MOCK EXAM PRODUCTION PLANNING & QUALITY CONTROL

QUESTION 1: GENERAL QUESTIONS (50 POINTS)

a. List the seven types of waste initially recognized by Toyota. (5p)

- Defects
- Overproduction
- Waiting
- Extra Processing
- Transport
- Inventory
- Motion

7 correct: 5 points
6 correct: 3 points
5 correct: 1 point
4 or less correct: 0 points
Not using skills/knowledge of staff is not part of original 7 types; only first 7 assessed.

b. Shortly describe what the following three perspectives on Lean Production mean: (i) Lean as a management philosophy (describe it and provide two examples of principles), (ii) collection of methods (describe it and provide two examples of methods), (iii) system for production planning and control (describe it and provide two examples of planning and control systems). (6p)
P87 book
Philosophy: principled on simplicity, organization, visibility, agility, etc. (from the book)
OR value, value stream, flow, pull, perfection. (from the slides)
Methods: small-batch production, setup time reduction, maintenance, pull production, etc.
System for planning and control: line balancing, pull production, 100% inspection
2p per subquestion. 0.5 deduction per incorrect/missing description or example.

c. Long setup times must be reduced in order to create a continuous flow of goods. One way of reducing setup times is the adoption of a technique named SMED. (i) Explain the relation between setup time and continuous flow. (ii) What does the acronym SMED stand for? (iii) Which are the steps in SMED? (6p)
(i) **Relation setup time and continuous flow**: A **continuous flow** requires the reduction of the **lot size** to (ideally) 1. To avoid extra capacity, the setup time needs to be **very short** in order to quickly change the production according to the demand. (2p, 0.5 deduction per missing element).

(ii) **SMED** = Single Minute Exchange of Dies: 2 points

(iii) **Steps in SMED**: 0.5 point per correct step

- Identify internal / external;
- Convert Internal to external;
- Improve all aspects of the setup operation;
- abolish setup.

d. Explain what the word 'focused' signifies in a focused factory. (5p).
Book, p. 262, ch9. Less elements to control (fewer products, machines, workers), resulting in more focus.

Alternative (full points): families of products with common production processes.

e. Argue for each of the following manufacturing performance criteria how a large production lot size can have an advantageous effect: cost, product quality, speed, and flexibility. (5p)
Ch.5
Cost: lower setups, so higher efficiency
Product quality: less setups, and after a setup there usually is a short period of instability
Speed: less setups, means a higher speed
Flexibility: higher speed also means being able to ramp up production and being able to deliver large quantities at short notice

1.25 point per good answer

f. Give an example of both internal lead time variability and external lead time variability. (4p)
P. 139 book, ch5.
Internal: equipment functioning, setup times, worker absenteeism and skill level, etc.
External: unreliable delivery.

2p per good example

g. Explain how transfer batches help to reduce the throughput time. (4p)
Lecture 4. If a batch is partly finished, that part is sent to the next department/workstation so it can start working on it before the whole batch is finished.

2p if student shows understanding of transfer batches
2p how it helps to reduce throughput time

h. Under which circumstances is corrective maintenance better than preventive maintenance? (5p)
Lecture 4:
Corrective maintenance better than preventive maintenance if malfunction occurs very seldom, is easy to fix, and with little disturbance to the production process.
Decision criteria include (but are not limited to):

- Fixed and variable cost of the different approaches
- Cost of downtime
- Time needed for maintenance
- Risk (and safety)
- Detectability of incipient failure
- Predictability of remaining useful life (RUL)
- Cost of spare parts
- Not to mention the inherent uncertainty of these variables…

3 correct circumstances = 5p
2 correct circumstances =3p
1 correct circumstance = 1p

i. Explain why a pull production system cannot be stockless. (5p)
Book p. 214, ch8. Having no stock means **waiting for raw material** (2.5p), which would **hold up all downstream processes** (2.5p).

j. (i) Which two basic types of kanban cards can be distinquished in a production environment, and what is their function? (ii) What elements must be taken into account when calculating the number of cards needed for each type? (5p)
Book p225 ev.

(i) **Two basic types of kanban cards**: Production cards and conveyance/move/withdrawal cards (0.5p card or function, total 2p)
(ii) **Elements to take into account when calculating each type**:

- Conveyance cycle (transport time upstream and downstream + waiting time in mailbox) C
- Production time (incl setup) P
- Container size or capacity Q
- Demand D
- (Safety factor SS)

K = D(P+C)/Q

4 or more correct = 3p
3 correct = 2p
2 correct = 1p
1 correct = 0p

QUESTION 2: THE SOCIAL SIDE OF LEAN (25 POINTS)

a. Managing the human resource is one of the most crucial aspects of managing change in any organization. It requires the coexistence of *control* and *cooperation*.

i. Name three aspects of the Toyota Production System associated to *control* and motivate your choice by explaining why these aspects can be associated to *control* (5p)

Lecture 3/HRM + ch11
(i) standardized tasks; visual management; takt-time; Kanban; statistical process control; …
3 correct: 5p
2 correct: 3p
1 correct, 1p

ii. Name three aspects of the Toyota Production System associated to *cooperation* and motivate your choice by explaining why these aspects can be associated to *cooperation* (5p)

Lecture 3/HRM.
(ii) autonomous teamwork; job rotation; suggestion system; job security;
3 correct: 5p
2 correct: 3p
1 correct, 1p

b. Although scientific management (or Taylorism) received many criticisms, the Toyota Production System (TPS) incorporates features of it.

i. Provide a description of the three main criticisms on scientific management (3p),

Lecture 3/HRM

- Significantly higher productivity – but at the cost of workers' wellbeing and of poor industrial relations
- Demonstrated an ignorance of nonfinancial aspects of individual motivation
- Demonstrated an ignorance of group psychology and motivation

3 correct: 3p
2 correct: 2p
1 correct, 1p

ii. Define what is meant by "job enlargement", "job enrichment", and autonomous work group (3p) and

Lecture 3/HRM

(ii) **Job enlargement**: the recombination of tasks which have been separated by Scientific management techniques to lengthen the work cycle
Job **enrichment** or 'vertical loading': consciously employed the theories of Herzberg (1966) to build 'motivators' into the work by giving more control and responsibility to the worker
Autonomous work group: Work should be organized in teams. Individual jobs should provide: meaningful tasks with sufficient variety, feedback of results, sufficient control over work standards, an 'optimum' work cycle and a perceived contribution to the end product.

1 point for each correct definition.

iii. Discuss how these three concepts/elements were used in Toyota to avoid (or at least reduce) such criticisms while incorporating scientific management to its production system (4p)

(iii) see slides 13, 14, 15 and 19 of Lecture 3.
Standardized tasks as in the Scientific management, but:

- Workers have responsibility for improving standardized work
- Shop-floor employees are the most familiar with the actual work and the actual problems that affect the work
- The rest of the hierarchy (the management) support them

1 point per element, 4 points for a complete answer

c. As discussed in Lecture 3, a very high percentage of lean projects fail. Name and discuss four possible causes that can explain why lean projects fail. (5 points)

Lecture 3.

- Superficial approach
- Most of the lean projects focuses on the technical part of lean, without paying attention to people and partners
- Obsession of waste elimination: stress in the workforce
- Autonomous teamwork: the team manage a lot more than would be traditionally expected from them.
- Transparency of measures: measures can be used to make workers work harder, psychological triggers for being considered a "slave" of the measurement system.
- Job-specific training: company specific
- Visual charts: pressure on staff
- …

1 point for each correct answer, 5 points for a complete answer

QUESTION 3: SCHEDULING AND LINE BALANCING (25 POINTS)

a. (i) Explain what is meant by uniform, leveled, production schedules. (ii) What are requirements for Level Production Schedules? (5p)

(i) Book, p. 387, ch14. **Level production schedules**: The **same quantity** (1p) for a product is made in each production run, and the production runs occur at **regularly scheduled intervals** (1p).

(ii) Book, p. 388, ch14. **Requirements Level production schedules**:

- Continuous stable demand
- short setup times
- production = demand.

1p per correct requirement

b. What are the main advantages and disadvantages of respectively the Shortest Processing Time priority rule and the Earliest Due Date priority rule? (3p)

Lecture 5.

SPT: Shortest Processing Time

- Advantage: many customers served
- Disadvantage: long jobs keep waiting

EDD: Earliest Due Date

- Advantage: less due date violations
- Disadvantage: perhaps many small due date violations instead of a single large one

0.75p per correct (dis)advantage.

c. What is the difference between a paced line and an unpaced line? (3p)

Lecture 4 & 6. Paced line is strictly based on the **cycle time**, and sends the work in process to the next station whether it is **finished or not**. Unpaced line sends the work in process to the next station **when it is finished**.

1p per correct paced/unpaced. 3p if both correct

d. A production company wants to balance its production line. The tasks, task times and precedence-relations are given as follows:

Task	Task time (minutes)	Preceding tasks
A	5	
B	8	A
C	10	A
D	16	B,C
E	7	D
F	14	E
G	9	D
H	6	F,G

The market demand of the product is 80 per week. The company works in one shift of 8 hours per day, 5 days per week.

(i) You are asked to propose a balanced production line by using either the Ranked Positional Weight algorithm or the longest operation time. Please clearly list and explain the steps you have taken to arrive at your solution, and include a precedence diagram in your solution. (10p)

(ii) What would be your advice to the management, to implement your solution, or not? Please motivate your answer. (4p)

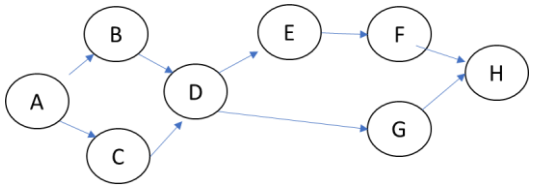
(i) Slides Lecture 6 or book p. 320, ch11.

Procedure Ranked Positional Weight

- Determine the cycle time
- Calculate PW of each tasks
- Sort the tasks in order of descending PW
- Arrange the tasks into workstations, starting with the highest PW.

Demand = 80/40hrs = 2/hr
CT = 8*5*60/80 = 30 mins

PW:
a.75
c.60
b.62
d.52
e.27
f. 20
g. 15
h. 6



Stations: ABC – DE – FGH

Procedure longest operation time:

- Determine the cycle time
- Sort the tasks in order of descending processing time
- Arrange the tasks into workstations, starting with the longest operation time.

d.16
f.14
c.10
g.9
b.8
e.7
h.6
a.5

Stations: DF – CGB - EHA

Precedence diagram: 3p
Correct CT: 2p
Correct steps (order can differ): 3p
Solution: 2p

(ii) Advice to management max 4p.