UNIVERSITY OF JOHANNESBURG

PROGRAM	:	BACHELOR OF TECHNOLOGY *ENGINEERING: INDUSTRIAL*
SUBJECT	:	**PROJECT ENGINEERING 4**
CODE	:	**IPE 411**
DATE	:	WINTER EXAMINATION 2019 01 JUNE 2019
DURATION	:	(SESSION 1) 08:30 - 11:30
WEIGHT	:	40: 60
TOTAL MARKS	:	100

ASSESSOR	:	MR P. DUBE
MODERATOR	:	MR S P. UBISSE
NUMBER OF PAGES	:	4 PAGES

INSTRUCTIONS TO STUDENTS

PLEASE ANSWER ALL QUESTIONS.

REQUIREMENTS

ONLY ONE POCKET CALCULATOR PER CANDIDATE MAY BE USED.

Question 1

Magashula Corporation, a South African based milk manufacturing company would need a new plant to manufacture pasteurized milk. This plant could be built and made ready for production in 2 years. It would require a 30-acre site, which can be purchased for R1.5 million in year 0. Building construction would begin early in year 1 and continue throughout year 2. The building would involve a R4 million payment due to the contract at the end of year 1, another R6 million would be payable at the end of year 2. The necessary manufacturing equipment would be installed late in year 2 and would be paid for at the end of year 2. The equipment would cost R13 million, including transportation and installation. When the project terminates in year 8, the land is expected to have an after-tax market value of R2 million, the building an after tax value of R3million, and the equipment an after-tax value of R3 million.

For capital budgeting purpose, assume that the cash flows occur at the end each year. Because the plant would begin operations at the beginning of year 3, the first operating cash flows would occur at the end of year 3. The pasteurized milk plant's estimated economic life is 6 years after completion, with the following expected after tax operating cash flows in millions.

Year	3	4	5	6	7	8
After-tax cash flows	6	8	13	18	14	8

1.1.1 Compute the cash flows from year 0 to year 8. (8)

1.1.2 Compute the equivalent worth of this investment (NPV) Assume the opportunity cost of capital is 15% (7)

1.2 A company wants to replace its old semi-automatic machine with a new fully automatic machine. In the market there are two models available in the market (Model A & Model B) at a cost of R 5,00,000 each. Salvage value of old machine is R 1,00, 000.The utilities of existing machinery can be used is company purchases model A and additional utilities to be bought is only R1,00,000. However, in case the company buys the model B then all the existing utilities will have to be replaced and new utilities cost R 2,00,000 and salvage value of old utilities is R20,000, The cash flows expected are as follows and discount rate is 15%. Using the discounted payback decide on the machine to buy. (15)

Year	A	B
1	R 1,00,000	R 2,00,000
2	R 1,50,000	R 2,10,000
3	R 1,80,000	R 1,80,000
4	R 2,00,000	R 1,70,000
5	R 1,70,000	R40,00
Salvage value expected	R 50,000	R60,00

Question 2

2.1 Construct a precedence diagram. (7)
2.2 On the diagram, compute the four schedule dates (ES, EF, LS, LF) and the Total Float (TF) and Free Float (FF) for each activity. (14)
2.3 Identify the critical path (2)

Activity	Duration	Predecessors
B	5	
M	4	B
N	9	B
Q	15	B
A	1	M,N
F	4	N,Q
X	9	Q
C	9	Q
Y	9	A,F,X
S	6	F
J	5	X,F
T	10	C
V	5	Y,S
U	10	V,T,J

Question 3

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

Activity	Predecessor Activity	Normal Time (Weeks)	Crash Time (Weeks)	Normal Cost (Rs)	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. (18)

Question 4

Consider a *PERT* network with the precedence relations specified in the table below.

Activity	Immediate Predecessor	Estimated duration (in days)	Optimistic Time (d)	Most likely Time (d)	Pessimistic Time (d)
A	–	2, 5, 14	2	5	14
B	–	1, 4, 7	1	4	7
C	*A*	3, 3, 3	3	3	3
D	*A, C*	1, 2, 3	1	2	3
E	*B, D*	1, 2, 21	1	2	21
F	*C, D*	2, 4, 24	2	4	24
G	*D, E*	1, 3, 5	1	3	5

(a) Draw the network and determine the earliest possible and latest allowable starting and finishing times. Find the critical path(s). What is the mean duration of the project? (7)

(b) Determine the variances of all activities on the critical path. (7)

(c) Calculate the probability that the project duration is 22 days. (3)

Question 5

You are one of three carpenters assigned to complete a short construction project. Right before the start of the project, one of your fellow carpenters was hospitalized and will not be available to work on the project.
Develop a resource-constrained schedule in the loading chart that follows to see how long the project will take with only 2 carpenters. Be sure to record the order in which you schedule the activities using the scheduling. Activities A, B, C, D, E, G, and H require 2 carpenters to complete. Activity F requires only 1 carpenter. No splitting of activities is possible. You will receive a bonus if the project is completed within 15 days. Should you start planning how you will spend your bonus? (12)