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 4 printed pages

Time Allowed: **3 hours**

Total Marks: **100**

Lecturer: C 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 labelled diagrams.
5. Started each question on a new page.

Question A1
Epoch Mine Corporation in Filabusi is planning its operations for the upcoming quarter. The projected sales and 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

Each mining unit requires 2 kg of raw minerals, which cost $2.50 per kg. The beginning inventory of minerals is 2,000 kg, and Epoch Mine Corporation aims to have 3,000 kg of minerals in inventory at the end of the quarter. Each unit extracted requires 30 minutes of labor, billed at $9.00 per hour. The standard cost per mining unit 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 labor budget. **[20 Marks]**

Question A2
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]**

Question A3

GSUCASTING is a manufacturer of steel balls for ball mills whose management has decided to move into the market for medium (standard) and high-priced (deluxe) steel balls. GSUCASTING's distributor is enthusiastic about the new product line and has agreed to buy all the steel balls GSUCASTING produces over the next three months. After a thorough investigation of the steps involved in manufacturing a steel ball, management determined that each steel ball produced will require the following operations:

1. Cutting and dicing
2. Stainless steel plating
3. Finishing
4. Inspection and packaging

The production manager analyzed each of the operations and concluded that if the company produces a medium-priced standard model, each ball will require 7/10 hour in the cutting and dicing department, ½ hour in the stainless-steel plating department, 1 hour in the finishing department, and 1/10 hour in the inspection and packaging department. The more expensive deluxe model will require 1 hour for cutting and dicing, ⅚ hour for stainless steel plating, ⅔ hour for finishing, and ¼ hour for inspection and packaging. GSUCASTING production is constrained by a limited number of hours available in each department. After studying departmental workload projections, the production manager estimates that 630 hours for cutting and dicing, 600 hours for plating, 708 hours for finishing, and 135 hours for inspection and packaging will be available to produce steel balls during the next three months.

The accounting department analyzed the production data, assigned all relevant variable costs, and arrived at prices for both balls that will result in a profit contribution of $10 for every standard ball and $9 for every deluxe ball produced.

a. Develop a mathematical model of the GSUCASTING that can be used to determine the number of standard balls and the number of deluxe balls to produce in order to maximize total profit contribution [**8 Marks]**

b. Use the graphical method to determine the number of balls of each type that must be produced in order to maximize profits [**7Marks]**

c. Due to covid 19 pandemic METHUB management is concerned about the fluctuation in the the prices of raw materials ,product demand and stock prices .what is the profit contribution range per ball that the market department must negotiate within in order to maintain the product distribution determined in question A. **[5 Marks]**

SECTION B
ANSWER ANY 2 QUESTION FROM THIS SECTION

Question 4

a. With the help of an example in the engineering field, describe Stages of Development of Operations Research. **10 marks**

b. What challenges might be faced during implementation stages of OR? **10 marks**

Question 5

a. Explain terms budget and budgetary control as applied to management. **5marks**

b. With the aid of well-illustrated example explain the Zero-Base Budgeting (ZBB) **15 marks**

Question 6

What are the major functions of inventory within an organization, particularly in the context of mining operations? Additionally, what factors can influence inventory management in this setting?**[20 marks]**

END OF QUESTION PAPER