



GWANDA STATE UNIVERSITY
FACULTY OF ENGINEERING AND ENVIRONMENT
DEPARTMENT OF METALLURGICAL ENGINEERING
MANAGEMENT FOR PROCESS ENGINEERS
EMG/ EMR 5202
Part V Examination Paper
2025

This examination paper consists of 5 printed pages

Time Allowed: 3 Hours

Total Marks: 100

Lecturer : Eng Charles Mazemo

INSTRUCTIONS TO CANDIDATES

1. Answer **ALL** questions in **Section A** and any **two** questions from **Section B**
2. Each question carries **20 marks**.
3. Where a question contains subdivisions, the mark value of each subdivision is shown in brackets.
4. Illustrate your answer, where appropriate, with clearly labeled diagrams.
5. Started each question on a new page.
6. This paper comprises of 3 printed pages

SECTION A

ANSWER ALL QUESTIONS

Question A1

Hwange Colliery Company produces two types of products thermal coal and metallurgical coke. The profits per tonne of the two products are \$30 and \$40 respectively. These two products require processing in three types of plants. Table A1 shows the available plant hours per day and the time required on each plant to produce one tonne of thermal coal and metallurgical coke.

- a) Formulate the problem in the form of linear programming model and determine the product distribution that the company must target to produce in order to maximize total profit contribution. [10 Marks]?

Table A1

Product	Thermal Coal	Metallurgical Coke	Total Available Plant Hours Per day
Profit Per Tonne	\$30	\$40	
Plant 1	3	2	600
Plant 2	3	5	800
Plant 3	5	6	1100

- b) Determine the idle capacity in each production plant [3Marks]
- c) Due to the increased power demand Hwange Colliery management is concerned about the fluctuations in prices of raw materials, product demand and stock prices. Determine the profit contribution range per tonne that the marketing department must negotiate within in order to maintain the product distribution determined in Question A1 [7 Marks]?

Question A2

Alpha Limited produces coat racks. The projected sales for the first quarter of the coming year and beginning and ending inventory data are as follows:

Sales in units	100 000
Unit price	\$15
Units in beginning inventory	8 000
Units in targeted ending inventory	12 000

The coat racks are moulded and then painted. Each rack requires 4 kg of metal, which costs \$4.5 per kg. The beginning inventory of materials is 2 000 kg. Alpha Limited wants to have 3 000 kg

of metal in inventory at the end of the quarter. Each rack produced requires 30 minutes of direct labour time, which is billed at \$9.00 per hour. The standard cost per rack is \$11.00.

Required:

Prepare the following budgets for the first quarter:

- (a) Sales budget;
- (b) Production budget;
- (c) Direct materials purchases budget;
- (d) Direct labour budget **[20 Marks]**

Question A3

A metallurgical project consists of several activities with the following time estimates for each activity. You need to determine the probability that the project will be completed in 30 weeks or less.

Activity	Predecessor Activity	Optimistic Time Estimate (t _o Days)	Most likely Time Estimate (t _m Days)	Pessimistic Time Estimate (t _p Days)
A	-	2	5	8
B	A	2	3	4
C	A	6	8	10
D	A	2	4	6
E	B	2	6	10
F	C	6	7	8
G	D, E, F	6	8	10

Using these time estimates, calculate the probability that the project will be completed in 30 weeks or less. **[20Marks]**

SECTION B

ANSWER ANY TWO QUESTIONS

Question 4

- a) Some business people think that inventory is a necessary evil while others think inventory is an asset. critic your view? **[10 Marks]**

- b) Explain the terms: event, predecessor event, successor event, activity, dummy activity as used in project management [10 Marks]

Question 5

The GSU-MET INSTITUTE has just made the winning bid of \$5.4 million to construct a new plant for a major mining company. The company needs the plant to go into operation within a year. Therefore, the contract includes the following provisions:

- A penalty of \$300,000 if GSU-MET has not completed construction by the deadline 47 weeks from now.
- To provide additional incentive for speedy construction, a *bonus* of \$150,000 will be paid to GSU-MET if the plant is completed within 40 weeks.

GSU-MET has assigned you to be project manager, to this project to help ensure that it stays on schedule. You look forward to the challenge of bringing the project in on schedule, and perhaps even finishing early. However, since you are doubtful that it will be feasible to finish within 40 weeks without incurring excessive costs, you have decided to focus your initial planning on meeting the deadline of 47 weeks.

You will need to arrange for several crews to perform the various construction activities at different times. Table B1 shows his list of the various activities. The third column provides important additional information for coordinating the scheduling of the crews.

Table B.1

Activity	Activity Description	Immediate Predecessors	Estimated Duration
A	Excavate	—	2 weeks
B	Lay the foundation	A	4 weeks
C	Put up the rough wall	B	10 weeks
D	Put up the roof	C	6 weeks
E	Install the exterior plumbing	C	4 weeks
F	Install the interior plumbing	E	5 weeks
G	Put up the exterior siding	D	7 weeks
H	Do the exterior painting	E, G	9 weeks
I	Do the electrical work	C	7 weeks
J	Put up the wallboard	F, I	8 weeks
K	Install the flooring	J	4 weeks
L	Do the interior painting	J	5 weeks
M	Install the exterior fixtures	H	2 weeks
N	Install the interior fixtures	K, L	6 weeks

Answers the following questions:

- How can the project be displayed graphically to better visualize the flow of the activities? [5 Marks]
- What is the total time required to complete the project if no delays occur? [3 Marks]
- When do the individual activities need to start and finish (at the latest) to meet this project completion time? [3 Marks]

- d) When can the individual activities start and finish (at the earliest) if no delays occur? **[3 Marks]**
- e) Which are the critical bottleneck activities where any delays must be avoided to prevent delaying project completion? **[3 Marks]**
- f) If extra money is spent to expedite the project, what is the least expensive way of attempting to meet the target completion time (40 weeks)? **[3 Marks]**

Question 6

A project has activities with the following normal and crash times and cost:

Activity	Predecessor Activity	Normal Time (Weeks)	Crash Time (Weeks)	Normal Cost (\$)	Crash Cost (\$)
A	-	4	3	8000	9000
B	A	5	3	16000	20000
C	A	4	3	12000	13000
D	B	6	5	34000	35000
E	C	6	4	42000	44000
F	D	5	4	16000	16500
G	E	7	4	66000	72000
H	G	4	3	2000	5000

Determine a crashing scheme for the above project so that the total project time is reduced by 3 weeks. **[20 Marks]**