cards) based on orders from a market place. Products which meet the required standards of quality and delivery are purchased by the market. Unacceptable products are rejected.

The Production Game typically provides a rich array of first-hand experience with which to think about the issues involved in the organisation and control of manufacturing systems.

Students are required to electronically submit two reports, a pre-game report, and a final report.

## Deliverable 1: pre-game report

Each team is required to submit a report before the game starts outlining the following:

- Resource allocation: How are your resources going to be allocated?
- Production Layout: Are you going to go for a functional or a product-based layout?
- Order selection: What type of orders would you pick?
- Coordination and control: What co-ordinating (integrating) and scheduling mechanisms are you going to use?
- It is important to not only describe the strategies, but to describe the manner in which the strategy was formulated. Prior preparation (e.g., time study, cost-benefit analysis) will pay dividends.

## Deliverable 2: Final report

Final report (individual): Each student should produce a report of a maximum of 2000 words in length which analyses the performance and activities of their company during the Game. Where appropriate, draw on material from 3P3 and 3P4 in your report. The report should include treatment of at least some of the following issues:

- Did your strategy prove to be correct – if so, why, if not, why not?
- How did you design, organize and control your manufacturing system? How did this reflect your wider strategic decisions vis a vis the market? What methods did you use to control costs, quality, time etc?
- How was whole enterprise managed? For example, how did coordination between 'Marketing and Sales' and 'Manufacturing', and 'Manufacturing' and 'Purchasing' occur? What formal and informal information systems were designed (or evolved) during the game? How appropriate were these?
- The things that you feel you did right, and the major errors you made; how you would do it differently next time.
- Comparisons between the performance and processes of your company and those of the other firms. Were there any patterns in who did well and who did badly?

## Evaluation

The coursework will be marked out of 30, with the following allocation of marks to different activities:

- Pre-game report 50%
- Final report 50%

Standard filenames for electronic submission through Moodle submission in the following format please:

Your coursework number followed by the coursework name.

e.g. **1234n\_ProdGame.pdf**



## Major Project

|                        |  |
|------------------------|--|
| <b>Project summary</b> | A major group design project seeking to apply learning from 3P3 and to integrate different elements of MET   |
| <b>Taught by</b>       | Prof Michael De Volder (Project Leader), Prof James Moultrie, Dr Sebastian Pattinson   |
| <b>Assessment</b>      | Coursework   |
| <b>Supervision</b>     | The staff meet with students during timetabled session on Thursday mornings to discuss progress and to steer the project. We also hold to 2 formal supervisions with each team to discuss team member contributions and provide feedback on progress; these are recorded in CamCors. |

### Overview

The Major Project runs from the end of Michaelmas term until the end of the academic year and aims to integrate the design, manufacturing and management elements of the course.

The main components of the project are the development of a viable design solution to a brief as provided by the module leaders. Students are expected to develop viable design solutions, including where possible, working prototypes and demonstrators.

Students also develop a comprehensive business plan, requiring detailed understanding of the potential market, customers and competition. The business plan is supported by a detailed financial model exploring investment, cash, return on investment to determine the financial viability of the proposed business.

A brief for the project will be circulated to students during Michaelmas term, before the project starts.

### Learning Outcomes

At the end of the project, students should have:

- Applied their engineering design skills to solve technical problems.
- Applied their industrial design skills to develop solutions which are fit for the intended users, are appropriately styled and have effective ergonomics.
- Applied their knowledge of materials and production engineering to develop solutions appropriate for the level of anticipated volume of production.
- Explored issues relating to environmental, economic and social sustainability relating to their products.
- Gained experience in market and user research.
- Applied their skills in financial analysis to develop a robust business model for their proposed designs.
- Developed their skills in producing a compelling and believable business plan.
- Developed their communication skills using a range of different approaches.

**Assessment**

Detailed assessment criteria will be outlined in the Major Project briefing during Michaelmas term. In total, the project contributes 140 marks.

## General information

## **Extensions and Penalties for late hand in of coursework**

There is a MET Extensions Policy and Penalty Policy (see Appendix 2).

Coursework extensions or re-arrangements can be requested prior to the submission date by emailing the IfM Teaching Office ([met-admin@eng.cam.ac.uk](mailto:met-admin@eng.cam.ac.uk)) however, not all coursework can be rearranged or have an extension (see policy for details).

There are automatic penalties for late submission of any piece of coursework without an approved extension. The penalty is outlined in the policy.

# Workshop Practical

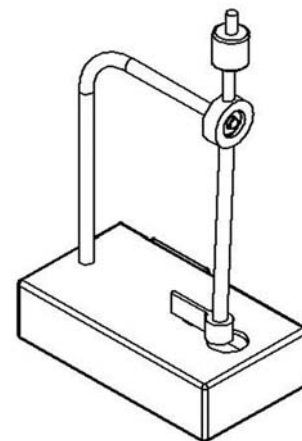
|  |   |
|--|---|
| <b>Workshop summary</b>                      | The objective of this workshop practical is to provide MET IIA students with a basic understanding of fabrication skills  |
| <b>Taught by</b>                             | Alan Thorne (Workshop Leader), Simon Sennitt, Chris Jennings  |
| <b>Assessment</b>                            | <b><u>This activity is not marked</u></b> (Training for use of studio & workshop equipment)   |
| <b>Links to other elements of the course</b> | To - MET IIB - MSE (Robot Lab - A. Thorne / D. McFarlane)<br>To - MET IIA - 3P3 (Major Design Project - J. Moultrie / M. De Volder)<br>To - MET IIA - 3P2 (Machine Configurations, Stiffness, Finishes - B. O'Neill)<br>To - MET IIA – CAD / CAM (CNC / Mutli Axis Machining – A. Thorne) |

## Overview

The objective of this workshop practical is to provide MET IIA students with a basic understanding of fabrication skills required to:

- a) Produce prototyped components using 3D printing, laser cutting and vacuum forming processes.
- b) Produce actual components using more traditional production processes such as a routing, turning, milling.
- c) Fabricate electronic components, populating a PCB, by soldering relevant components in place, programme a PIC micro controller and test the operation of the pendulum.

The workshop sessions have been designed to enable students to produce components required for the fabrication of a perpetual pendulum. The pendulum makes use of an electro-magnet to provide the pendulum with pulses of energy to overcome losses in the mechanical system.



The pendulum blister pack and transport jig will be made using Rapid Proto Type (RPT) technologies. The Pendulum body, arm and base containing the electromagnetic drive will be made using more traditional production processes.

Students will be asked to attend two workshop sessions. The first workshop session will focus on skills required to use the RPT equipment within the design studio. The second workshop session will focus on skills required to operate hand tools, machine tools and electronic fabrication tools within the IfM workshop. A series of workshop sessions will be scheduled, each accommodating a maximum of four students.

At the end of the workshop sessions the students are expected to have a good understanding of the different production processes as well as the use of various equipment in a safe

manner. Successful completion of this activity will allow students to utilise the facilities within the IfM for other project activities such as the Design Project and CAD/CAM.

### **Information**

- Students will attend a safety lecture, successfully complete a safety questionnaire and risk assessments for the activity and related equipment before entering the workshop.
- Students should be appropriately dressed to work within a workshop environment. Closed toe shoes, no loose clothing or jewellery and hair tied back. (Lab coats and safety glasses will be provided.)

## Technology Libraries Team

The Technology Libraries team provide specialist information and library services support for the departments of Engineering, Computer Science and Chemical Engineering and Biotechnology.

Based in the Engineering Library in the Baker Building on Trumpington Street and at the West Hub on JJ Thomson Avenue, the team is available in person and online to help with any questions you may have about resources, search strategies, managing references and more.

The team provide a range of teaching and training of topics ranging from finding the resources you need for your projects to poster design and presentation skills to time management. You can explore the range of [open sessions](#) that you are welcome to attend. We can also be contacted for 1-1 or small group support at anytime throughout your course.

[Visit the website](#) to discover the range of services and support available to you.

Contact the team [techlib@lib.cam.ac.uk](mailto:techlib@lib.cam.ac.uk) or come and say hello at one of our libraries.

## Further Library Support

Other libraries at Cambridge that may have further resources to support your studies include:

### [The University Library](#)

Home to huge research collections and a wide range of spaces to study.

### [Judge Business School Information & Library Services](#)

Providing a specialist information and library service in the field of business and management studies, including a large range of specialist databases and electronic resources.

[Visit the website](#) to find out more and how to register for access.

## Appendix 1: Referencing and Plagiarism

### University of Cambridge General Board Statement on Plagiarism

The General Board, with the agreement of the Board of Examinations and the Board of Graduate Studies, has issued this guidance for the information of candidates, Examiners and Supervisors. It may be supplemented by course-specific guidance from Faculties and Departments.

Plagiarism is defined as submitting as one's own work that which derives in part or in its entirety from the work of others without due acknowledgement. It is both poor scholarship and a breach of academic integrity.

Examples of plagiarism include **copying** (using another person's language and/or ideas as if they are a candidate's own), by:

- *quoting verbatim* another person's work without due acknowledgement of the source;
- *paraphrasing* another person's work by changing some of the words, or the order of the words, without due acknowledgement of the source;
- *using ideas* taken from someone else without reference to the originator;
- *cutting and pasting* from the Internet to make a pastiche of online sources;
- **submitting someone else's work** as part of a candidate's own without identifying clearly who did the work. For example, buying or commissioning work via professional agencies such as 'essay banks' or 'paper mills', or not attributing research contributed by others to a joint project.

**Plagiarism might also arise from colluding** with another person, including another candidate, other than as permitted for joint project work (i.e. where collaboration is concealed or has been forbidden). A candidate should include a general acknowledgement where he or she has received substantial help, for example with the language and style of a piece of written work.

Plagiarism can occur in respect to all types of sources and media:

- **text, illustrations, musical quotations, mathematical derivations, computer code, etc;**
- **material downloaded from websites or drawn from manuscripts or other media;**
- **published and unpublished material, including lecture handouts and other students' work.**

Acceptable means of acknowledging the work of others (by referencing, in footnotes, or otherwise) vary according to the subject matter and mode of assessment. Faculties or Departments should issue written guidance on the relevant scholarly conventions for submitted work, and also make it clear to candidates what level of acknowledgement might be expected in written examinations. Candidates are required to familiarize themselves with this guidance, to follow it in all work submitted for assessment, and may be required to sign a declaration to that effect. If a candidate has any outstanding queries, clarification should be sought from her or his Director of Studies, Course Director or Supervisor as appropriate.

Failure to conform to the expected standards of scholarship (e.g. by not referencing sources) in examinations may affect the mark given to the candidate's work. In addition, suspected cases of the use of unfair means (of which plagiarism is one form) will be investigated and



may be brought to one of the University's Courts. The Courts have wide powers to discipline those found guilty of using unfair means in an examination, including depriving such persons of membership of the University.

The University's plagiarism and good academic practice website (<https://www.educationalpolicy.admin.cam.ac.uk/plagiarism-and-academic-misconduct> ) provides more information and guidance.

### **Plagiarism and good academic practice: your responsibilities**

If, after reading the guidance, you have any outstanding queries you should seek clarification at the earliest opportunity from your Director of Studies or supervisor.

### **Sources of further information and support**

*The University's plagiarism website:*

<https://www.educationalpolicy.admin.cam.ac.uk/plagiarism-and-academic-misconduct>

*Department's plagiarism advice:*

<http://teaching.eng.cam.ac.uk/node/526>

## **Appendix 2: MET Extension and Penalty Policy**

## Obtaining extensions or rearrangements for assessed work on the Manufacturing Engineering Tripos

### Introduction

MET IIa and IIb consists of a range of assessed activities including examinations and coursework. Coursework has a variety of forms and may be completed both individually and in groups.

We expect students on MET IIa and MET IIb to attend all timetabled sessions and respect hand-in deadlines.

We understand that there may be valid reasons why this may not always be possible. This document sets out the conditions where extensions or rearrangements may be allowed for MET IIa and MET IIb as agreed by the Faculty board.

This policy is intended to reduce paperwork and complexity by removing the need for simple and straightforward issues to be submitted to the EAMC. It is not intended to deal with complex matters.

This policy has been updated as of the **1 October 2025** to align with the new University Policy on coursework extensions.

### Policy principles for both MET IIa and MET IIb

All timetabled coursework activities are compulsory parts of the course.

In general, marks will not be awarded for activities that are not completed.

For the purposes of this document, extensions and rearrangements are defined as:

- **Extensions:** *a change to the anticipated submission time for a piece of assessed work.*
- **Rearrangements:** *arrangement to complete an activity which is assessed or leads to a piece of assessed work at a time different to the one timetabled.*

Extensions or rearrangements are feasible in specific circumstances. In general, the conditions where extensions or rearrangements can be made are:

- *Extensions are possible for individual pieces of assessed work where the submission date is not close to the end of term, when there is sufficient time for subsequent examination and when there is not a subsequent piece of work which would be adversely affected by a delay.*
- *Rearrangements are only possible for activities which are not group based, which do not depend on availability of external resources and for which the resources are available internally at multiple times in the term.*

Where **extensions** are feasible, students may obtain 7 additional days to submit the assessed work on a self-declaration basis. No tutorial support or medical evidence is required and no reason need be given. In such cases:

- The student must inform the IfM teaching office in advance, unless this is not possible and in any case within a week of the deadline.
- When the IfM teaching office is notified, students will be informed of their revised submission date.
- The student must inform their College Tutor of the request for an extension. All decisions will be copied to the student's tutor.
- Where extensions of more than 7 days are required, an application must be made to EAMC.

Where **rearrangement** is feasible, students must contact the IfM teaching office ([MET-admin@eng.cam.ac.uk](mailto:MET-admin@eng.cam.ac.uk)) who will then liaise with the relevant academic to identify an alternative time for the activity. If re-arrangement is not feasible and as a result the student is not awarded marks, then the student will need to consult with their tutor regarding the possibility of an application to the EAMC at a later date.

Students may not accrue more than **28** days of extensions over the academic year. Where the **28** day limit is exceeded:

- Further extension requests need to be made via EAMC.

Students may lose marks for work submitted late (without an agreed extension of rearrangement) or for non-attendance in accordance with the MET Penalty Policy at the end of this document. Students who wish to appeal these penalties must apply to the EAMC in respect of marks for missed sessions or penalties for late submission.

Decisions under this procedure will normally be made by the MET Course Director and Chair of Examiners acting on behalf of the department. On request decisions can be reviewed by the Deputy Head (Teaching) of the Department of Engineering. Students remain free to approach the EAMC if a deadline extension is not approved by the department.

### **Reasonable grounds for requesting rearrangements**

**Illness:** Students may self-certify that they are ill as the reason for requesting a rearrangement (where this is feasible). A rearrangement will not be granted without self-certification. 'Illness' includes medical appointments.

**Compassionate or religious grounds:** Students may request rearrangement on compassionate or religious grounds. Examples of compassionate grounds includes attendance at a funeral of a close family member or a family or medical emergency. Attendance at a family event, such as a family holiday, wedding or graduation would not be considered compassionate grounds. Applications to rearrange timetabled activities for religious observance that usually occurs over a restricted period (e.g. Eid al-Fitr, Shavuot, Pesach, Shivaratri, Vaisakhi) will be considered. Where observance extends over a

significant period of time (e.g. Ramadan), and where it is normally expected that daily activities (including teaching) will continue as normal, applications would not be considered. Rearrangements for the purpose of holy visits, pilgrimages etc. cannot be approved.

**Interviews:** When applying for jobs, work placements or sponsorship, students may be invited for interview on days that conflict with coursework activities. Students should in the first instance seek to rearrange the interview rather than the coursework. If this proves impossible, then the student should try to rearrange the coursework. Such re-arrangements must be made in advance. Retrospective requests will not be accepted.

**Sporting and social commitments:** Coursework may not be rearranged to accommodate College sporting/social commitments or College or University training sessions. Students may be allowed to seek to rearrange coursework that conflicts with University sporting fixtures. Such re-arrangements must be made in advance. Retrospective requests will not be accepted.

### MET IIA Project and Coursework

| Activity           | Description of each element | Maximum marks associated with the activity | Mode of assessment  | Ability to reschedule (if appropriate)               | Ability to extend the deadline (if appropriate)   |
|--------------------|-----------------------------|--|---|--|---|
| Industrial visits  | Debrief presentation        | 15 marks                                   | Contribution to a group presentation                            | It is not possible to reschedule this group activity | NA  |
|                    | Final presentation          | 25 marks                                   | Contribution and engagement in a group presentation             | It is not possible to reschedule this group activity | None  |
| CAD/CAM            | CAD work                    | 15 marks maximum                           | Coursework submission completed in a small group (2-3 students) | NA   | It is not possible to extend the deadline without impacting on subsequent work.                     |
|                    | CAM work                    | 15 marks max                               | Coursework submission completed in a small group (2-3 students) | NA   | It is not possible to extend the deadline as it is at the end of term.                              |
| Production game    | Pre-game report             | 15 marks                                   | Group report  | NA   | It is not possible to request an extension as the report must be submitted prior to the game itself |
|                    | Post-game reflective report | 15 marks                                   | Individual piece of written work                                | NA   | It is possible to request an extension  |
| 3P3 Product Design | Portfolio submission        | 60 marks                                   | Individual piece of design work                                 | NA   | It is possible to request an extension  |

|                      |                    |          |                                |  |  |
|----------------------|--------------------|----------|--------------------------------|--|--|
| Major design project | Design Review 1    | 5 marks  | Group presentation             | It is not possible to reschedule these group presentations | NA   |
|                      | Design review 1    | 10 marks | Group presentation             |  |  |
|                      | Design review 2    | 15 marks | Group presentation             |  |  |
|                      | Final presentation | 20 marks | A group presentation           |  |  |
|                      | Design completion  | 60 marks | A group submission (portfolio) | NA   | It is not possible to request an extension |
|                      | Business plan      | 20 marks | A group submission (report)    | NA   | It is not possible to request an extension |

### MET IIB Coursework

| Activity                       | Mode of Assessment                        | Ability to reschedule or extend deadline            |
|--------------------------------|---|---|
| Strategy & Marketing           | Individual Assignment                     | 7-day extension allowed                             |
| TIM                            | Individual Assignment                     | No rearrangement allowed                            |
| DDS                            | Individual Assignment                     | No rearrangement allowed                            |
| AOM                            | Individual Assignment                     | No rearrangement allowed                            |
| PTM                            | Timed Assessment                          | No rearrangement allowed                            |
|                                | Group work                                | No rearrangement/extension allowed                  |
| Sustainable Manufacturing      | Individual Assignment                     | No rearrangement allowed                            |
| Leadership and Managing People | Individual Assignment                     | No rearrangement allowed                            |
| 2-Week Project                 | Group Presentation                        | No rearrangement allowed                            |
|                                | Group Report                              | No extension allowed                                |
| 4-week Project                 | Group Presentation                        | No rearrangement allowed                            |
|                                | Group Report                              | No extension allowed                                |
| Long Project                   | Individual Presentation                   | No rearrangement allowed                            |
|                                | Individual Report                         | No extension allowed                                |
| Robot Lab                      | Lab work                                  | No rearrangement allowed – attendance is compulsory |
|                                | Technical Report                          | No extension allowed                                |
|                                | Final Presentation                        | No extension/rearrangement allowed                  |
|                                | Final Integrated Solution & Demonstration | No extension/rearrangement allowed                  |
|                                | Individual Report                         | 7-day extension allowed                             |

## **MET Penalty Policy**

Work submitted after an agreed deadline (either the original deadline or an agreed extension), will be assessed on submission as normal. It will be marked as if submitted on time. A penalty will subsequently be applied which will be a reduction of 20% of the assessed grade for each week (or part week) that the work is late as outlined below.

| Original mark (%) | 1 week late | 2 weeks late | 3 weeks late |
|-------------------|-------------|--------------|--------------|
| 80.0              | 64.0        | 38.4         | 15.4         |
| 75.0              | 60.0        | 36.0         | 14.4         |
| 70.0              | 56.0        | 33.6         | 13.4         |
| 65.0              | 52.0        | 31.2         | 12.5         |
| 60.0              | 48.0        | 28.8         | 11.5         |
| 55.0              | 44.0        | 26.4         | 10.6         |
| 50.0              | 40.0        | 24.0         | 9.6          |
| 45.0              | 36.0        | 21.6         | 8.6          |

Where an extension was not feasible, the piece of work will either not be assessed (if no work is submitted) or the student will be assessed on the work they have completed up to the submission date.

Where students miss activities which cannot be rescheduled, students will not gain the marks associated with those activities.

Students are able to submit an application to the EAMC where marks have been lost due to activities which cannot be rescheduled or where an extension is not available.

Your College Tutor can assist you in making an application to the EAMC. You should note that EAMC approves allowances in the case of illness or other "grave cause."

This should be done after marks have been released, normally at the end of Easter term. You should not make applications piecemeal throughout the year. You should also note that the EAMC typically only considers cases which would lead to change in your degree classification.

Any application to the EAMC will be reliant on the evidence submitted to support the application and therefore you should keep evidence, including any emails confirming that extensions or rearrangements were not possible and notes of any interactions that you had with your GP, Tutor or College Nurse at the time to confirm illness. You should also keep evidence of any positive COVID test etc.

**Appendix 3: Progression from Manufacturing Engineering  
Tripos IIA (BA, 3<sup>rd</sup> year) to Manufacturing Engineering Tripos  
IIB (MEng, 4<sup>th</sup> year)**



## **Proposal for Re-Examinations for Progression from Manufacturing Engineering Tripos IIA (BA, 3<sup>rd</sup> year) to Manufacturing Engineering Tripos IIB (MEng, 4<sup>th</sup> year)**

For progression from MET Ila to MET I Ib, the following rules on progression apply:

- **Rule 1:** Students must have taken Engineering or Chemical Engineering and Biotechnology in Part 1. Thus, students taking MET Ila having first completed other part 1 courses are not able to progress to MET I Ib.
- **Rule 2:** Students must gain a 2:2 or higher in at least one of Engineering 1b and MET Ila. Students who gain a 3<sup>rd</sup> in both 1b and Ila are not able to progress to the MEng degree and will graduate with a BA.

To satisfy Professional Institution Accreditation purposes, the MEng degree can only be awarded to students who achieve a **pass** mark for **all** of the individual assessed elements of MET Ila. The pass mark for an element is as determined by the Examiners and is typically around **40%**. Thus, a third rule for progression is:

- **Rule 3:** students must NOT fail any individual element of MET Ila.

This rule applies to the 10 examined modules (3P1-3P10).

For the purposes of this policy, the coursework activities are treated as a single assessed item. It should be noted that it is not possible to re-sit or retake these elements, so failure to achieve a pass mark for the coursework activities would mean a student is unable to progress to MET I Ib.

Should a student pass overall, but fail one of the examined modules and there are no valid mitigating circumstances, then they will not be permitted to progress to MET I Ib and will therefore automatically be eligible to graduate with a BA degree.

### ***Re-Examination***

Should a student pass overall, but fail one (or more) of the examined modules and they believe there to be valid mitigating circumstances, then should they wish to, they may apply to the EAMC for these circumstances to be considered. Students may elect to graduate with a BA if they do not wish to apply for mitigation.

Applications should be made in the usual way and success will be dependent upon the evidence submitted to support the application. Students are advised to keep all evidence regarding these circumstances; including any emails, notes of any interactions with their GP, Tutor or College Nurse etc.

If the EAMC is content that there are valid mitigating circumstances, then they will recommend that the student be offered the appropriate re-examination(s). Note, this is only sensible if the student will satisfy Rule 2 above after successfully passing any re-examination(s).

Any re-examination would be an assessment of competence for progression and would therefore be marked as pass/fail.

Any other decisions made by the EAMC regarding a student's classification would be treated separately.

### ***Format of the re-examinations for MET IIa***

Where modules are grouped to form a single exam paper, it is the grade for the individual module which is of concern. Re-examination(s) would be at a module (rather than paper) level.

Should a student fail 3P3, they will be offered the opportunity to revise their coursework submission, which will be re-marked on completion. Marks for this resubmission will be capped using the same approach as for exam-based re-examination.

The typical format of a re-examination paper will be a short (1.5 hour) examination, comprising 2 compulsory questions. The paper examiner will produce the test paper at the request of the Chair of Examiners (usually following a successful EAMC appeal). Paper examiners will be asked to consider the likely questions for a test paper after the final examiners meeting in the event of one or more students failing their module exam.

The assessment will take place after the decision from EAMC, as early as possible in September. Resit papers will be marked quickly so that progression decisions can be made before the start of the following Michaelmas term. The chair of examiners will consult with other examiners as appropriate

Should a student fail the re-examination, they will not be offered the opportunity of a second attempt and will therefore automatically be eligible to graduate with a BA degree.

Students will be informed immediately following the final examiners meeting of any failed assessed elements. At that point, they may decide whether to pursue an application via the EAMC or to graduate with a BA degree.

### ***Option for non-accredited IIb route***

In some cases, and at the discretion of the Faculty Board, the student may have the option to transfer to the non-accredited route in IIb in Engineering.

### ***Right to appeal***

Any student informed that they will be limited to the non-accredited pathway in Part IIB because they were not offered a re-assessment will have the right to appeal via the Reviews of Decisions of University Bodies (RDUB) process.