M.Sc. 3rd Semester Examination, 2023

APPLIED MATHEMATICS OCEANOLOGY AND COMPUTER PROGRAMMING

PAPER – MTM-306(A)(New)

Special Paper (Operations Research)

[Operational Research Modelling-I]

Full Marks : 50

Time : 2 hours

The figures in the right hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

Calculator may be used

PAPER—MTM-306 A

1. Answer any *four* questions : 2×4

   (*a*) What are the critical paths and critical activities in network analysis ?

(*b*) What are the differences between analogue and computer simulations ?

(*c*) Explain the six parameters a, b, c, d, e, f in the queue system $(a/b/c) : (d/e/f)$.

(*d*) Write the procedure to obtain EOQ of two price breaks inventory problem.

(*e*) Define the terms : 'Individual Replacement Policy' and 'Group Replacement Policy'.

(*f*) What is supply chain management ?

2. Answer any *four* questions : 4×4

(*a*) What is simulation ? Describe its advantages in solving the problems.

(*b*) Explain the Monte Carlo simulation to find the value of π.

(*c*) Explain the terms with example :

(*i*) Single phase and channel queue model.

(*ii*) Multiple phases and multiple channels queue model.

(*d*) For an equipment, the maintenance is a function increasing with time and scap value is constant. Ignoring time value of money and considering interest rate as zero, find at what time it is advisable to replace the equipment.

(*e*) A baking company sells cake by its weight in kg, It makes a profit of Rs. 4.00 on every kg sold on the day it is baked. It disposes of all cakes not sold on the date they are baked, at a loss of Rs. 1.00 per kg. If the demand is known to be rectangular distribution between 2000 and 4000 kgs, determine the optimal daily amount baked.

(*f*) Write short notes on the following terms : Replenishment, Planning horizon, Shortages cost, Lead time and Back-logged.

3. Answer any *two* questions from the following : 8×2

(*a*) Find the probability on n customers in the queue at any instant and the expected queue length for the queuing model $(M/M/C) : (\infty/FCFS/\infty)$.

(*b*) A project consists of eight activities with the following relevant information :

Activity	Time estimates (days)			Predecessor
	t_0	t_m	t_p	
A	1	1	7	None
B	2	4	7	None
C	2	2	8	None
D	1	1	1	A
E	2	5	14	B
F	2	5	8	C
G	3	6	15	D, E
H	1	2	3	F, G

(*i*) Draw the project network.

(*ii*) Find the expected duration and variance of each activity.

(*iii*) Calculate the earliest and latest occurrence time for each event and the expected project length.

(*iv*) Calculate the variance and standard deviation of project length.

(*v*) What is the probability that the project will be completed at least 4 weeks earlier than expected ?

(*c*) A company produces three items has limited storage space of averagely 750 items of all types. Determine the optimal production quantities for each item separately, when the following information is given :

Item	I	II	III
Set-up cost(Rs.)	50	40	60
Holding cost (Rs.)	0.5	0.6	0.4
Demand rate (units)	100	120	80

(*d*) At time zero, all the items in a system are new. Each item has a probability p of failing immediately before the end of the 1st month of life and probability q,$(= 1-p)$ of failing immediately before the end of 2nd month. If all items are replace as they fail, show that the expected number of failures $f(x)$ at the end of x month is given by

$$f(x) = \frac{N}{1+q}[1-(-q)^{x+1}],$$

where N be the number of items in the system.

If the cost per item of individual replacement policy is C_1 and the cost per item of group replacement policy is C_2. Find the conditions under which

(*i*) A group replacement policy at the end of 1st month is most profitable.

(*ii*) A group replacement policy at the end of 2nd month is most profitable.

(*iii*) Above group replacement policies (*i*) and (*ii*) are not better than individual replacement policy.

[Internal Assessment — 10 Marks]
