NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

BACHELOR OF ENGINEERING (HONS) INDUSTRIAL AND MANUFACTURING ENGEEERING

MANUFACTURING SYSTEMS II

TIE 3212

SECOND SEMESTER MAIN EXAMINATION

APRIL / MAY 2015

This examination paper consists of 6 pages

Time Allowed: **3 hours**

Total Marks: **100**

Special Requirements: **Nil**

Examiner's Name: **Eng. T R Chikowore**

INSTRUCTIONS AND INFORMATION TO CANDIDATES

1. Answer ALL questions in SECTION A, and any THREE questions from SECTION B.
2. Each question carries 20 marks.
3. Use Table in Appendix A.

SECTION A (COMPULSORY)

Question 1

a) Table Q1 shows the machine - part matrix for an engineering workshop. Using Binary Ordering Algorithm (BOA) determine the natural groups that can be formed. [14]

Table Q1: Machine – part matrix

Machine	Part									
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**K**
1	1	1				1	1	1		
2			1	1	1				1	1
3			1	1	1					1
4			1	1		1			1	
5	1	1					1	1		

b) Outline the weaknesses of the Binary Ordering Algorithm (BOA). [3]

c) Briefly describe an approach that can be used to improve on the solution obtained in *part (a)* of this question. [3]

Question 2

Table Q2 contains information on the cost of allocating four jobs to four available workers. Using the Hungarian method determine an assignment plan that will minimise costs. Also calculate the total cost associated with your plan. [20]

***Table Q2: Cost of running jobs on machines* ($)**

Job	Worker			
	A	**B**	**C**	**D**
1	8	6	2	4
2	6	7	11	10
3	3	5	7	6
4	5	10	12	9

SECTION B

Question 3

a) Processing times, due dates and the number of remaining operations for six jobs waiting to be processed at a work center are given in Table Q3. Assuming that the jobs arrived in the order shown, determine the sequence of jobs, the average flow time, average tardiness, and the average number of jobs at the work center, for each of these rules:

i) Shortest Processing Time (SPT), [4]
ii) Earliest Due Date (EDD), [4]
iii) Critical Ratio (CR), [5]
iv) Slack per Operation (S/O). [5]

b) Select the best sequence. Give reasons for your choice. [2]

Table Q3: Processing times and due dates for jobs

Job	Processing Time (days)	Due date (days)	Remaining number of operations
A	4	14	3
B	16	32	6
C	8	8	5
D	20	34	2
E	10	30	4
F	18	30	2

Question 4

a) The Theory of Constraints by Dr. Eli Goldratt is another approach to scheduling. Discuss this approach showing clearly how it contrasts with traditional management of maximising the output of every operation. [10]

b) Doctors' and dentists' offices frequently schedule patient visits at regularly spaced intervals.

i) Discuss the problems that this approach can create. [5]
ii) Suggest alternative approaches to reduce these problems. [2]
iii) Outline the circumstances under which regularly spaced appointments constitute a reasonable approach to scheduling. [3]

Question 5

a) MRP is one of the earliest applications of computers to scheduling. By also making references to Manufacturing Resources Planning (MRP II) and Enterprise Resources Planning (ERP) discuss how this application of computers to scheduling has evolved. [12]

b) Table Q5 shows processing times for five jobs on an assembly station and a polishing station. Determine the schedule that minimises makespan. [8]

Table Q5: Processing times for jobs

Job	Job time (Hours)	
	Assembly	Polishing
1	3.0	5.5
2	8.0	1.5
3	12.0	13.5
4	9.0	4.0
5	4.5	4.0

Question 6

a) Describe five benefits that a company can gain by implementing Group Technology (GT). [5]

b) Using examples to aid your answer distinguish clearly between a hierarchical code and an attribute code. [10]

c) Figure Q6 shows the design of a certain part type. Develop a form code using the Optiz system. [5]

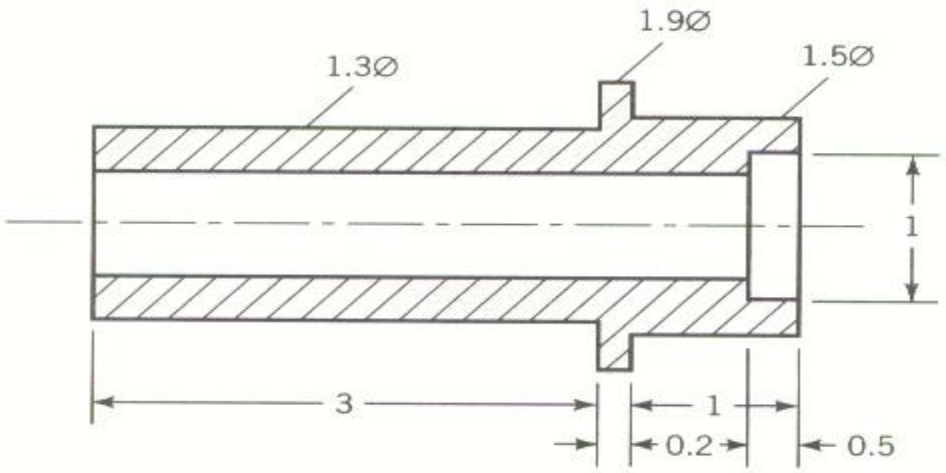

Figure Q6: Part design

Question 7

a) Distinguish clearly between Group Technology and Cellular Manufacturing. [6]

b) Let c_i be the cost of tooling (fixture) if tooling is designed specifically for part *i*. an alternative is to use a generic fixture for all parts in the family along with a part-specific

insert. Let c_f be the cost of a generic fixture to hold all parts in family f and c_{if} be the cost of the special insert for part i. Assume $c_{if} < c_i < c_f$.

i) Assuming that all c_{if} are the same, indicate graphically the cost of using each alternative as a function of the number of parts in the family. [8]
ii) Derive an algebraic expression for selecting the tooling approach to be used as a function of cost parameters. [6]

END OF EXAMINATION PAPER

APPENDIX A: Table for Opitz code

Digit 1		Digit 2		Digit 3		Digit 4		Digit 5	
Part class		External shape, external shape elements		Internal shape, internal shape elements		Plane surface machining		Auxiliary holes and gear teeth	
Rotational parts	0 $L/D \leqslant 0.5$	0	Smooth, no shape elements	0	No hole, no breakthrough	0	No surface machining	No gear teeth	0 No auxiliary hole
	1 $0.5 < L/D < 3$	Stepped to one end or smooth	1 No shape elements	Smooth or stepped to one end	1 No shape elements	1	Surface plane and/or curved in one direction, external		1 Axial, not on pitch circle diameter
	2 $L/D \geqslant 3$		2 Thread		2 Thread	2	External plane surface related by graduation around a circle		2 Axial on pitch circle diameter
	3		3 Functional groove		3 Functional groove	3	External groove and/or slot		3 Radial, not on pitch circle diameter
	4	Stepped to both ends	4 No shape elements	Stepped to both ends	4 No shape elements	4	External spline (polygon)		4 Axial and/or radial and/or other direction
	5		5 Thread		5 Thread	5	External plane surface and/or slot, external spline		5 Axial and/or radial on pitch circle diameter (p.c.d.) and/or other directions
	6		6 Functional groove		6 Functional groove	6	Internal plane surface and/or slot		6 Spur gear teeth
Nonrotational parts	7	7	Functional cone	7	Functional cone	7	Internal spline (polygon)	With gear teeth	7 Bevel gear teeth
	8	8	Operating thread	8	Operating thread	8	Internal and external polygon, groove and/or slot		8 Other gear teeth
	9	9	All others	9	All others	9	All others		9 All others