



PROGRAM : NATIONAL DIPLOMA
INDUSTRIAL ENGINEERING

SUBJECT : **MECHANICAL MANUFACTURING III**

CODE : **IMV 321**

DATE : SUMMER SSA EXAMINATION 2014
1 DECEMBER 2014

DURATION : (SESSION 1) 08:00 - 11:00

WEIGHT : 40 : 60

TOTAL MARKS : 100

ASSESSOR : MR R P MUTYAVAVIRE

MODERATOR : MR S CHIKUMBA FILE NO

NUMBER OF PAGES : 4 PAGES

INSTRUCTIONS : ONLY ONE POCKET CALCULATOR PER CANDIDATE
MAY BE USED.

REQUIREMENTS : GRAPH PAPER.

INSTRUCTIONS TO STUDENTS

PLEASE ANSWER ALL QUESTIONS.

QUESTION 1

- 1.1.1 The degree of automation can be measured by the manning level index. Briefly explain how this index can be calculated. (4)
- 1.1.2 Briefly discuss three (3) reasons why single station cells are widely used in the manufacturing industry. (6)
- 1.2 A polymer blow moulding plant produces 50 million containers annually. The plant operates three (3) shifts per day, 360 days per year. The moulds are replaced every 6000 containers produced. The average mould changeover time is = 2.5 hr, and on average, 15 containers are produced per minute. Given a scrap rate = 1%, and average machine availability = 95% during run time. Availability during changeover is assumed to be 100%. Determine the number of machines required to meet production demand. (10)

[20]

QUESTION 2

An Industrial Engineer is required to design a single model assembly line to produce a television sets amounting to 200,000 units per year. According to the country's labour laws, the line will operate 8 hours per shift, two shifts per day, five days per week, 50 weeks per year. Work content time = 45.0 min. For planning purposes, it is anticipated that the proportion uptime on the line will be 95%. Determine:

- (a) Average hourly production rate, (5)
- (b) Cycle time, (5)
- (c) Theoretical minimum number of workers required on the line. (5)
- (d) If the balance efficiency is 0.93 and the repositioning time = 6 sec, how many workers will actually be required? (5)

[20]

QUESTION 3

- 3.1 List and briefly explain four (4) reasons why buffer storage is necessary in automated assembly lines. (8)
- 3.2 A ten-station automated production line produces automotive component parts. The longest process time on the line is 1.30 min. A mechanised part transfer mechanism takes 9.0secs to move the parts

between workstations. Failure statistics indicate that machine breakdowns occur at an average frequency of 0.007 for all machines. When there is a breakdown, it takes an average of 10.0 min to diagnose the problem and make repairs. Determine:

- (a) Line efficiency (4)
- (b) Average actual production rate. (4)
- (c) Explain how flexibility and product variety may be introduced in manual assembly lines. (4)

[20]

QUESTION 4

Nine (9) parts are manufactured on eight (8) machines in a particular job shop. The routing for the individual parts through machines 1-9 are illustrated below. Apply the rank order clustering technique to identify logical part families and machine cells. Parts are identified by letters, and machines are identified numerically.

- A 2-4-7
- B 2-4-6-8
- C 1-5-7
- D 1-4-7
- E 1-5
- F 3-8
- G 2-3
- H 2-3-6-8
- I 2-6-8

[20]

QUESTION 5

- 5.1 A junior industrial engineer is required to design a warehouse. The warehouse must have the capacity to store 2000 pallet loads, with an allowance of no less than 20% additional storage compartments for peak periods and flexibility. The unit load pallet dimensions are: depth (x) = 100cm and width (y) = 150cm. Maximum height of a unit load = 90cm. It has been determined that the AS/RS will consist of four aisles with one S/R machine per aisle. The maximum ceiling height (interior) of the building permitted by local ordinance is 20m, so the AS/RS must fit within this height limitation. The rack structure will be built 50cm above ground level, and the clearance between the rack structure and the ceiling of the building must be at least 50cm. Determine the dimensions (height, length, and width) of the rack structure.

(10)

- 5.3 Discuss the production conditions under which group technology and cellular manufacturing are most ideal for implementation? (5)
- 5.4 Explain briefly, the underlying technology in machine vision. What are its principal applications in industry? (5)

[20]

TOTAL = 100
