



UNIVERSITY EXAMINATIONS

FIRST SEMESTER 2025/2026 ACADEMIC YEAR

**THIRD YEAR EXAMINATION FOR THE DEGREES OF
BACHELOR OF SCIENCE (STATISTICS) AND BACHELOR
OF ECONOMICS (MATHEMATICS)**

MATH 317: OPERATIONS RESEARCH

STREAM: R

TIME: 2 HRS

DAY: WEDNESDAY [11.30 – 13.30 P.M]

DATE: 04/02/2026

THIS QUESTION PAPER CONSISTS OF FOUR (4) PAGES

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INSTRUCTIONS: DO QUESTION ONE AND ANY OTHER TWO QUESTIONS

QUESTION ONE (30 MARKS)

$$\begin{aligned} \text{Maximize } Z &= 16x_1 + 15x_2 \\ \text{Subject to } 40x_1 + 31x_2 &\leq 124 \end{aligned}$$

$$\begin{aligned} \text{a) } -x_1 + x_2 &\leq 1 \\ x_1 &\leq 3 \\ x_1, x_2 &\geq 0 \end{aligned}$$

Solve the given model using graphical method.

(10 Marks)

b) Form the dual of the following problem.

$$\begin{aligned} \text{Minimize } 30A + 60B + 20C \\ \text{Subject to } 5A + 10B + 15C &\geq 2,000 \\ 2A + 3B + C &= 300 \\ 8A + 6B + 4C &< 650 \end{aligned}$$

(4 Marks)

c) Using the given table find the time estimate for each activity, hence draw the network indicating the time estimate for each activity.

Activity	Optimistic	Most likely	Pessimistic
1 – 2	9	12	21
1 – 3	6	12	18
2 - 4	1	1.5	5
3 – 4	4	8.5	10
2 – 5	10	14	24
4 – 5	1	2	3
3-5	4	3	10

(8 Marks)

d) What are the reasons for keeping inventories within an organization?.

(8 Marks)

QUESTION TWO (20 MARKS)

(a) A Company is involved in the production of two items (X and Y). The resources needed to produce X and Y are twofold, namely machine time for automatic processing and Craftsman time for hand finishing. The table below gives the number of minutes required for each item;

	Machine time	Craftsman time
Item X	13	20
Item Y	19	29

The Company has 40 hours of machine time available in the next working week, but only 35 hours of Craftsman time. Machine time costed at 10 pounds per hour worked. And Craftsman time costed 2 pounds per hour work. The revenue received for each item produced is 20 pounds for X and 30 pounds for Y. The company has a specific contract to produce 10 items of X per week for a particular customer. Formulate the problem of deciding how much to produce per week as a linear program. **(10 Marks)**

$$\begin{aligned} \text{Max } Z &= 3x_1 + 2x_2 \\ \text{Subjected to } 2x_1 + 2x_2 &\leq 5 \\ 2x_1 + x_2 &\leq 4 \\ x_1 + 2x_2 &\leq 4 \\ x_1 \geq 0, \quad x_2 &\geq 0 \end{aligned}$$

(b) Given the following model Use the graphical method

find the optimal solution to the model. For which objective function coefficient value ranges of x_1 and x_2 does the solution remain optimal? Hence find the dual of the model. **(10 Marks)**

QUESTION THREE (20 MARKS)

(a) A certain project is composed of Mini activities whose time estimates are given below

Activity	1-2	1-3	1-4	2-5	3-5	4-6	5-6	6-7	5-7
Duration	1	3	2	1	3	2	4	6	3

Draw the project network and find out the critical path. **(8 Marks)**

(b).A research and development is developing a new power supply for a console Television set.

It has broken the project into the following jobs with their duration time in days.

Job	Preceding Activity	Duration in Months
A	—	5
B	A	7
C	B	2
D	B	3
E	C	1
F	D	2
G	C	1
H	E,F	3
I	G,H	10

Required.

i) Draw a critical path scheduling diagram, identifying jobs letters and associated tiem with each indicate the critical path..

ii) What is the minimum time for the completion of the project **(12 Marks)**

QUESTION FOUR (20 MARKS)

- a) The arrivals at a bank counter are considered to be Poisson distribution, with an average time of 12 minutes between two successive arrivals. The time required to serve is distributed exponentially with a mean of 5 minutes. The probability that an arrival does not have to wait for service are 0.25, 0.75, 0.9, 0.5.
- Determine the probability that an arrival does not have to wait for the service. **(5 Marks)**
 - Determine the probability of system being idle hence compare the two. **(5 Marks)**
- b) If EOQ=1000 units, ordering costs are Rs 200 per order and sales total 5000 units, what is the carrying cost per units? **(6 Marks)**
- c) Name **four** various types of stocks. **(4 Marks)**

QUESTION FIVE (20 MARKS)

- a) A department head has four subordinates and four tasks have to be performed. Subordinates differ in efficiency and tasks differ in their intrinsic difficulty. Time each man would take to perform each task is given in the effectiveness matrix. How the task should be allocated to each person so as to minimize the total man hours?.

	I	II	III	IV	
A	8	26	17	11	
B	13	28	4	26	
C	38	19	18	15	
D	19	26	24	1	(10 Marks)

- b) Use Vogel`s approximation method, to find the initial basic feasible solution for the following transportation problem.

	A	B		C	Availability
a	2	7		4	5
b	3	3		1	8
c	5	4		7	7
d	1	6		2	14
Requirement	79	9		18	

(10 Marks)