GWANDA STATE UNIVERSITY

FACULTY OF ENGINEERING AND ENVIRONMENT

DEPARTMENT OF METALLURGICAL ENGINEERING

MANAGEMENT FOR PROCESS ENGINEERS

EMR 5202

Part V Second Semester Examination Paper

August 2022

This examination paper consists of 4 printed pages

Time Allowed: **3 hours**

Total Marks: **100**

Nkomo Fortune

INSTRUCTIONS

1. Answer **ALL questions in Section A and any TWO from Section B**
2. Each question carries 25 marks
3. Use of calculators is permissible

Additional Requirements

MARK ALLOCATION

Section A	50 Marks
Section B	50 Marks
Part Questions	As shown in each part question
Total Attainable	100

SECTION A (50 MARKS)

ANSWER ALL QUESTIONS

USE THE INFORMATION BELOW TO ANSWER QUESTIONS A1 AND A2

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, 5/6 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.

Question A1

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 [**15 Marks]**
b) Use the graphical method to determine the number of balls of each type that must be produced in order to maximize profits [**10 Marks]**

Question A2

a) Determine the idle capacity in each production department **[5 Marks]**

b) Due to the COVID19 pandemic GSUCASTING management is concerned about the fluctuations in prices of raw materials, product demand and stock prices. Determine the profit contribution range per ball that the marketing department must negotiate within in order to maintain the product distribution determined in Question 1A (b) **[20 Marks]?**

SECTION B (50 MARKS)

ANSWER ANY TWO QUESTIONS

Question B1

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 the project manager, to 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 this 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:

a) Display the project graphically to better visualize the flow of the activities? **[4 Marks]**
b) What is the total time required to complete the project if no delays occur? **[5 Marks]**
c) When do the individual activities need to start and finish (at the latest) to meet the stipulated project completion time? **[4 Marks]**

d) When can the individual activities start and finish (at the earliest) if no delays occur? **[4 Marks]**
e) Which are the critical bottleneck activities where any delays must be avoided to prevent delaying project completion? **[5 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 B2

Discuss the stages of a project life cycle giving practical examples. **[25 Marks]**

Question B3

Explain terms budget and budgetary control as applied to management. **[25 Marks]**

END OF QUESTION PAPER