QP CODE: 23104233

23104233

Reg No : .....

Name : .....

B.Sc DEGREE (CBCS) REGULAR / IMPROVEMENT / REAPPEARANCE EXAMINATIONS, JANUARY 2023

Third Semester

B.Sc Mathematics Model II Computer Science

COMPLEMENTARY COURSE - MM3CMT02 - MATHEMATICS - OPERATIONS RESEARCH - QUEUEING THEORY

2017 Admission Onwards

879464B7

Time: 3 Hours

Max. Marks : 80

Part A

*Answer any **ten** questions.*

*Each question carries **2** marks.*

1. Define the term Zero-Sum Game.
2. Define the term Pure Strategy
3. Define Payoff Function $E(X, Y)$
4. Examine the payoff matrices for saddle points. In case the saddle point exists, find the optimal strategies and value of the game. $\begin{bmatrix} 2 & -1 & -2 \\ 1 & 0 & 1 \\ -2 & -1 & 2 \end{bmatrix}$
5. Explain Dummy Activity.
6. Define Independent Float.
7. Define Critical Path and its length.
8. How can you identify a critical path in a network diagram?
9. Explain The Structure of a Queuing System
10. Define queue length.
11. Write the formula for expected number of customers in the system.
12. Write the formula for Expected length of non-empty queue.

(10×2=20)

Part B

*Answer any **six** questions.*

*Each question carries **5** marks.*

13. Explain Problem of Game Theory with an example.

14. Solve the payoff matrices $\begin{bmatrix} 1 & 5 \\ 7 & 2 \end{bmatrix}$

15. Listed in the table are the activities and sequencing requirement necessary for light system maintenance project at a particular stadium.
Draw the network diagram of activities associated with the project.

Activity	Description	Predecessor Activity
A	Assemble crew	-
B	Test lights for burned bulbs	-
C	Obtain needed bulbs	B
D	Paint light standards below banks	A
E	Replace burned bulbs	C
F	Deactivate system	B
G	Check all wiring for wear	A,F
H	Obtain needed wire	G
I	Clean lenses on lights	A,F
J	Remove worn wire	G
K	Cut new wire wire to needed lengths	J,H
L	Check insulators that support wires	J
M	Replace worn insulators	L
N	Replace old wire	M,K
O	Splice new wire with old	N
P	Insulate splices	O
Q	Paint light banks	P
R	Replace broken lenses	E
S	Reactivate system	Q,D,I,R
T	Clean up	R

16. An insurance company has decided to modernize and refit one of its branch offices.Some of the existing office equipments will be returned to branch of completion of the renovation work.Tenders are invited from a number of selected contractors.
The contractors will be responsible for all the activities in connection with the renovation work expecting the prior removal of the old equipment and its subsequent replacement.
The major elements of the project have been identified as follows along with their durations and immediately preceding elements.

Activity	Description	Duration(Weeks)	Predecessors
A	Design new premises	14	-
B	Obtain tenders from the contractors	4	A
C	Select the contractor	2	B
D	Arrange details with selected contractor	1	C
E	Decide which equipment is to be used	2	A
F	Arrange storage of equipment	3	E
G	Arrange disposal of other equipment	2	E
H	Order new equipment	4	E
I	Take delivery of new equipment	3	H,L
J	Renovations take place	12	K
K	Remove old equipment for storage or disposal	4	D,F,G
L	Cleaning after the contractor has finished	2	J
M	Return old equipment for storage	2	H,L

1. Draw the network diagram showing the interrelationship between the various activities of the project.
2. Calculate the minimum time that the renovation can be take from the design stage
3. Find the effect of the overall duration of the project if the estimates or tenders can be obtained in two weeks
from the contractors by reducing their numbers.
4. Calculate the independent float that is associated with the non-critical activities in the network.

17. Explain Backward Pass Method

18. An architect has been awarded a contract to prepare a plans for an urban renewal project.The job consists of the following activities and estimated times.

Activity	Description	Duration(Weeks)	Predecessors
A	Prepare preliminary sketches	2	-
B	Outline specifications	1	-
C	Prepare drawings	3	A
D	Write specifications	2	A,B
E	Run off prints	1	C,D
F	Have specifications	3	B,D
G	Assemble bid packages	1	E,F

1. Draw the network diagram of activities for the project
2. Indicate the critical path,calculate the total float and free float for each activity.

19. Explain Queuing process
20. In a railway marshaling yard, goods trains arrive at a rate of 30 trains per day. Assuming that the inter arrival time follows an exponential distribution and the service time (the time taken to hump a train) distribution is also exponential with an average of 36 minutes. Calculate
    (a) expected queue size (line length)
    (b) probability that the queue size exceeds 10.
    If the input of trains increases to an average of 33 per day, what will be the change in (a) and (b)
21. At what average rate must a clerk at a super market work in order to ensure a probability of 0.90 so that the customer will not wait longer that 12 minutes? It is assumed that there is only one counter at which customers arrive in a Poisson fashion at at average rate of 15 per hour.The length of service by the clerk has an exponential distribution.

(6×5=30)

Part C

*Answer any **two** questions.*

*Each question carries **15** marks.*

22. Write both the primal and the dual LP problems corresponding to the rectangular games with the following payoff matrices.

    Solve the game by the LP problem by simplex method $\begin{bmatrix} 2 & -1 & 4 \\ 3 & 6 & -5 \\ 2 & 5 & -2 \end{bmatrix}$

23. A nationalist wishes to plan and schedule the development and installation of a new computerized cheque processing system.The change over in cheque-processing producers requires employment of additional personnel to operate the new system,development of new systems,and modification of existing cheque sorting equipment.The activities required to complete the project along with three time estimates and the precedence relationship among the activities have been determined by bank management and are given in the following table.

Activity	Activity Description	Immediate Predecessors	Activity time in days		
			Optimistic	Most likely	Pessimistic
A	Position recruiting	-	5	8	17
B	System development	-	3	12	15
C	System training	A	4	7	10
D	Equipment training	A	5	8	23
E	Manual system test	B,C	1	1	1
F	Preliminary system changeover	B,C	1	4	13
G	Computer-personnel interface	D,E	3	6	9
H	Equipment modification	D,E	1	2.5	7
I	Equipment testing	H	1	1	1
J	System debugging and installation	F,G	2	2	2
K	Equipment changeover	G,I	5	8	11

1.Draw a network diagram for this project and find critical path and its length.

2. Calculate the total and free floats for non-critical activities.

3.What is the probability that the length of the critical path does not exceed 40 days?

24. A company manufacturing plant and chemical processing is in the process of quoting a tender called by a public sector undertaking.Delivery data once promised is crucial and penalty clause is applicable.Project manager has listed down the activities in the project as under:

Activity	Predecessor activity	Activity time(weeks)		
		Optimistic	Most likely	Pessimistic
A	-	1	3	5
B	-	2	4	6
C	A	3	5	7
D	A	5	6	7
E	E	5	7	9
F	D	6	8	10
G	B	7	9	11
H	E,F,G	2	3	4

1.Find out the delivery week from the date of commencement of the project.

2. Find total and free float for each of the non-critical activities.

25. Customers arrive at a box office window, being manned by a single individual according to a Poisson input process with a mean rate of 30 per hour. The time required to serve a customer has an exponential distribution with a mean of 90 seconds. Find the average waiting time of a customer. Also determine the average number of customers in the system and average queue length.

(2×15=30)