UNIVERSITY OF CAMBRIDGE

Department of Engineering

Institute for Manufacturing

METIIA Course

Handbook 2017-18

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.

Contents

MET IIa People

Course Directors

Chander Velu (IIa)

Ajith Parlikad (IIb)

Teaching office

Shane Strawson (Senior MET Administrator)

SallyKing (Senior ISMM Administrator)

Megan Flood (Administrator)

Cassandra Richards (Administrator)

3P1 Materials into Products (Mich)

Hugh Shercliff (module leader)

Claire Barlow

Graham McShane

3P2 Operation and Control of Production Machines and Systems (Mich)

Bill O'Neill (module leader)

Duncan McFarlane

3P3 Product Design (Mich)

James Moultrie (module leader)

Michaël De Volder

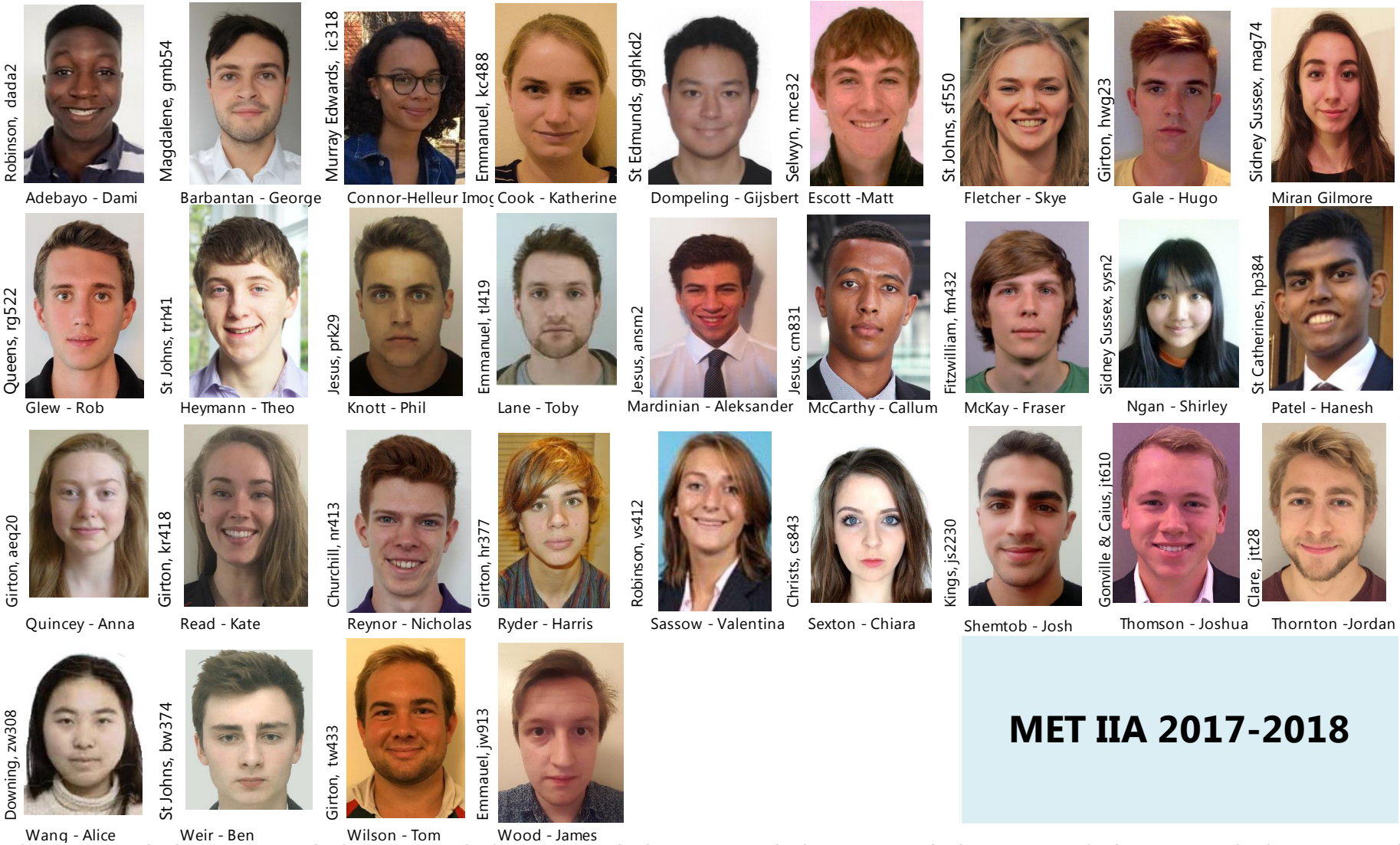
Lucia Corsini

Davor Copic

3P4 Operations Management (Lent)	 Alexandra Brintrup (module leader)	 Feryal Erhun	
3P5 Industrial Engineering (Lent)	 Ajith Parlikad (module leader)		
3P6 Organisational Behaviour (Mich)	 Mukesh Kumar (module leader)		
3P7 Managing Business and People (Lent)	 Mukesh Kumar (module leader)	 Tim Minshall	
3P8 Financial and Management Accounting (Mich) ***And*** **3P9 Industrial Economics, Strategy and Governance (Lent)**	 Chander Velu (module leader)		
3P10 Contemporary Issues in Manufacturing (Mich)	 Ronan Daly (module leader)	 Claire Barlow	 Dr E O'Sullivan

Major Project	 James Moultrie	 Michaël De Volder	 Chander Velu
IT Support	 Lewis Grantham (Heads the IT team)	 Giles Hainsworth (Senior Computing Technician)	
Workshop / Technical support	 Alan Thorne (Technical officer)	 Chris Jennings (Workshop technician, mechanical)	 Simon Sennitt (Workshop technicial, electrical)
Others who you should know	 IfM Divisional Administrator	 Trina Holmes (Catering manager)	 Ella Whellams (Events manager and supports the design show)	 Sarah Fell (Senior Communicatoins Editor and supports the design show)

2017-18 Year Group



MET IIA 2017-2018

Course overview and timetables

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 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 (b) Lectures to introduce current topics	100% Examination	Michaelmas

Examinations and Coursework Structure

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

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	02-Oct	Monday		**Induction** [0], VELU, I*fM*			*Lunch*	**Induction** [0], VELU, I*fM*			
1	09-Oct		**3P6: Organisational Behaviour** [1,2], KUMAR, *IfM SR3*		**3P10: Contemp issues in manuf.** [1], BARLOW, *IfM SR3*			***Rapid Prototype Workshop (group of 15 students)***			
2	16-Oct			**3P6: Organisational Behaviour** [3-8], KUMAR, *IfM SR3*		**3P10: Contemp issues in manuf.** DALY [2-5,8] / O'SULLIVAN [6-7], *IfM SR3*		***Workshop (2) - (Group of 4 students)***			
3	23-Oct							***Workshop (6) - (Group of 4 students)***			
4	30-Oct							*3P2: Production machines & systems [4], O'NEILL, IfM SR3*			
5	06-Nov										
6	13-Nov										
7	20-Nov										
8	27-Nov										
0	03-Oct	Tuesday	**Induction** [0], VELU, I*fM*				*Lunch*	**Induction** [0], VELU, I*fM*			
1	10-Oct		**Industrial Visit:** *scheduled all day but may finish earlier depending upon location*								
2	17-Oct		**Visit debrief**	**Skills workshop**			*Lunch*	***Workshop (3) - proposed***			
3	24-Oct		**Industrial Visit:** *scheduled all day but may finish earlier depending upon location*								
4	31-Oct		**Visit debrief**	**Skills workshop**			*Lunch*				
5	07-Nov		**Industrial Visit:** *scheduled all day but may finish earlier depending upon location*								
6	14-Nov		**Visit debrief**	**Skills workshop**			*Lunch*				
7	21-Nov										
8	28-Nov										
0	04-Oct	Wednesday	**Induction** [0], VELU, I*fM*					**Induction** [0], VELU, I*fM*			
1	11-Oct		**3P1: Materials into products** [1-8], BARLOW/ MCSHANE/ SHERCLIFF, *Main Site Engineering*		**3P8: Financial & management accounting, [1-8],** VELU, *IfM SR3*		*Lunch*	***Rapid Prototype Workshop (group of 15 students)***			
2	18-Oct							***Workshop (4) - (Group of 4 students)***			
3	25-Oct							***Workshop (7) - (Group of 4 students)***			
4	01-Nov							***Workshop (8) - (Group of 2 students)***			
5	08-Nov										
6	15-Nov										
7	22-Nov										
8	29-Nov										
1	05-Oct	Thursday	**3P3** L1 Design process (JM)	**3P3** L2 Prototyping (JM)	**Workshop: Group design exercise**			**Workshop: Sketching (not compulsory)**			
2	12-Oct		**Workshop: Design exercise debrief**	**3P3** L3 Machine Systems (MDV)		**Coursework Briefing (JM/MDV)**		**Introduction to Solidworks**			
3	19-Oct		**3P3** L4 Actuators and bearings (MDV)		**3P3** L5 Engineering Drawing and Tolerances			**CAM:** *Milling, Briefing of CAD/CAM coursework*			
4	26-Oct		**3P3** L6 Mechanisms (DC)		**3P3** L7 Design for Manufacture (MDV)		*Lunch*	**CAM:** *Turning*			
5	02-Nov		**3P3** L8 Design for Assembly (JM)		**Workshop: Design for Assembly (JM/MDV)**			**Major Project Briefing: & team partnership agreement**		**CAD/CAM:** Informal support	
6	09-Nov		**3P3** L9 Design History (JM)		**3P3** L10 Product Form (LC)	**Workshop: design portfolios (MDV)**		**3P3 Workshop**: Photoshop & photography (not compulsory)			
7	16-Nov		**3P3** L11-12 Physical & Cognitive Ergonomics (LC)		**Major Project: group work**			**Major Project: Idea Fair**			
8	23-Nov		**Major Project: project group consultations**								
9	30-Nov		**Major Project: Project proposal presentations**								
1	06-Oct	Friday	**3P1: Materials into products** [1-8], BARLOW/ MCSHANE/ SHERCLIFF, *Main Site Engineering*		**3P2: Production machines & systems** [1-3], MCFARLANE/O'NEILL, *IfM SR3*			**3P10: Contemp issues in manuf.** [1], BARLOW, *IfM SR3*			
2	13-Oct							***Workshop (1) - (Group of 4 students)***			
3	20-Oct							***Workshop (5) - (Group of 4 students)***			
4	27-Oct										
5	03-Nov						*Lunch*	**3P2: Production machines & systems** [5], MCFARLANE, *IfM SR3*			
6	10-Nov				**3P2: Production machines & systems** [6-8], MCFARLANE/O'NEILL, *IfM SR3*			**3P10: Contemp issues in manuf.** [6], **O'SULLIVAN**, *IfM SR3*			
7	17-Nov										
8	24-Nov										
9	01-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	15-Jan	**Monday**									
1	22-Jan			**3P7: Managing Business and People** [1-8], KUMAR/ MINSHALL, *IfM SR3*	**3P5: Industrial Engineering** [1-8], PARLIKAD, *IfM SR3*		*Lunch*				
2	29-Jan										
3	05-Feb										
4	12-Feb										
5	19-Feb										
6	26-Feb										
7	05-Mar										
8	12-Mar										
0	16-Jan	**Tuesday**									
1	23-Jan		**Industrial Visit:** *scheduled all day but may finish earlier depending upon location*								
2	30-Jan		**Visit debrief**		**Skills workshop**		*Lunch*				
3	06-Feb		**Industrial Visit:** *scheduled all day but may finish earlier depending upon location*								
4	13-Feb		**Visit debrief**		**Skills workshop**		*Lunch*				
5	20-Feb		**Industrial Visit:** *scheduled all day but may finish earlier depending upon location*								
6	27-Feb		**JIT/Arena Simulation**				*Lunch*	**Visit debrief**			
7	06-Mar		**Annual visits debrief (LT2)**								
8	13-Mar										
0	17-Jan	**Wednesday**									
1	24-Jan										
2	31-Jan										
3	07-Feb										
4	14-Feb		**3P9: Industrial Economics** [1-8], VELU, *IfM SR3*		**3P4: Operations Management**, [1-4] ERHUN [5-8] BRINTRUP IfM SR3		*Lunch*				
5	21-Feb										
6	28-Feb										
7	07-Mar										
8	14-Mar										
1	18-Jan	**Thursday**	**Major Project: project group consultations**								
2	25-Jan		**Major Project: Supervisions (max 1 hour per group)**					***Major Project Supervisions (1 hour per group)***			
3	01-Feb		**Major Project: Design review 1**								
4	08-Feb		**Major Project: project group consultations (introduction to financials**								
5	15-Feb		**Major Project: project group consultations**				*Lunch*				
6	22-Feb		**Major Project: Design review 2**								
7	01-Mar		***Major Project Supervisions (1 hour per group)***					***Major Project Supervisions (1 hour per group)***			
8	08-Mar										
9	15-Mar										
1	19-Jan	**Friday**		**3P7: Managing Business and People** [1-8], KUMAR/ MINSHALL, *IfM SR3*			*Lunch*				
2	26-Jan										
3	02-Feb										
4	09-Feb										
5	16-Feb										
6	23-Feb										
7	02-Mar							**Production Game** [7], *IfM, SR3*			
8	09-Mar										
9	16-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	23-Apr	**Monday**	*Exam period*								
1	30-Apr		*Exam period*								
2	07-May		*Major Project Period*								
3	14-May										
4	21-May										
5	28-May										
6	04-Jun										
7	11-Jun										
8	18-Jun										
0	24-Apr	**Tuesday**	*Exam period*								
1	01-May		*Exam period*								
2	08-May		Major Project period								
3	15-May										
4	22-May										
5	29-May										
6	05-Jun							***DESIGN SHOW SET UP***			
7	12-Jun										
8	19-Jun										
0	25-Apr	**Wednesday**	*Exam period*								
1	02-May		*Exam period*								
2	09-May		Major Project period			***MET OPEN DAY***					
3	16-May		Major Project period								
4	23-May										
5	30-May										
6	06-Jun		**MAJOR PROJECT FINAL PRESENTATIONS**								***DESIGN SHOW***
7	13-Jun										
8	20-Jun										
1	26-Apr	**Thursday**	*Exam period*								
2	03-May		*Exam period*								
3	10-May		**Major Project Studio Session,** MOULTRIE, DE VOLDER, *IfM Design Studio*				*Major Project Period*				
4	17-May		**Major Project Studio Session,** MOULTRIE, DE VOLDER, *IfM Design Studio*								
5	24-May		**Major Project Studio Session,** MOULTRIE, DE VOLDER, *IfM Design Studio*								
6	31-May		*HAND IN OF FINAL DESIGN PORTFOLIO AND BUSINESS PLAN*								
7	07-Jun				***DESIGN SHOW, INTERNAL VIEWING***				***DESIGN SHOW - TAKE DOWN***		
8	14-Jun										
9	21-Jun										
1	27-Apr	**Friday**	*Exam period*								
2	04-May		*Exam period*								
3	11-May		*Major Project Period*								
4	18-May										
5	25-May										
6	01-Jun										
7	08-Jun										
8	15-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 3P10 Company Visits; 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 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.

Induction programme

Mon 2nd October		
10:00 – 10:30	Introductions Welcome and overview of induction programme Discussion: your hopes from MET	CV
10:30 – 10:45	Welcome from Professor Tim Minshall	TM
10:45 – 11:30	Course overview and administration	CV
11:30 – 11:45	*Break*	
11:45 – 12:45	Safety and workshop introduction	AT
12:45 – 13:00	Facilities tours	SS/CJ
13:00 – 14:00	**Buffet lunch with ISMM, MET and Staff**	**ALL**
14:00 – 15:00	Manufacturing awareness	CYB / RD
15:00 – 16:00	Company visits: aims, visits process, themes and topics, assessment, safety Introduction to tablets	RD
Tues 3rd October		
09:00 – 09:30	Careers talk	Joy Warde
09:30 – 10:15	Introduction Library Facilities	Emma Etteridge
10:15 – 10:30	*Break*	
10:30 – 11:00	Retail shop exercise: Briefing	CV/JM
11:00 – 14:00	Retail shop exercise: Store Observation and Presentation Preparation Lunch: Own arrangements	CV/JM
14:00-15:30	Retail shop exercise: Group Presentation and Feedback	CV/JM
Wed 4th October		
0900 – 10:30	Presentation Methods	CV
10:30 – 11:15	Presentation Preparation	CV
11:15 – 11:30	*Break*	
11:30 – 12:30	Group Presentation and Lessons Learnt	CV
	Break	
16:30 - 17:30	Talk by UK CEO of Siemens (Common Room)	Juergen Maier

Skills Workshops and Industrial Visits

Programme

The skills development workshops are delivered during the Michaelmas term to allow maximum opportunity for practicing the skills as the course progresses.

The workshops start in the Induction programme and thereafter normally follow the debriefing sessions arranged as part of the Company Visits programme.

Industrial visits: Briefing and Debriefing

Each visit day addresses a different business sector. All students therefore make six visits, one for each business sector.

Each visit group is divided into teams of three with each team focusing on a different generic theme during the visit. The themes will be rotated between the teams so that each team focuses on a different theme for each visit (see table below). One team will be responsible for collating the input from all the teams in their group to make the debrief presentation. This responsibility will also be rotated between the teams.

The following approach is suggested:

i. Teams collect information on their theme during the visit.
ii. Teams structure their information and feed to the presenter team. This should be started on the return coach trip while the details are still fresh. Summary power point slides should be given to the presenter team by the Thursday following the visit.
iii. The presenter team prepares a 30 minute power point presentation incorporating information from all the teams. The presentation should be structured and edited to ensure an integrated overview of the company.
iv. The formal debrief normally takes place on the Tuesday following the visit. Students from both visit groups come together, with their visit supervisors and the member of staff responsible for the visits programme.
v. For the debrief 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 themes in turn, drawing out comparisons and differences between the companies.
vi. During the discussions the presenters annotate their power point slides with comments from the discussion. The annotated slides are made available to all students on Moodle for reference and revision.
vii. At the end of the year, there is a review of the visits, addressing each theme in turn and identifying lessons to be learned. The process is as follows:
    a. Brief introduction to explain the process
    b. Students allocated to generic theme groups – approximately 6 per group.
    c. Theme group discussions to review material from all visits, to identify learnings, and to prepare a presentation – up to 2 hours.
    d. Presentation from each theme group followed by discussion. Presenters annotate their slides to record the discussion.

Expenses

If you will be out of Cambridge over lunchtime, then either the company will provide lunch, or MET will make a contribution towards the cost of meal purchased by students. In this case students will be told explicitly that they may claim for lunch on that day. The maximum amount which may be claimed for lunch is £3.00. This is reckoned on the basis of the difference between the cost of a College meal and the cost of a meal on the open market; it is not expected to cover the full cost of a meal. Claims should be made on expenses forms which are available from the IfM Teaching Office. Expenses can only be claimed against receipts.

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. Men should normally wear jacket and tie; a suit can be the easy option. You should always wear sensible shoes and **not** trainers on factory visits (no high heels or sandals). Other requirements, including the use of photography, may be specified by the company and must be adhered to.

Company visits schematic

Visit group 1 names	Visit group 2 Names	**Primary processes**	**Aerospace**	**Automotive**	**Pharma**	**Electro-mech**	**FMCG**
Team 1A	*Team 2A*	Materials Prod process	Ops Mgt	Industrial Eng	Design Mgt	HR	CSR
Team 1B	*Team 2B*	Ops Mgt	Industrial Eng	Design Mgt	HR	CSR	Materials Prod Process
Team 1C	*Team 2C*	Industrial Eng	Design Mgt	HR	CSR	Materials Prod process	Ops Mgt
Team 1D	*Team 2D*	Design Mgt	HR	CSR	Materials Prod process	Ops Mgt	Industrial Eng
Team 1E	*Team 2E*	HR	CSR	Materials Prod process	Ops Mgt	Industrial Eng	Design Mgt
Team 1F	*Team 2F*	CSR	Materials Prod process	Ops mgt	Industrial Eng	Design Mgt	HR

Visit themes

Theme	Details
Industry level context	• *History* - how has the industry developed: what technical and structural changes have occurred. • *Markets* - 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. • *Competition* - who are the major players; what market shares.
Company level context	• *History* – what is the history of the company; has the ownership structure changed; is there a specific culture, ethos, or set of values. • *Scale* - key metrics for this site – turnover, employees, products • *Structure* – how is the company structured; how does it fit into the whole organisation. • *Market* - where does the company position itself in the market; who is the competition; who are the customers; where are they. • *Products* - what is the range of products - to what extent are products customised • *Strategy* - 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.
Materials, production processes and technology	• *Materials* - what range of materials is used – why; where are they sourced. • *Production processes* - 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. • *Technology* - how does the company stay abreast of technical developments; how is new equipment selected and justified.
Operations Mgt - organisation and control	• How many product variants are there – how does uncertainty affect the business and manufacturing operations • What are the key challenges in matching supply and demand • What is the typical time from order to delivery. • How is production configured - cell, line, functional etc – why. • What cost reduction techniques are used. • How are lean processes applied. • What are the systems for controlling production flow e.g. MRP, JIT, Kanban etc
Industrial engineering and quality	• *Industrial engineering* - how are work study methods applied; how is work place layout determined; how are task times determined; what performance measures are used. • *Quality* - what quality control systems are in place; are statistical approaches in evidence; what continuous improvement techniques are used e.g. quality circles, kaizan projects, suggestion schemes
Design management	• How is the brand positioned inthe market? • 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?

	• What is the company's design strategy? • How are industrial and engineering design linked?
Human Resources	• *Recruitment and training* - how are employees recruited and trained; what are the critical skills; how are they developed; how are they forecast to change. • *Remuneration* - what pay systems are in place – e.g. piece work, salary, bonus; what non pay reward systems are in place. • *Employee relations* - are any unions recognised; what structures are in place to work with them; how are communications with employees handled.
Corporate social responsibility, H&S, environment and sustainability	• *H&S* – what is the company's safety record; how is safety managed. • *Environment* - 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. • *Sustainability* - 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.

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:

- ***Communication & presentation skills***: the essential principles underlying all successful communication, stressing particularly the importance of structure, clarity and logical development and substantiation of the argument. This topic is introduced during the Induction Programme, and the early practical focus is on making presentations linked to the induction visits.
- ***Writing skills***: these are essential both in exams and detailed reports that require you to present a broad set of ideas in a coherent, evidence-based structure. A workshop and discussion will develop the skills, which will be of use throughout your career.
- ***Process improvement skills***: 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.
- ***Working in Teams***: this session focuses on understanding and identifying the different skills, personalities and motivations which individuals bring to a team, and the ways in which they can be harnessed to optimum effect.
- ***Artefacts workshop****:* exploring how different components are manufactured.
- ***JIT Game:*** *a game to help understand the principles of Just in Time.*
- ***Arena simulation:*** discrete event process simulation.
- ***Examination skills:*** giving guidance on examinations and examination preparation skills.

Michaelmas workshops and visits programme

The class will be split into two groups, 1 and 2, and companies will be informed of those attending. If a particular student needs to change a scheduled visit, please inform the IfM Teaching office (met-admin@eng.cam.ac.uk).

NOTE: Please check email and MOODLE for any changes to the schedule

All debrief and workshop sessions will be held at the IfM, Alan Reece Building

Date	Activity	Leader
Tue 10th October	**Primary Process Visit :** All: British Steel, Scunthorpe	 R. Daly
Tue 17th October	9:30 – 10:45 Visit debrief	R. Daly, C. Velu
	11:00-13:00 Workshop: Process improvement	Ed West (Newton Consultants)
Tue 24th October	**Automotive /Aerospace Visits :** Group 1: Caterpillar (UK) Ltd Group 2: Marshall, Cambridge	 A. Brintrup R. Daly
Tue 31st October	09:00 – 10:45 Visit debrief	R. Daly, A. Brintrup
	11:00-13:00 Workshop: Creative Teamwork	Chris Legge, Toni Marshall (OE Cam LLP)
Tue 7th November	**Automotive/Aerospace Visits:** Group 1: Rolls Royce, Derby Group 2: Jaguar Land Rover	 M. De Volder A. Thorne
Tue 17th November	09:00 – 10:45 Visit debrief	A. Thorne, M. De Volder
	11:00 – 13:00 Writing skills for MET	Anthony Haynes

Provisional Lent workshops and visits programme (to be confirmed)

The class will be split into two groups, 1 and 2, and companies will be informed of those attending. If a particular student needs to change a scheduled visit, please inform the IfM Teaching office (met-admin@eng.cam.ac.uk).

NOTE: Please check email and MOODLE for any changes to the schedule

All debrief and workshop sessions will be held at the IfM, Alan Reece Building

Date	Activity	Leader
Tue 23rd January	**Pharmaceutical visits:**	
	All: GSK, Ware	R. Daly
Tue 30th January	09:30 – 10:45 Debrief Pharmaceutical visits	R. Daly, J. Srai
	11:00 – 13:00 Artefacts workshop	R. Daly, C. Barlow
Tue 6th February	**Electro-Mechanical visits**	
	Group 1: MK Electric, Southend	F. Tietze
	Group 2: SMC, Milton Keynes	M. Kumar
Tue 13th February	09:00 – 10:45 Debrief electro-Mechanical sector visits	F. Tietze, M. Kumar
	11:00-12:30 Examination skills	C. Barlow
Tue 20th February	**FMCG Visits**	
	Group 1: Hain Daniels, Histon	B. O'Neill
	Group 2: Mars, Slough	C. Velu
Tue 27th February	09:00 – 13:00 JIT Game/Arena Simulation	A. Shaw, A. Parlikad
	14:00 – 16:00 Debrief FMCG Sector	B. O'Neill, C. Velu
Tue 7th March	09:00 – 13:00 Annual Visits Debrief (LT2)	All leaders, C. Velu

Module Specifications

Note: PART IIA BOOKLIST

The Library Shelfmark indicates where these works can be found in the Library.

An additional copy of books marked with a star (*) will be available in a Special Part II Reference Collection kept in the Library; the attention of Directors of Studies (for College Librarians) will be drawn to these titles.

3P1: Materials into products

Module summary	From microstructure to final properties: manufacturing process optimisation for all classes of materials.
Taught by	Dr H Shercliff (module leader) Dr C Barlow, Dr G McShane
Supporting activities	Artefacts workshops - Dr R Daly
Assessment	100% by examination. Paper 1, single module paper common with Engineering Part IIA 3C1
Supervision	3-4 supervisions, using a combnation of groups of 3-4 and larger classes

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 classes of polymers and composites, and understand the processing and design considerations in selecting these for a given component.
- Know the main deformation processes for wrought alloys, and be able to conduct simple 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.
- Understand the processes and issues in the manufacture of powder metallurgy and ceramic products.
- 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 Introduction and Process Selection	Classification of manufacturing processes. Review of material and process selection. Coupled problems in design and manufacturing: the interaction between material, process and design parameters.	Take a structured approach to choosing material-process combinations for making components
2 Heat Treatment of Steels	Revision of phase transformations and TTT diagrams. CCT diagrams and hardenability for steels.	Predict steel microstructure and mechanical properties following a known thermo-mechanical treatment
3 – 4 Casting of Metals	Ingot and shaped casting technology. Revision of phase diagrams and transformations applied to solidification: segregation, constitutional supercooling, casting alloys and microstructures. Casting defects and design of shaped castings. *Examples paper 1*	Describe the factors involved in optimising casting processes, alloys and design to achieve required physical and mechanical properties for a component.
5 - 8 Deformation Processing of Wrought Alloys, Heat treatment.	Wrought alloy processing and microstructure evolution. Simple modelling of plastic forming processes (stress analysis, and upper bound method). Application to rolling, forging, extrusion, machining of metals; case studies. *Examples paper 2*	Describe the factors involved in optimising wrought processes, alloys and design to achieve required physical and mechanical properties for a component. Calculate processing stresses for shaping processes involving plastic deformation of metals.
9 - 10 Processing of Polymers and Composites	Polymer and composite processing technology. Design, material and process selection for polymers and composites.	Select and optimise polymer and process to achieve required physical and mechanical properties for a component. Select and optimise polymer matrix, reinforcement and manufacture process to achieve required physical and mechanical properties

11 – 13 Powder Processing, Welding and Joining, Surface Engineering	Sintering, HIPing and other processing technologies for powder metals and ceramics. Welding technology: fusion, friction, laser, ultrasonic. Other joining processes: diffusion bonding, brazing, soldering, adhesives. Surface engineering processes and their applications	Select and optimise powder routes for component manufacture. Make informed decisions about choice of powder route versus conventional processing for metals and ceramics Make recommendations for suitability of joining technologies for different materials and applications. Select surface treatments to achieve required physical and mechanical properties; make recommendations for when such treatments are appropriate.
14 - 16 Design against Failure.	Processing as the origin of defects and failures (microstructure, damage, residual stress). Environmental factors in failure of materials. Analysis and case studies of failures. *Examples paper 3*	Identify likely sources of failure for components made from all classes of materials. Propose ways in which such failures can be avoided

Reading List

*ASHBY, M.F.	MATERIALS SELECTION IN MECHANICAL DESIGN Butterworth-Heinemann 4th edition 2010, 3rd edition available as an ebook at: http://www.myilibrary.com?id=75447	JA.208
*ASHBY, M.F. & JONES, D.R.H.	ENGINEERING MATERIALS 2 Butterworth-Heinemann 3rd edition 2006 (mainly revision) Available as an ebook at: http://www.myilibrary.com?id=75451	JA 191
ASHBY, M., SHERCLIFF, H. & CEBON, D.	MATERIALS: ENGINEERING, SCIENCE, PROCESSING AND DESIGN Butterworth-Heinemann 3rd edition 2014 2nd edition 2010 2nd edition available as an ebook at: https://www.dawsonera.com/guard/protected/dawson.jsp?name=https://shib.raven.cam.ac.uk/shibboleth&dest=http://www.dawsonera.com/depp/reader/protected/external/AbstractView/S9780080961552	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: https://www.dawsonera.com/guard/protected/dawson.jsp?name=https:// shib.raven.cam.ac.uk/shibboleth&dest=http://www.dawsonera.com/depp/reader/protected/external/AbstractView/S9780080488448	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 http://www.myilibrary.com/?id=101358	JG 216
*POLMEAR, I.	LIGHT ALLOYS Butterworth-Heinemann 4th edition 2006 Available as an ebook at: https://www.dawsonera.com/guard/protected/dawson.jsp?name=https:// shib.raven.cam.ac.uk/shibboleth&dest=http://www.dawsonera.com/depp/reader/protected/external/AbstractView/S9780080496108	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., SHERCLIFF H.R. & NINABER VAN EYBEN, B.	MANUFACTURING AND DESIGN Butterworth-Heinemann 1st 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

Module summary	The specification, operation and management of production machines and systems
Course leader	Prof Bill O'Neill
Courses	a. Operation of production machines, 4 x 2hr lectures, Michaelmas Term (Prof W ONeill) b. Control of production machines and systems, 4 x 2hr lectures, Michaelmas Term (Prof D McFarlane)
Supporting activities	Integrated coursework – CAD/CAM exercise
Assessment	100% by examination. Paper 2 - single module paper.
Supervision	The course will be supported by two examples papers, for each of which one supervision will be arranged.
Timetable	Lectures are given in 2 hour blocks on Fridays (some changes may occur due to time-table issues) in Michaelmas term

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. Understand the types of interaction between components and process tooling
3. Understand the factors that affect the accuracy and precision of machining and grinding operations
4. Understand the various control strategies used to mitigate the sources of error in machining processes
5. Understand the issues in cell-level control and be able to model cell operations using Petri Nets and Ladder Logic
6. Know the means by which machining cells are integrated into factory wide operations

Syllabus: Operation of Production Machines

Lecture	Syllabus	On completion students should be able to ...
1 Introducti-on to machine tols	History and development of machine tools. 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. Know elements of machine tool design and their configurations. Know their manufacturing and operational capabilities. Know the applications domain and range of materials processed by modern machine tools.
2 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). Know the range of cutting tool materials and cutting tip geometries. Know the range of machining methodologies employed in modern machining operations.
3-4 Cutting tools and machinabili ty	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. Understand the causes of wear and process strategies to reduce it. Know the techniques applied to characterize machining performance. Understand roughness classifications and measurement techniques. Understand Taylor's tool life equation and be able to apply it to make informed decisions on tool choice for a range of materials. Determine cost and times of machining operations.
5-6 Process 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. Know the sources of variation in machining. Understand the various strategies used to mitigate the sources of error in machining processes.

7 - 8 Quality Control	Testing and inspection points in machining operations. Statistical process control- control charts, process improvement techniques, causes of variation, control chart patterns, control chart applications.	Understand quality control techniques in machining operations. Know how to measure and minimize process variation using statistical process control (SPC). 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 Machine automation and 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 Design a feedback control loop to compensate for machine tool deflection during operation Describe how sensing and actuation is achieved to implement control Describe how machine tools are automated Articulate challenges in robotic control
11 – 12 Cell Control Using PLC Programming	Issues in cell-level control, Programmable Logic Controllers, Ladder Logic Diagrams, modeling of cell operations using FSM,	Understand requirements for cell automation Develop Ladder Logic code to automate the operations of a manufacturing cell Learn how to develop Finite State Machine process representations Use Finite State Machines to develop Ladder Logic Code
13 – 14 Petri Net Based Automation Modelling and 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 discreteevent models for automated systems Understand how to develop Petri Net models Develop a cell management scheme using a Petri Net approach Convert Petri Nets to equivalent Ladder Logic code
15-16 Factory Automation & Comms	Automation options in factory wide operations. Communication systems. Future automation developments	Understand automation requirements across the factory. Learn different options for communications at different levels in the factory, 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, — FUNDAMENTALS OF METAL MACHINING AND MACHINE TOOLS, Third Edition.

Geoffrey Boothroyd 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)

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 4TH Edition 2006

3P3: Product Design

Module summary	Integrating engineering and industrial design in the creation of new products
Taught by	Dr J Moultrie (Module leader), Dr M De Volder
Assessment	Two pieces of coursework, assessed by submission of individual design portfolios
Supervision	The lecture courses are supported by studio time with group supervision of projects.

Module Learning Outcomes

On completion of the module students should be able to:

1. Apply basic engineering principles to the design of products
2. Determine a product's architecture
3. Understand and apply dimensional tolerances to engineering drawings
4. Structure the estimation of unit cost analysis of a design
5. Understand and be able to apply basic ergonomic principles
6. Understand why products are designed as they are and be able to explore a product's form

Syllabus

Lecture	Syllabus	On completion students should be able to ...
1 The design process	Overview of the design process and product architecture	Understand the difference between a theoretical and real design processes. Understand how a product's architecture influences the change and variety
2 Prototyping & Evaluation	Types and roles of prototypes, simulations and models in design	Understand the importance of prototyping in the design process and the role of different types of prototype
3 Machine system design	Overview of good design practices used in machine and product design	Application and understanding of kinematic design, force loops, flexure hinges, etc
4 Actuators and bearings	Introduction to different types of actuation principles and techniques to guide the generated motion	Understand that different types of actuators serve different needs. Understand the need for bearings, and be able to select the appropriate type of bearings in a design
5 Engineering Drawing and Tolerancing	Introduction to dimensional and geometric tolerances, basic drawing conventions, limits and fits, dimensioning assemblies	Produce and read engineering drawings Apply engineering tolerances
6 Mechanisms	Intoduction to linkages, cams and other mechanisms	Understanding of the opportunities and limitations of mechanisms.

7 Design for manufacture	Basic principles of design for manufacture	Consideration of design rules for manufacture, with emphasis on injection moulding and 3D printing.
8 Design for Assembly	Boothroyd & Dewhurst / Lucas Engineering DfA methods DfA Heuristics A structured approach to design for assembly	Apply the basic principles of design for manufacture/ assembly
9 Design history	Key design movements, designers, forms and technologies	Understand how design has evolved since the start of the industrial revolution. Be aware of key design movements and their ascociated forms and designers as well as the technological, social and economic context influencing this.
9-10 Design history & product form	Principles of creating product form	Understand how designers create a product's form. Apply basic principles to create a product's form
11-12 Physical & cognitive ergonomics	Physical interaction with products How we relate to and understand products	Apply basic principles of design for use

Workshop activities

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

1. Group design exercise: to focus attention on prototyping and basic mechanical design.
2. Design Sketching: basic design skills development
3. Design for assembly exercise: to put theory into practice
4. Photography and Photoshop: basic design skills development

Reading List

*BAXTER, M.R.	PRODUCT DESIGN: A PRACTICAL GUIDE TO THE SYSTEMATIC METHODS OF NEW PRODUCTS DEVELOPMENT Nelson Thornes 1995 (2002 reprint)	AP 308
*ULRICH, K.T. & EPPINGER, S.D.	PRODUCT DESIGN AND DEVELOPMENT McGraw-Hill/Irwin 3rd edition 2004	BN 220
*NORMAN, D.A.	THE DESIGN OF EVERYDAY THINGS Basic Books 1988 (2002 reprint)	AP 313
OTTO, K. & WOOD, K.	PRODUCT DESIGN: TECHNIQUES IN REVERSE ENGINEERING AND NEW PRODUCT DEVELOPMENT Prentice Hall 2001	AP 309
PHEASANT, S.	BODY SPACE: ANTHROPOMETRY, ERGONOMICS AND THE DESIGN OF WORK Taylor & Francis 2nd edition 1996 (1999 reprint)	BJ 6
SLOCUM A H	PRECISION MACHINE DESIGN, 1991	AP 323
SCLATER N, & CHIRONIS N P	MECHANISMS AND MECHANICAL DEVICES SOURCEBOOK, McGraw Hill, 1996	RE 52

3P4: Operations Management

Module summary	The management of material and information flow in the supply chain
Taught by	Dr A Brintrup (Module leader), Dr F Erhun
Supporting activities	Class Production Game to simulate the operation of a card-manufacturing company. Combined with 3P5
Assessment	100% by examination. Paper 3, double paper with 3P5
Supervision	The course will be supported by four examples papers, for each of which one supervision will be arranged

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 IT systems in supporting operations across the supply chain

Syllabus and Lecture Learning Outcomes

Lecture	Syllabus	On completion students should be able to ...
1 - 2 Introduction	Course introduction, introduction to operations management, management levers, Volume vs Variety	Discuss the key issues in manufacturing and supply chain operations and the key levers available to managers to tackle them. Discuss the importance of the volume-variety choice in process design Describe how volume-variety choice affects the manufacturing system layout Describe how volume-variety choice affects the choice of automation systems

3 - 4 Forecasting	Moving average, exponential smoothing, regression, time series analysis	Calculate demand forecasts using different forecasting methods Discuss the appropriateness of different forecasting methods
5 - 6 Inventory management	EOQ, POQ Safety stock, other inventory models	Discuss the role of inventory in a production system Derive the expression for and calculate the Economic Order Quantity Discuss the concept of safety stock in inventory management
7 - 8 Capacity Management	Capacity planning, Queuing Theory	Discuss reasons why actual capacity will be lower than theoretical and the levers that a manager can "pull" to improve capacity Discuss different options for a manager to cope with variations in demand and capacity Model a manufacturing operation as a queuing system and calculate key process parameters
9 - 10 Scheduling	Line balancing, EDD, SPT, FIFO scheduling rules	Balance a production line Implement different production scheduling rules
11 – 12 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 Logistics & transportation	Transportation model, warehousing and distribution, DRP	Solve simple transportation problems for allocating product flows between two supply chain locations Determine the optimal factory/warehouse location for a given demand distribution Generate DRP records for a product
15 - 16 Enterprise & SC information systems	SC Dynamics, ERP/SCM systems, CPFR, VMI	Discuss the implications of dynamics in supply chains Discuss the role of the Internet and IT in improving supply chain visibility Discuss various mechanisms used by organizations to coordinate product and information flows within a supply chain

Reading List

GOLDRATT, E.M. & COX, J.	THE GOAL: A PROCESS OF ONGOING IMPROVEMENT Gower 3rd edition 2004
*PINEDO, M. & CHAO, X.	OPERATIONS SCHEDULING WITH APPLICATIONS IN MANUFACTURING AND SERVICES Irwin/McGraw-Hill 1999
*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 Click on 'Connect to MyiLibrary resource' for access
WOMACK, J.P., JONES D.T. & ROOS, D.	THE MACHINE THAT CHANGED THE WORLD: THE TRIUMPH OF LEAN PRODUCTION Rawson Associates 1990

3P5: Industrial Engineering

Module summary	The design of production flows and operations in manufacturing
Taught by	Dr A Parlikad (Module leader)
Supporting activities	The Production Game course work integrates material from 3P4 and 3P5
Assessment	100% by examination, consisting of 2 questions. Students will attempt all questions.
Supervision	The module is supported by 3 supervisions: EP 1 – Lectures 1-6; EP 2 – Lectures 7-10; EP 3 – Lectures 11-16.

Syllabus and Lecture Learning Outcomes

Lecture	Syllabus	On completion students should be able to ...
1-2 Introduction and Method Study	Introduction to Industrial Engineering; objectives of Method Study. Method Study procedure: Select, Record, Examine, Develop, Define, Install, Maintain	Understand and be able to apply the traditional techniques of method study.
3-4 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 Lean Production Techniques	Toyota Production System: JIT, TPM, 5S, Kaizen.	Understand the principles of Lean production, and be able to relate these to traditional work study
7-8 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. Know the different ways in which time standards can be determined and the advantages and disadvantages of each method. 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 Work 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 Know how standard data systems are developed Understand work sampling is used for measuring proportion of time spent in different activities

11-12 Process Organisation	Project, jobbing, batch, line, continuous flow; cellular production; group technology	Understand the different types of process layout and the advantages and disadvantages of each. Appreciate the factors that affect the layout of a factory. Group technology
13-14 Plant Layout	Factory, Department and Workplace layout; Systematic Layout Planning	Understand and be able to apply the techniques used in planning factory layouts.
15	Warehousing and Material Handling	Know the different methods of materials storage and handling and be able to choose the appropriate method for a particular task.

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, 4th Edition, PICSIE Books,2009
*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,8th 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

3P6: Organisational Behaviour

Module summary	An introduction to theories of organisational behaviour
Taught by	Dr Mukesh Kumar (Module leader)
Assessment	100% by examination. Paper 4, double module paper combined with 3P7
Supervision	There will be three supervisions on Organisational Behaviour in the Michaelmas term

Syllabus and Learning Outcomes

Lecture	Syllabus	On completion students should be able to ...
1 Introduction	Introducing *Organisational Behaviour*	Understand some of the central issues in work organizations Define organisational behaviour
2 Corporate Social Responsibility, and Business Ethics	Free Market Business Ethics Sustainability and Corporate Social Responsibility	Explain ethical dilemma in the workplace Describe key principles of corporate social responsibility, business ethics and sustainability
3 Culture	Levels of Organizational Culture Cultural Typology Cultural Change	Understand advantages of managing people through culture Distinguish between Schein's three levels of organizational culture Explain how mangers try to change culture
4 Personality and Individual Differences	Nomothetic Approach Personality Testing Ideographic Approach Social-radical Approach	Understand key approaches to study personality Explain how personality is mesured in organisational settings
5 Communication	Organizational Communication Noise Information, Communication, and Technology	Describe theories and processes of comminucation in organisations Explain how technology mediates communication, producing a trade-off between efficiency and richness of communication
6 Social Organisation	Hawthorne Studies Human Relations	Describe the power of the informal organisation Explain how the Hawthorne studies lead to the foundations of organisational behaviour
7 Motivation	Extrinsic Motivators Intrinsic Motivators Bahavioural, Content, Process and Social Theories	Understand what motivates people to work Use theories to identify motivational problems in organizations and recommend solutions

8 Groups and Teams	Definitions of Groups and Teams Types of teams and loafing Groupthink Social Identity Theory	Understand the differences between groups and teams Explain the link between teamwork and productivity Analyse the factors needed to produce an effective team Explain how groupthink can have negative implications on teams
9 Work Design	Rational Work design Rational Production Capitalist Working Relationship	Describe the principles behind Taylorist and fordist rational work design Analyse the effect that Taylorism and Fordism are said to have upon workers
10 Changing the Organisation	Force-field analysis Approaches to change Three-Step Model	Describe approaches to the managem,ent of chnage Explain how change can be messy, causing conflict and resistance
11 Organization Design and Bureaucracy	Bureaucracy Rational Organisation Design Iron Cage Bureaucracy	State the main characteristics of a bureaucratic organization structure as specified by Max Weber Explain how bureaucracy is a form of rational organisational design
12 Contemporary Trends	Globalisation The service Leisure economies	Explain how national and local cultures affect the ways in which organisations operate globally Explain how many service sector organisations create an experience
13 Leadership	Behaviourism Contingency theory Post-heroic	Describe the key leadership theories Explain the diffences between leadership and management Analyse whether there is too much emphasis on the individual leader
14 Perception and Decision Making	Attribution Theory Drawback in judgments Link between perception and decision making Organizational Decision-making	Undertand perception and explain the factors that influence it Identify the shortcuts Individuals use in making judgement about others Decribe the common Decision Biases or errors
15 Power and Politics	Office politics Emancipation False Consciousness Empowerment	Describe the power as property view Explain why power and politics exist within organisations Analyse the different underlying assumptions
16 Review /Summary	Challenges of Organisations Changing Nature of OB Predicting Future trends	Explain the importance of connecting organisational behaviour theories 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

A list of additional readings for each topic will be made available online.

3P7: Managing Business and People

Module summary	An introduction to the processes involved in starting and running a business.
Taught by	Dr M Kumar (Module leader), Prof T Minshall
Assessment	100% by examination. Double module paper combined with 3P6 Organisational Behaviour. Students will be required to answer one question from Managing Business and one from Managing People.
Supervision	There will be two hours of supervisions.

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 Introduction	The key integrating frameworks for understanding a manufacturing business Module overview Key areas of activity of a manufacturing business External factors that influence a manufacturing business 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 Entrepreneurship	Starting and growing a business The role of entrepreneurship in an economy Defining entrepreneurship: Resource-based versus opportunity based activities How a firm grows: Typical growth trajectories and common management challenges	Describe entrepreneurial activity and its place in the economy, and to outline the most significant challenges faced by those managing a young firm

3 Staying competitive	Guiding and managing an established business Managing steady state c.f. managing change Tools for planning Managing Innovation (product, process, business model, organisational, etc)	Explain the challenges faced in managing an established business, and some of the tools available to assist in planning and implementing change
4 Marketing	Identifying future business opportunities The business planning cycle Identifying customer needs and opportunity areas Designing business models to address new needs	Outline the marketing function and its contribution to the business
5 Sales	Accessing customers (PBH) The links between business models and routes to market The key tools and techniques for sales Integrating sales with other business activities	Describe the sales process, its role in the business, and a selection of key tools and techniques
6 Case study	Integrating example	Discuss how the principles covered in lectures 1 to 5 might be applied practice
7 Introduction to HRM	Managing people to deliver business objectives People as a resource The principles of HRM (and contrasts with earlier models) The application of HRM (Hard & Soft; integrated, devolved, outsourced) Strategic HRM	Describe the core principles of HRM and discuss its practical application
8 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 Performance management	Goals of performance measurement Performance appraisals Potential biases in appraisals Stack ranking 360 degree appraisals Appropriate employee compensation and different means of achieving it	Describe how employee performance is measured and managed.

10 Nurturing talent	Models of learning Training/learning methods Segmenting talent Employee retention	Discuss the process of employee learning and different methods of training employees Describe how employee talent should be recognised and managed effectively to deliver value to the organisation
11 Change Management	Types of change in organisations Resistance to change and overcoming resistance Satir Model of change Kotter's 8 steps for successful change management	Discuss why change is an issue for organisations Describe the implications of change for the management of people
12 Legislation and regulation	Managing within the legal framework Employment law (hiring, firing, equal opportunities etc) Workplace legislation Employee participation and consultation	Describe the main features of the regulatory and legal framework for employment
13 Dispute Resolution and Governance	Managing people within a framework Dispute resolution 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 International practices/Globalisation	Addressing diversity - Cultural and regulatory variations; Pan-national influences Universalist and contextualist paradigms Convergence and divergence Cultural and institutional explanations Variations in practice	Explain, with examples, how cultural and national norms influence the nature and practice of HRM
15 Current trends	including globalisation, new technology, demographics, flexible working, outsourcing (People management) Technology in HRM Dynamic organisations	Demonstrate awareness of current trends and developments in HRM and in the management of people
16 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: Harper Business 1991

*MULLINS, J. W THE NEW BUSINESS ROAD TEST: WHAT ENTREPRENEURS AND EXECUTIVES SHOULD DO BEFORE WRITING A BUSINESS PLAN. London, FT Prentice Hall. 2003

*STOREY, J. (ed)	HUMAN RESOURCE MANAGEMENT: A CRITICAL TEXT Thomson Learning 3rd edition 2007	1844806154
*TIMMONS, J. A. & SPINELLI, S	NEW VENTURE CREATION: ENTREPRENEURSHIP FOR THE 21ST CENTURY McGraw-Hill 8th edition, 2008	0071276327
*BEARDWELL, J., & CLAYDON, T.	HUMAN RESOURCE MANAGEMENT: A CONTEMPORARY APPROACH Financial Times/Prentice Hall 5th edition 2007	0273707639
*LEGGE, K	HUMAN RESOURCE MANAGEMENT: RHETORICS AND REALITIES, Palgrave Macmillan, 2005	1403936005

3P8: Financial and Management Accounting

Module summary	An introduction to the principles and practice of financial & management accounting and finance
Taught by	Dr C Velu (Module leader)
Supporting activities	The module content is used in the production of business plans for the major project
Assessment	100% by examination, Paper 5 combined with 3P9 Economics of Industry and Strategy
Supervision	Four supervisions will be offered in support of this module.

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. Understand the principles, conventions and regulatory framework of financial accounting.
3-4	• The mechanics of accounting • Balance Sheet, Profit and Loss Account/Income	• Understand the principles of double entry bookkeeping. • 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 • Analysing and interpreting financial statements • Creative accounting	• Understand and be able to use firm performance ratios. • Be familiar with company reports and their analysis, be able to compare performance of firms. • 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 • Product costing systems and activity based costing	• Understand the classification of different costs • Understand and be able to apply different costing methods and to apply different methods for dealing with overhead costs
11-12	• Building a budget • Budgeting and variance analysis/cash flow management	• Understand budgeting methods and processes. • Understand and be able to apply variance analysis, and manage the cash in a business.
13-16	• Investment Appraisal • Financing decisions	• Understanding the approaches to compare the financial viability of different projects - payback method - capital budgeting decisions (opportunity cost of capital, investment rules such as net present value and real options) - time value of money and risk versus return; - financing decisions (debt versus equity). • Understand financing decisions (debt versus equity) and the capital markets.

Reading List

ATRILL, P. & McLANEY, E.J.	ACCOUNTING AND FINANCE FOR NON-SPECIALISTS FT/Prentice Hall 9th edition 2014
ATRILL, P. & McLANEY, E.J.	FINANCIAL ACCOUNTING FOR DECISION MAKERS FT/Prentice Hall 7th edition 2013
ATRILL, P. & McLANEY, E.J.	MANAGEMENT ACCOUNTING FOR DECISION MAKERS Prentice Hall 7th edition 2012
BARKER, R.	SHORT INTRODUCTION TO ACCOUTING, Cambridge University Press, 2011
ATKINSON, A.A., *et al.*	MANAGEMENT ACCOUNTING: INFORMATION FOR DECISION MAKERS AND STRATEGY EXECUTION Prentice Hall 6th edition 2011
ROSS, S.A., WESTERFIELD, R.W. & JORDAN, B.D.	FUNDAMENTALS OF CORPORATE FINANCE. McGraw-Hill Irwin. 11th ed. 2015.

3P9: Industrial Economics, Strategy and Governance

Module summary	An introduction to the principles and practice of economics in order to understand the structure of industries and corporate strategy
Taught by	Dr C Velu (Module leader)
Assessment	100% by examination, Paper 5, combined with 3P8 Financial and Management Accounting
Supervision	Four supervisions will be offered in support of this course

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 The importance of manufacturing The rise of the service economy The role of strategy and strategic planning	Understand the global economy and the changing structure of markets and industries. Understand the development of the manufacturing and service industries. Appreciate of different views of strategic planning
3-4	Firm boundaries	Understand the theory of the firm Understand the horizontal and vertical boundaries of the firm
5-6	Competitive analysis	Appreciate the analytical framework of standard microeconomics. Understand the principles of models of perfect competition, monopoly and oligopoly. Understand the economics of entry and exit Understanding dynamics of competing across time
7-8	Industry and strategic positioning	Appreciate the main issues affecting the macro environment Understand the benefits of coopetition Analyse how firms may respond strategically to its changing environment. Understand strategic positioning and competitive advantage
9-10	Resources and capabilities	Appreciate of positioning versus resource base view Sustaining competitive advantage

13-14	Strategic marketing	Understand the role of marketing in the execution of strategy Appreciation of marketing objectives and strategies Understand product and pricing 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 Appreciate of organizational structures Understanding efficient information processing

Reading List

BESANKO, D., DRANOVE, D., SHANLEY, M. & SCHAEFER, S.	ECONOMICS OF STRATEGY, 6th 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, 8TH edition, Wiley, 2013

3P10: Contemporary Issues in Manufacturing.

Module summary	a. Integrative industrial visits to study modern industrial practice b. Lectures to introduce current topics
Taught by	Dr R Daly (Module leader), Dr C Barlow, Dr E O'Sullivan
Supporting activities	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.
Assessment	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
Supervision	a. Whole group briefing and debriefing for each industrial visit b. Industrial Sustainability - One review and discussion class for the whole group (1.5h) c. Bioengineering & Medical Device Manufacturing - One examples paper and class for whole group (1.5h) d. Scaling up to Manufacturing – One examples paper and class for whole group (1.5h)

Syllabus: Industrial sustainability

Lecture	Syllabus	On completion students should be able to ...
1 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 Discuss major resource implications relevant to manufacturing industry
2 The detailed picture	Measurement and legislation 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 Know what the legislation is Discuss the strengths and weaknesses of different metrics
3 Mitigation measures	How can eco-efficiency be improved? Design for sustainability Optimising materials and process selection The role and limitations of recycling Waste reduction measures Paradigm shifts: Product service systems; zero waste systems	Choose materials and processes to minimise eco-impact Discuss the role and limitations of recycling Identify sources of waste and suggest how waste may be reduced Be aware of radically different ways of meeting materials needs of society

4 Effecting industrial change	How and why do companies 'go green'? Case studies	Assess the eco-impact of a company and make reasoned proposals for how to reduce it.

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	Understand the breadth of the medical device industry and the classification of devices. Display familiarity with the range of synthetic and biomaterials used to form medical devices.
2	The medical device industry Sector analysis in UK and international context Regulatory bodies and their influence on manufacturing	Explain the evolution and essential features of the medical device industry. Explain the unique features and considerations of this manufacturing sector show an understanding of the regulatory procedures that are followed.
3	Key challenges in manufacturing of medical devices.	Explain the specific challenges faced in manufacturing of medical devices, e.g. sterilisation, Q.C., storage/transport.
4	Future trends in medical devices and potential impact on manufacturing. E.g. Nanomanufacturing, personalised medicine	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 Case-studies of scale-up challenges	Understand the multidimensional nature of scale-up in manufacturing Systematically think through the scale-up challenges for an emerging technology
2	Introduce risks leading to the Valley of Death Techniques for risk management Innovation infrastructure for scale-up	Assess combination of risk factors when scaling up Understand the industrial innovation infrastructure needed to address risks
3	Challenges of scale-u can be addressed through contributions from science, engineering, industry and policy	Systematically address risks of scale-up Understand the international approaches to addressing scale-up risks
4	Invited speaker to discuss experiences in scaling up to manufacturing	Understand the business context through shared experiences of manufacturing scale-up

Examinations

The tripos examination for 3P10 Contemporary Issues in Manufacturing will consist of three compulsory 30 minute questions, one on each of the lecture sets.

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, 2008

Reading List – Bio Engineering: Medical Devices and Bio materials

BIRLA, RAVI	Introduction to Tissue Engineering: Applications and Challenges, Wiley-IEEE Press, 2014
SINGER, P.A., VIENS, A.M.	Cambridge Textbook of Bioethics, Cambridge University Press, 2008
WORLD HEALTH ORGANISATION	Medical Device Regulations- Global overview and guiding principles, Geneva, 2003, ISBN 92 4 154618 2.

Coursework

CAD/CAM Exercise

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, and operate the machine tool to produce the parts. The coursework contributes 30 marks. The group will be split into half, with one half producing drawings and programmes for the machining of a milled component, the other half for a turned component.

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 3rd component in the assembly. This must be approved before any programming can begin;
- produce a programme to be loaded onto the machine tool.

Hand-in

The CAD drawings must be handed in on or before **8.45 a.m. Thursday 26th October**. They will be marked and returned by the end of the following week.

Your drawing must include your candidate numbers. A pdf file of your engineering drawing is to be submitted to the IfM Teaching office (met-admin@eng.cam.ac.uk), using the following file name structure, where you replace the numbers with your own: **70n_72x_CAM_date.pdf**

The CAM programmes must be handed in on or before **8:45 a.m**. **Friday 1st December**.

To hand in of CAM component of coursework, please create a zip file, named using the following convention: **70n_72x_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 elegance in programming

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 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 25%
- Performance in the game 25%
- Final report 50%

Standard filenames for hand-in to: met-admin@eng.cam.ac.uk in the following format please:

Your group coursework numbers followed by the coursework name and date

e.g. **70n_71f_73x_ProdGame_date.doc or .pdf**

Major Project

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 genuine problem or issue, in tandem with understanding the market and producing a comprehensive business plan. The business plan will also include some detailed analysis of the financial viability of the product.

The brief for the project will be to develop a new manufacturing technology with the overall theme of 'manufacturing a better future'.

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, appropriately styled and clearly explained visually;
- applied their knowledge of materials and production engineering to produce solutions that could be produced in volume;
- 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.

Assessment

Detailed assessment criteria are outlined in the course handbook. In total, the project contributes 140 marks.

General information

Late Hand In of Coursework

There are normally automatic penalties for late submission of any piece of coursework.

The penality will be **20% of marks per week, or part week, that the work is late.**

Workshop Practical

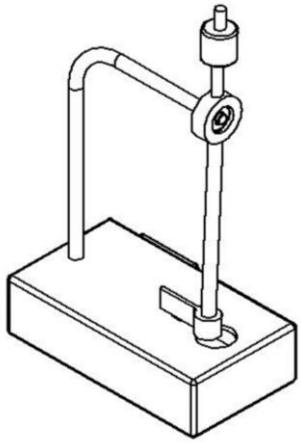
Alan Thorne, Simon Sennitt, Chris Jennings
Marks: **This activity is not marked** (Training for use of studio & workshop equipment)

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 turning, milling and electronic assembly techniques.

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. An option of two RPT sessions will scheduled, each accommodating up to half of the class. 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. Students will be asked to sign up to workshop sessions on a first come first served basis. (A signup sheet will be posted on the MET IIA notice board)

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 complete a safety questionnaire 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.)

CUED Information and Library Services

The library team at the Department of Engineering is available to help with any questions you may have about resources, search strategies and managing references.

A member of the team is based at IfM on Friday mornings, or you can visit them in the CUED Library in the Baker Building, Trumpington Street.

Contact them at 01223 332626 or cued-library@eng.cam.ac.uk

Judge Business School: Information and library services

The Business Information Centre is located in the left-hand wing on the ground floor of the Judge Business School building.

Opening Hours

Term-time:		**Vacation:**	
Mon-Fri	08.45-18.00	Mon - Fri	09.00-17.00
Weekends	Closed	Weekends	Closed

Registration

Please register at the Information Centre desk when you first visit. You will need to present your University card and your email address.

Printed Resources

The Information Centre's printed collection includes core texts on Judge Business School reading lists, together with general research texts and journals. You may place reservations on books that are on loan and renew books that are not reserved by other users. Fines are charged for overdue items at 50p per day. You may borrow a maximum of 5 items.

Electronic Resources

Electronic resources are housed on the CJBS Information Blog (http://www.blogs.jbs.cam.ac.uk/infolib/) and a linked portal (for which you will need to use your Raven password) which can be accessed wherever you are in the world. *Databases available:*

- ABI Inform Complete
- Business Insights
- Business Source Complete
- Capital IQ
- Factiva
- Fame
- Global Insight
- Key Note
- Passport GMID
- Thomson One Banker
- WRDS

(Compustat, CRSP,I/B/E/S & RiskMetrics)

In addition to the resources on the blog, we provide access to Bloomberg and Datastream on terminals in the Information Centre.

Staff and Contact Details

Please contact us by if you have any enquiries about our service:

Email: infolib@jbs.cam.ac.uk, Tel: 01223 339599

Guidance on referencing, collaboration and plagiarism

1. The confidence which a reader has in the contents of a report, paper or dissertation is based on trusting the author. An important contribution to building that trust is through the author demonstrating clearly how they have built on the work of others, and giving full credit to previous contributions, as well as indentifying unambiguously which parts of the overall work are their own, original contribution. That is the role of references in technical writing: to give recognition to other people's work and to provide an 'audit trail' of links to previous work. Developing a good style of referencing takes some effort; in many cases, facts and ideas are so well known and standard that no reference is needed, but if you have any doubts about whether the reader might misinterpret the extent of your own contribution you should always refer explicitly to the source of previous work.
2. In some of your work you will collaborate with other students. Not only does this often make sense in terms of splitting up a larger task into smaller parts, but it can also be a very fruitful method of generating new ideas. Learning how to manage and work within a collaborating team forms an important part of your training as an engineer. In some cases work which results from a team effort will be assessed for examination credit. In such cases all authors of the work must be clear among themselves as to which parts have been contributed by each member, and where required by the Examiners this should be indicated by initials at the bottom of each page.
3. If a report contains material of which you (or in the case of a collaborative report, a member of your team) are not the originator, then you must make the origin of the material explicitly clear by suitable references. Not to do so constitutes plagiarism, which is defined as 'submitting as your own work material which derives in part or in whole from the work of others without due acknowledgement'. Wherever you use sources of information or data such as books, journal articles, internal company sources, personal interviews, web-sites or other internet resources you should ensure that they are fully referenced, so that the reader can locate the source and if necessary make an independent judgement of the quality of the information. You should include text which you have not generated yourself only if it is clearly marked as a quotation (e.g. by placing it in quotation marks with a full reference to its source).
4. Plagiarism is both poor scholarship and a breach of academic integrity, and is regarded extremely seriously within the University. Plagiarism is a form of cheating and any incident in work assessed for examination credit will be reported to the Head of Department, who will normally refer the matter to the University Proctors.
5. Forms of plagiarism include copying someone else's language and/or ideas as if they are your own by, for example, quoting verbatim, paraphrasing, cutting and pasting from the internet, or submitting someone else's work as part of your own without full and explicit acknowledgement of the source. Plagiarism applies to all types of sources and media, whether published or not.
6. The guiding principle is that Examiners and others who may read your work must be in no doubt as to which parts of it are your own original work and which parts are the work of others, or have been produced by you in collaboration with others.

7. These guidelines apply to all assessed work: for example, coursework and project reports.
8. Further guidance can be found in the statement of the University's Policy on Plagiarism at www.admin.cam.ac.uk/univ/plagiarism. If you are uncertain about these guidelines or have any questions about their application, the MET Course Director will be glad to provide advice.

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 familiarise 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 (www.cam.ac.uk/plagiarism) provides more information and guidance.

Student information on the use of Turnitin

The University subscribes to Turnitin UK software which is widely used in UK universities and matches text in work submitted to the software to that in a large database of online sources. This document explains how Turnitin UK will be used by the Department of Engineering and explains the implications of submitting your work to the software.

You are reminded that Turnitin is only one method of checking the originality of your work. Examiners may initiate the standard investigative procedures if they have unresolved queries about the originality of your work, regardless of whether Turnitin has been used or whether it has substantiated any concerns.

The University Advocate may decide to prosecute a student suspected of plagiarism even where that student has not consented to the use of Turnitin. In such circumstances the student may be specifically asked by the Advocate to consent to submission to Turnitin and a failure to consent will be proved as part of the evidence against him or her.

Plagiarism and good academic practice: your responsibilities

You should also familiarise yourself with the statement on plagiarism which is appended to this document. This statement is posted on the University's plagiarism website www.cam.ac.uk/plagiarism which also features links to useful resources and guidance.

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.

About Turnitin UK text-matching software

Who controls the service?

Turnitin UK is part of the JISC Plagiarism Advisory Service (JISCPAS). This University is the recognised Data Controller for the data held and processed by, or on behalf of, the service. An American company, iParadigms, is the Data Processor.

How does Turnitin UK work?

Turnitin UK may detect direct plagiarism, paraphrasing and collusion as submitted work is compared with a vast database of online material and with a 'private' database of previous submissions. Therefore, submitting work to the database helps to protect it from future attempts to plagiarise it, and helps to maintain the integrity of the University's qualifications.

The software makes no judgement about whether a student has plagiarised, it simply shows the percentage of the submission that matches other sources and produces an originality report which highlights the text matches and, where possible, displays the matching text and its immediate context.

In many cases the software highlights correctly cited references or 'innocent' matches. Therefore, Examiners will carefully review all originality reports to determine whether the work does contain plagiarism.

How will Turnitin UK be used in the Manufacturing and Management Division, Department of Engineering?

Work submitted for assessment in the Manufacturing and Management Division, Department of Engineering will be subjected to spot checks from time to time, or in cases where there is cause for concern. Students should note that, upon screening work, the resulting originality reports will be referred only to the Examiners responsible for the academic assessment of the work if there is prima facie evidence of plagiarism or poor academic practice. Work must be submitted electronically.

What will happen if matches are identified between my work and another source?

If Turnitin UK detects matches between your work and another source, the Examiners will review the resulting originality report to judge whether the matches are innocent, or whether you have appropriately referenced these matches (if not, this may constitute plagiarism), and/or whether you have made excessive use of material from other sources (which may be poor academic practice).

The Examiners will mark your work purely on the basis of its academic merit. However, depending on the extent and context of the matches, your work may be referred to the Proctors for further investigation. In such cases the Turnitin UK originality report may be used as evidence. If you are found to have plagiarised the penalty may be severe and your degree may be withheld.

Will Turnitin UK affect my intellectual property rights or copyright?

The copyright and intellectual property rights of the submitted material remain wholly with the original owner (normally the student, with the exception of some collaborative or sponsored research projects). However, you are asked to permit Turnitin UK to:

- reproduce your work to assess it for originality;
- retain a copy of your work for comparison at a later date with future submissions.

Will my personal data be retained by Turnitin UK?

Material submitted to Turnitin UK will be identified by your examination number, course details and institution: personal data will not be used.

What will happen if text submitted by another student matches that in my work?

Matches to text submitted from other HE institutions

If a report generated by another institution identifies a match to your work the report will only show the extent of the match and the contact details of the University's Turnitin UK Administrator. If approached, the Turnitin UK Administrator will attempt to contact you about the matter. The contents of your work will not be revealed to a third party outside Cambridge without your permission.

Matches to text submitted from within the University

If a match is found to material submitted from within the University, the Examiners can obtain the full text without approaching you.

How do I apply for my work to be removed from Turnitin UK?

Work submitted to Turnitin UK will be stored indefinitely on the Turnitin UK database unless you specifically request that it be removed. To maximise the effectiveness of the software it is hoped that such requests will be kept to a minimum. However, once examinations have been concluded, you may at any time contact [the Department's Turnitin UK contact] to request that your work be removed.

Sources of further information and support

The University's plagiarism website: www.cam.ac.uk/plagiarism

Department's plagiarism advice: http://teaching.eng.cam.ac.uk/node/526

Plagiarism guidance in the Second Notice on Fourth-year Projects: www.eng.cam.ac.uk/teaching/courses/projects/yr4_proj/2ndNotice.pdf

Turnitin UK's website: http://www.turnitinuk.com/