G.S.MANDAL'S

MARATHWADA INSTITUTE OF TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

ACADEMIC YEAR 2017-18 PART-II

SUBJECT: PROJECT MANAGEMENT AND OPERATIONS RESEARCH

QUESTION BANK

INTRODUCTION TO OPERATIONS RESEARCH

Q.1] Discuss the objective of Operations Research in brief.

Q.2] Enlist the various definitions of Operations research in brief.

Q.3] "Operations Research is a bunch of mathematical techniques to break industrial problems".Critically comment.

Q.4] What are the various characteristics of Operations research? Explain in detail.

Q.5] Explain the Methodology of Operations research in detail.

Q.6] Explain the applications of Operations research in:

I) Industry II) Defence III) Agriculture IV) Planning & V) Public Utilities

Q.7] Explain the scopes of Operations research in detail.

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TRANSPORTATION MODEL

Q.1] Which are the steps involved in the solution of transportation problem? Explain it properly?

Q.2] Enlist the methods used for finding the IBFS in transportation problems. Find out IBFS

Q.3] What is degeneracy in transportation problems? Explain.

Q.4] The following table represents a transportation problem involving sources and destinations. The cell entries represent cost. Find the optimum scheduling of transportation. [May/June-2010]

Destinations

	1	2	3	4	Supply
1	3	1	7	4	300
2	2	6	5	9	400
3	8	3	3	2	500
Demand	250	350	400	200	

Sources

Q.5] The following table shows unit transportation cost, if goods are transported from a particular factory to a particular market area. Find the transportation schedule to minimize the transportation cost. [November/December 2009]

Market

Factory	M1	M2	M3	M4	Capacities
F1	15	20	21	18	100
F2	10	18	16	19	150
F3	13	14	12	23	200
Requirements	75	180	70	125	

Q.6] Solve the following transportation problem. [May/June-2009]

Destinations

Origins	A	B	C	D	E	Supply
X	4	5	8	9	3	400
Y	6	8	3	7	5	600
Z	1	3	3	5	7	300
Demand	200	200	200	300	400	

Q.7] The following table shows unit profit. If particular area is supplied by particular factory. Find the maximum transportation pattern: [November/December 2008]

To

From	A1	A2	A3	A4	A5	Capacity
F1	20	15	17	21	18	150
F2	11	14	13	15	10	120
F3	19	16	24	12	11	130
Requirement	100	90	110	70	40	

Q.8]Solve the following transportation problem.

	D1	D2	D3	D4	D4	Available
1	68	35	4	74	15	18
2	57	88	91	3	8	17
3	91	60	75	45	60	19
4	52	53	24	7	82	13
5	51	18	82	13	7	15
Requirement	16	18	20	14	14	

Q.9] Solve the following transportation problem using Vogel's approximation method in order to minimize the total transportation cost:

Destination

Origin / Demand	D1	D2	D3	D4	D5	Availability
	3	5	8	9	11	20
	5	4	10	7	10	40
	2	3	8	7	7	30
	10	15	25	30	40	

Q.10] Solve the following transportation problem. (Nov/Dec-2011)

	1	2	3	4	Supply
A	10	0	20	11	15
B	12	7	9	20	25
C	0	14	16	18	5
Demand	5	15	15	10	

Q.11] A company has three plants X, Y, Z and four ware houses situated at locations 1, 2, 3 and 4. The following table shows the cost of transportation from each plant to each ware houses:

Warehouses [April/May-2011]

Plants	1	2	3	4
X	40	44	48	35
Y	37	45	50	52
Z	35	40	45	50

The present allocations are as follows:

X to 1= 80, X to 2= 80, Y to 3=10, Y to 4=30 & z to 4= 190. Check whether the present allocations are optimum or not? If not find the optimum allocations and the cost of transportations.

Q.12] The following table gives the cost of transporting material from supply point A, B, C, D to demand point E, F, G, H and J. [November/December-2010]

To → / From ↓	E	F	G	H	J
A	8	10	12	17	15
B	15	13	18	11	9
C	14	20	6	10	13
D	13	19	7	6	12

The present allocations are as follows:

A to E= 90, A to F= 10, B to F= 150, C to F= 10, C to G= 50, C to J=120, D to H= 210, D to J= 70. Check whether these allocations are optimum or not? If not find the optimum solution.

Q.13] Solve the following transportation problem using Vogel's approximation method. Note that the transportation from X to E, Y to B & Z to D is not possible.

	A	B	C	D	E	Capacity
X	36	16	2	32	_	300
Y	20	_	12	22	8	250
Z	8	6	16	_	14	500
Requirement	150	400	200	100	150	

Q.14] The Dream-Drink Company has to work out a minimum cost transportation scheduleto distribute crates of drinks from three of its factories *X*, *Y*, and *Z* to its three warehouses *A*,*B*, and *C*. The required particulars are given below. Find the least cost transportation schedule. Transportation cost in Rs per crate.

From / To	*A*	*B*	*C*	*Crates Available.*
X	75	50	50	1040
Y	50	25	75	975
Z	25	125	25	715
Crates required.	1300	910	520	2730

Q.15]The demand pattern for a product at for consumer centers, *A*, *B*, *C* and *D* are 5000 units,7000 units, 4000 units and 2000 units respectively. The supply for these centers is from three factories *X*, *Y* and *Z*. The capacities for the factories are 3000 units, 6000 units and 9000 units respectively. The unit transportation cost in rupees from a factory to consumer center is given below. Develop an optimal transportation schedule and find the optimal cost.

From:	To			
	A	B	C	D
X	8	9	12	8
Y	3	4	3	2
Z	5	3	7	4

Q.16] From three warehouses, *A*, *B*, and *C* orders for certain commodities are to be supplied to demand points *X*, *Y*, and *Z*. Find the least cost transportation schedule with relevant information given below:

From Warehouses	To demand points (Transportation cost in Rs. per units).			Availability in units.
	X	Y	Z	
A	5	10	2	100
B	3	7	5	25
C	6	8	4	75
Units demand	105	30	90	

Q.17] From three warehouses *A*, *B*, and *C* orders for certain commodities are to be supplied todemand points 1, 2, 3, 4 and 5 monthly. The relevant information is given below:

Warehouses	Demand points (Transportation cost in Rs per unit.					Availability in units.
	1	2	3	4	5	
A	4	1	2	6	9	100
B	6	4	3	5	7	120
C	5	2	6	4	8	120
Units demand:	40	50	70	90	90	

Q.18]Solve the following transportation problem.

Destination

Source	A	B	C	D	E	Supply
W	20	19	14	21	16	40
X	15	20	13	19	16	60
Y	18	15	18	20		70
Z	0	0	0	0	0	50
Demand.	30	40	50	40	60	

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QUESTION BANK

ASSIGNMENT MODEL

Q.1Explain in detail the steps involved in the solution of assignment model by Hungerian method.

Q.2] Solve the assignment problem given below: [May/June-2010]

Machines

	I	II	III	IV	V	VI
1	5	3	4	7	1	6
2	2	3	7	6	5	4
3	4	1	5	2	4	3
4	6	8	1	2	3	7
5	4	2	5	7	1	6
6	3	5	6	4	6	5

Jobs

Q.3] Solve the assignment problem given below:[November/December-2009,May/June-09]

Machines

	I	II	III	IV	V
1	11	17	8	16	20
2	9	7	12	6	15
3	13	16	15	12	16

4	21	24	17	28	26
5	14	10	12	11	15

Jobs

Q.4] A

	1	**2**	**3**	**4**	**5**
1	10	11	4	2	8
2	7	11	10	14	12
3	5	6	9	12	14
4	13	15	11	10	7

batch of 4 jobs can be assigned to five different machines. The set up time for each machine is given below. Find the optimum assignment of jobs which will minimize the total setup time. [November/December-2008]

Machines

Jobs

Q.5] Solve the assignment problem for maximization. [November/December-2011]

Jobs

Workers

	J1	**J2**	**J3**	**J4**	**J5**
W1	14	27	8	24	24
W2	8	27	10	21	32
W3	16	15	4	27	32
W4	12	15	16	30	40
W5	14	24	20	27	36

	A	B	C	D	E
1	30	37	40	28	40
2	40	24	27	21	36
3	40	32	33	30	35
4	25	38	40	36	36
5	29	62	41	34	39

Q.6] Five different machines can do any of the required five jobs with different profit resulting from each assignment given below.

Machines

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Jobs

Find out the optimal profit possible through optimal assignment

Q.7] Solve the following assignment problem.

12	10	15	22	18	8
10	18	25	15	16	12
11	10	3	8	5	9
6	14	10	13	13	12
8	12	11	7	13	10

Q.8] Solve the following assignment problem.

20	16	_	17	14	23
15	_	17	_	23	16
14	16	18	19	11	20
18	20	14	16	15	_
_	17	15	20	17	16

Q.9] Explain the steps required for solving travelling salesmen's problem in brief.

Q.10] A salesman stationed at city A has to decide his tour plan to visit cities B, C, D, E and back to city A. The order of his choice so that total distance traveled is minimum. No sub touring is permitted. He cannot travel from city A to city Aitself. The distance between cities in Kilometers is given below:

Cities	*A*	*B*	*C*	*D*	*E*
A	M	16	18	13	20
B	21	M	16	27	14
C	12	14	M	15	21
D	11	18	19	M	21
E	16	14	17	12	M

Q.11] Solve the traveling salesman problem given below for minimizing the total distance traveled.Distance in Km.

Cities	*A*	*B*	*C*	*D*	*E*
A	M	10	8	29	12
B	16	14	12	10	9
C	6	3	17	14	12
D	12	19	17	14	12
E	11	8	16	13	M

Q.12] The productivity of operators A, B, C, D, and E on different machines P, Q, R, S, and T are given in the matrix below. Assign machine to operators of maximum productivity.

Operators	P	Q	R	S	T
A	9	14	10	7	12
B	8	11	12	---	13
C	10	10	8	11	---
D	12	14	11	10	7
E	13	10	12	13	10

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SEQUENCING MODEL

Q.1] Explain the steps used for solving the 'n' jobs, '2' machines sequencing problem. List out the conditions used for 'n' job, multiple machines.

Q.2] Write down the assumptions used in sequencing models.

Q.3] Explain the steps used for solving the '2' jobs, 'n' machines by graphical method.

Q.4] 7 jobs are to be processed through 2 machines A & B. The processing time in hrs. are given below. Find the optimum sequencing. (May/June-2010)

JOBS	MACHINE A	MACHINE B
1	10	12
2	9	8
3	7	7
4	15	12
5	18	10

6	20	6
7	14	13

Q.5] There are five jobs, which are to be processed on two machines A and B in the order AB. The processing times in hours for the jobs are given below. Find the optimal sequence and total elapsed time.

Jobs:	1	2	3	4	5
Machine A (Time in hrs.)	2	6	4	8	10
Machine B (Time in Hrs)	3	1	5	9	7

Q.6] A machine operator has to perform two operations, turning and threading, on a number of different jobs. The time required to perform these operations in minutes for each job is given. Determine the order in which the jobs should be processed in order to minimize the total time required to turn out all the jobs.

Jobs:	1	2	3	4	5	6
Time for turning (in min.)	3	12	5	2	9	11
Time for threading (in min).	8	10	9	6	3	1

Q.7] Find the sequence that minimizes the total elapsed time required to complete the following tasks. Each job is processed in the order ABC. Also calculate Idle time for each machine. (Nov/Dec-2009)

JOBS → / MACHINES ↓	1	2	3	4	5	6	7
A	12	6	5	11	5	7	6
B	7	8	9	4	7	8	3

C	3	4	1	5	2	3	4

Q.8] A machine operator has to perform three operations, namely plane turning, step turning and taper turning on a number of different jobs. The time required to perform these operations in minutes for each operating for each job is given in the matrix given below. Find the optimal sequence, which minimizes the time required.

Job.	*Time for plane turning In minutes*	*Time for step turning in minutes*	*Time for taper turning. in minutes.*
1	3	8	13
2	12	6	14
3	5	4	9
4	2	6	12
5	9	3	8
6	11	1	13

Q.9] There are 5 jobs each of which is to be processed on three machines A, B, and C in the order ACB. The time required to process in hours is given in the matrix below. Find the optimal sequence.

Job:	1	2	3	4	5
Machine A:	3	8	7	5	4
Machine B:	7	9	5	6	10
Machine C:	4	5	1	2	3.

Q.10] Table shows time required for different jobs on different machines. Assuming every job goes on machines in the sequence M1-M2-M3-M4. Find the sequence of jobs to minimise the total elapsed time and find the idle time of each machine. (May/June-2012,May/June-2011, Nov/dec-2008))

	J1	J2	J3	J4
M1	15	20	25	38
M2	10	12	14	11
M3	8	7	15	13
M4	18	28	30	25

Q.11] There are 4 jobs A, B, C and D, which is to be, processed on machines M1, M2, M3 and M4 in the order M1 M2 M3 M4 .The processing time in hours is given below. Find the optimal sequence.

Job	*Machine (Processing time in hours)*			
	M_1	M_2	M_3	M_4
	a_{i1}	a_{i2}	a_{i3}	a_{i4}
A	15	5	4	14
B	12	2	10	12
C	13	3	6	15
D	16	0	3	19

Q.12] 4 jobs are to be processed through 4 machines M1,M2,M3&M4. The processing time in hrs.are given below. Find the optimum sequencing.

	M1	M2	M3	M4
A	20	10	9	20
B	17	7	15	17
C	21	8	10	21
D	25	5	9	25

Q.13] In a maintenance shop mechanics has to reassemble the machine parts after yearly maintenance in the order PQRST on four machines A, B, C and D. The time required to assemble in hours is given in the matrix below. Find the optimal sequence.

Machine.	Parts (Time in hours to assemble)				
	P	Q	R	S	T
A	7	5	2	3	9
B	6	6	4	5	10
C	5	4	5	6	8
D	8	3	3	2	6

Q.14] Solve the sequencing problem given below to give an optimal solution, when passing is not allowed.

Machines (Processing time in hours)

Jobs	P	Q	R	S
A	11	4	6	15
B	13	3	7	8
C	9	5	5	13
D	16	2	8	9
E	17	6	4	11

Q.15] Four jobs are to be processed on each of the six machines in the order M1,M2,…..M6. Processing time in hrsare given below. Determine the sequence of these four jobs that minimises the total elapsed time T. (Nov/Dec-2011)

	M1	M2	M3	M4	M5	M6
Job A	18	8	7	2	10	25
Job B	17	6	9	6	8	19
Job C	11	5	8	5	7	15
Job D	20	4	3	4	8	12

Q.16] Table shows time required for different jobs on different machines. Find the sequence of jobs to minimize the total elapsed time & find the idle time of each machine. (May/June-2010)

	A	B	C	D	E

M1	11	13	9	16	17
M2	4	3	5	2	6
M3	6	7	5	8	4
M4	15	18	13	9	11

Q.17] Find the sequence that minimizes the total elapsed time required to complete the following tasks. Each task is processed on any two machines in any order.

TASKS → / MACHINES ↓	1	2	3	4	5	6	7
A	12	6	5	3	5	7	6
B	7	8	9	8	7	8	3
C	3	4	11	5	2	8	4

Q.18] Solve the following sequencing problem graphically. (Nov/Dec-2014)

Job 1	Sequence	A	B	C	D	E
	Time	3	4	2	6	2

Job 2	Sequence	B	C	A	D	E
	Time	5	4	3	2	6

19] Use graphical method to minimize the time needed to process the following jobs on the machines as shown. For each machine find which job is to be loaded first. Calculate the total time required to process the jobs. The time given is in hours. The machining order for job 1 is ABCDE and takes 3, 4, 2, 6, 2 hours respectively on the machines. The order of machining for job 2 is BCADE and takes 5, 4, 3, 2, 6 hours respectively for processing.

Job 1	Sequence:	A	B	C	D	E
	Time in Hrs.	3	4	2	6	2
Job2	Sequence:	B	C	A	D	E
	Time in Hrs.	5	4	3	2	6

Q.20] Two jobs are to be processed on four machines A, B, C and D. The technological order for these two jobs is: Job 1 in the order ABCD and Job 2 in the order DBAC. The time taken for processing the jobs on machine is:

Machine:	*A*	*B*	*C*	*D*
Job 1:	4	6	7	3
Job 2:	5	7	8	4

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INVENTORY MODEL

Q.1] Explain the following terms:

A] Economic order quantity B] Direct inventories C] Inventory carrying costs

Q.2] What is the necessity of maintaining inventory?

Q.3] What is inventory? Explain various types of inventories and inventory models.

Q.4] The demand for an item is 8000 units per annum and the unit cost is Re.1/-. Inventory carrying charges of 20% of average inventory cost and ordering cost is Rs. 12.50 per order. Calculate optimal order quantity, optimal order time, optimal inventory cost and number of orders.

Q.5] A producer has to supply 12,000 units of a product per year to his customer. The demand is fixed and known and backlogs are not allowed. The inventory holding cost is Rs.0.20 per unit per month and the set up cost per run is Rs. 350/- per run.

Determine:

(a) The optimal lot size.

(b) Optimum scheduling period.

(c) Minimum total expected yearly cost.

Q.6] A particular item has a demand of 9,000 units per year. The cost of one procurement is Rs. 100/- and the holding cost per unit is Rs. 2.40 per year. The replacement is instantaneous and no shortages are allowed.

Determine:

(a) Economic lot size.

(b) The number of orders per year.

(c) The time between orders.

(d) The total cost per year if the cost of one units is Re.1/-.

Q.7] A stockiest has to supply 400 units of a product every Monday to his customers. He gets the product at Rs. 50/- per unit from the manufacturer. The cost of ordering and transportation from the manufacturer is Rs. 75 per order. The cost of carrying inventory is 7.5% per year of the cost of the product. Find

(i) Economic lot size

(ii) The total optimal cost (including the capital cost).

Q.8] ABC manufacturing company purchase 9,000 parts of a machine for its annual requirement, ordering one month's usage at a time. Each part costs Rs. 20/-. The ordering cost per order is Rs. 15/ - and the inventory carrying charges are 15% of the average inventory per year. You have been asked to suggest a more economical purchasing policy for the company. What advice would you offer and how much would it save the company per year.

Q.9] The demand for an item is 8000 units per annum and the unit cost is Re.1/-. Inventory carrying charges of 20% of average inventory cost and ordering cost is Rs. 12.50 per order. Calculate optimal order quantity, optimal order time, optimal inventory cost and number of orders.

Q.10] A shopkeeper has a uniform demand of an item at the rate of 50 units per month. He buys from supplier at the cost of Rs. 6/- per item and the cost of ordering is Rs. 10/- each time. If the stock holding costs are 20% per year of stock value, how frequently should he replenish his stocks? What is the optimal cost of inventory and what is the total cost?

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GAME THEORY

Q.1] Explain the steps involved in the solution of game model

A] With Saddle point. B] Without Saddle point.

Q.2] Write down the steps involved in the solution of game model by Dominance property.

Q.3] Explain the Graphical method for m×2 and 2×n games.

Q.4] Explain the following terms with reference to game theory:

A. Game
B. Strategy
C. Pure Strategy
D. Mixed Strategy
E. Pay-off Matrix
F. Two person zero sum game
G. Max min principle
H. Min max principle
I. Saddle point
J. Game value
K. Dominance property

Q.5Solve the game given below:

		Player B		
		I	II	III
Player A	I	1	9	2
	II	8	5	4

Q.6] Solve the game whose pay of matrix is:

		B		
		I	II	III
A	I	–3	–2	6
	II	2	⓪	4
	III	5	–2	–4

Q.7]In a certain game player has three possible courses of action L, M and N, while B has twopossible choices P and Q. Payments to be made according to the choice made.

Choices	*Payments.*
L,P	A pays B Rs.3
L,Q	B pays A Rs. 3
M,P	A pays B Rs.2
M,Q	B pays A Rs.4
N,P	B pays A Rs.2
N,Q	B pays A Rs.3

What are the best strategies for players A and B in this game? What is the value of the game.

Q.8] Find the solution of the game whose payoff matrix is given below:

		B				
		I	II	III	IV	V
A	I	–4	–2	–2	3	1
	II	1	0	–1	0	0
	III	–6	–5	–2	–4	4
	IV	3	1	–6	0	–8

Q.9] Table gives the pay-off matrix (for A): (Nov/dec-2011)

	B		
A	3	4	8
	1	2	-2
	6	5	2

Determine the optimum mixed strategies for each of the player A and B. There is no saddle pt. Use domination theory.

Q.10] Solve the following 3×5 game using dominance property: (April/May-2011)

	Player B				
	1	**2**	**3**	**4**	**5**
1	2	5	10	7	2
Player A 2	3	3	6	6	4
3	4	4	8	12	1

Q.11] Solve the following 4×4 game using dominance property: (Nov/Dec-2010,May/June-09)

Player B

Player A	**1**	**2**	**3**	**4**
1	3	2	4	0
2	3	4	2	4
3	4	2	4	1
4	3	4	3	4

Q.12] Solve the following game by converting it to 2×2 matrix by dominance rule: (April/May-11)

	Player B				
Player A	3	6	1	-4	2
	4	2	2	-3	3
	5	-1	-1	0	-1

Q.13] Use the concept of dominance to solve the game:

		B			
		I	II	III	IV
A	I	3	2	4	0
	II	3	4	2	4
	III	4	2	4	0
	IV	0	4	0	8

Q.12] Solve the game whose payoff matrix is:

		B				
		1	2	3	4	5
A	1	1	3	2	7	4
	2	3	4	1	5	6
	3	6	5	7	6	5
	4	2	0	6	3	1

Q.13] A and B play a game in which each has three coins, a 5 paise, 10paise and 20 paise coins. Each player selects a coin without the knowledge of the other's choice. If the sum of the coins is an odd amount, A wins B's coins. If the sum is even, B wins A's coins. Find the optimal strategies for the players and the value of the game.

Q.14] Solve the game whose payoff matrix is:

		B		
		I	II	III
A	I	–4	3	–1
	II	6	–4	–2

Q.15] Solve the following 2 × n sub game:

		B	
		I	II
A	I	1	8
	II	3	5
	III	11	2

Q.16] Solve the game whose payoff matrix is given below by method of sub games.

		B		
		I	II	III
A	I	–5	5	0
	II	8	–4	–1

Q.17] Solve the following game graphically: (May/June-2010)

	Player B	
Player A	1	2
	5	4
	-7	9
	-4	-3
	2	1

Q.18] Solve the following 2×3 game graphically: (Nov/Dec-2009)

	Player B		
Player A	1	3	11
	8	5	2

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MARATHWADA INSTITUTE OF TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

ACADEMIC YEAR 2017-18PART-II

SUBJECT: PROJECT MANAGEMENT AND OPERATIONS RESEARCH

QUESTION BANK

QUEUING MODEL

Q.1] Explain the following terms in brief:

A] Traffic Intensity B] Balking

C] Reneging D] Jockeying

Q.2] Explain the following queue parameters in brief.

A] Customer B] Queue (Waiting line)

C] Service channel (Facility) D] Service Station (Centre)

Q.3] Explain the following queuing system elements in brief:

A] Arrival Pattern B] Service Pattern

C] Service Discipline

Q.4] Write a short note on Kendall's notation.

Q.5] Arrival rate of telephone calls at a telephone booth is according to Poisson distribution, with an average time of 9 minutes between consecutive arrivals. The length of telephone call is exponentially distributed with a man of 3 minutes.

a) Determine the probability that a person arriving at the booth will have to wait.
b) Find the average queue length that forms from time to time.
c) The telephone company will install a second booth when conveniences that an arrival would expect to wait at least four minutes for the phone. Find the increase in flow of arrivals, which will justify a second booth.
d) What is the probability that an arrival will have to wait for more than 10 minutes before thephone is free?

Q.6] A branch of a Nationalized bank has only one typist. Since typing work varies in length (number of pages to be typed), the typing rate is randomly distributed approximating a Poisson distribution with a mean service rate of 8 letters per hour. The letter arrives at a rate of 5 per hour during the entire 8- hour workday. If the typist is valued at Rs. 4 per hour, determine: (May/June-2012)

a) Equipment utilization.
b) Time for which typist remain idle.
c) Cost of idle time.
d) Average time a letter has to wait for typing.

e) Average no. letters kept pending.

Q.7] A branch of a Nationalized bank has only one typist. Since typing work varies in length (number of pages to be typed), the typing rate is randomly distributed approximating a Poisson distribution with a mean service rate of 8 letters per hour. The letter arrives at a rate of 5 per hour during the entire 8- hour workday. If the typist is valued at Rs. 1.50 per hour, determine: (Nov/Dec-2011)

a) Equipment utilization.
b) The percent time an arriving letter has to wait.
c) Average system time.
d) Average idle time cost of the typewriter per day.

Q.8] The arrival rate of a customer at a service window of a cinema hall follows a poisons distribution with a mean rate of 45 per hour. The service rate of the clerk also follows Poisson distribution with a mean of 60 per hour. Find: (Nov/Dec-2010)

a) The probability of having no customers in the queue?
b) The probability of having five customers in the queue?
c) Ls, Lq, Ws and Wq

Q.9] A T.V. Repairman finds that the time spent on his jobs have an exponential distribution with mean of 30 minutes. If he repairs sets in the order in which they come in, and if the arrival of sets is approximately Poisson with an average rate of 10 per 8 hour day, what is repairman's expected idle time each day? How many jobs are ahead of the average set just brought in?

Q.10] In a departmental store one cashier is there to serve the customers. And the customers pick up their needs by themselves. The arrival rate is 9 customers for every 5 minutes and the cashier can serve 10 customers in 5 minutes. Assuming Poisson arrival rate and exponential distribution for service rate, find:

a) Average number of customers in the system.
b) Average number of customers in the queue or average queue length.
c) Average time a customer spends in the system.
d) Average time a customer waits before being served.

Q.11] A barbershop has space to accommodate only 10 customers. He can serve only one person at a time. If a customer comes to his shop and finds it is full he goes to the next shop. Customers randomly arrive at an average rate $\lambda = 10$ per hour and the barber service time is negative exponential with an average of $1/\mu = 5$ minute. Find p_0 and p_n.

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QUESTION BANK

NETWORK THEORY (CRITICAL PATH METHOD)

Q.1]Write down the steps involved in the solution of network problem by using CPM?

Q.2] Explain the Fulkerson's rule used for numbering the events?

Q.3]A project schedule has the following characteristics:

Activity	Preceding Activity	Duration
A	-	4
B	-	8
C	A	2
D	A	4
E	A	9
F	D	1
G	C	7
H	D	3
I	E,F	2
J	B,I	2
K	G,H	5
L	J,K	4

Draw the network, find the critical path, find ET & LT for starting & finishing. Also find the total float, free float & independent float.

Q.4] A project schedule has the following characteristics:

Activity	Preceding Activity	Duration(Hrs.)
A	-	2
B	-	5
C	A,B	7
D	A,B	12

E	C	5
F	D	5
G	E,F	10

Draw the network, find the critical path, find ET & LT for starting & finishing. Also find the total float, free float & independent float.

Q.5] A project schedule has the following characteristics:

Activity	Preceding Activity	Duration
A	-	5
B	A	2
C	A	6
D	B	12
E	D	10
F	D	9
G	D	5
H	B	9
I	C,E	1
J	G	2
K	F, I, J	3
L	K	9
M	H, J	7
N	M	8

Draw the network, find the critical path, find ET & LT for starting & finishing. Also find the total float, free float & independent float.

Q.6] A project schedule has the following characteristics:

Activity	Preceding Activity	Duration (Hrs.)
A	-	3
B	-	5
C	-	8

D	A	12
E	A	5
F	B,D,C	7
G	E	9
H	E,F	12
I	H,G	10

Draw the network, find the critical path, find ET & LT for starting & finishing. Also find the total float, free float & independent float.

Q.7] A project has the following activities:

Activity	Preceding Activity	Duration (Hrs.)
A	-	9
B	-	20
C	-	10
D	A	11
E	C	10
F	B,C	4
G	F	2
H	E,F	5
I	E,F,K	18
J	G,H	14
K	C	24
L	K	6
M	L,I,J	8

Construct the network, find critical path, ET and LT for each activity. Also find out total, free and independent float.

Q.8] The task A, B, C… H, I constitute a project. The precedence relationships are A < D, A < E, B < F, D < F, C < G, C < H, F < I, G < I.

Draw the network to represent the project and find the minimum time for completion of the project when time in days of each task is given as follows:

Task	A	B	C	D	E	F	G	H	I

Time	8	10	8	10	16	17	18	14	9

Q.9] A project has the following activities:

Activity	Time in Weeks
1-2	4
1-3	1
2-4	1
3-4	1
3-5	6
4-9	5
5-6	4
5-7	8
6-8	1
7-8	2
8-10	5
9-10	7

Construct the network, find critical path, ET and LT for each activity. Also find out total, free and independent float.

Q.10] The utility data for a network are given below. Determine the total, free and independent floats and identify the critical path.

Activity	Time in Weeks
0-1	2
1-2	8
1-3	10
2-4	6
2-5	3

3-4	3
3-6	7
4-7	5
5-7	2
6-7	8

Q.11]A company manufacturing plant and equipment for chemical processing is in the process of Quoting tender called by public sector undertaking. Help the manager to find the project completion time to participate in the tender.

S.No.	Activities		Days
1	A	-	3
2	B	-	4
3	C	A	5
4	D	A	6
5	E	C	7
6	F	D	8
7	G	B	9
8	H	E,F,G	3

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ACADEMIC YEAR 2017-18PART-II

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QUESTION BANK

NETWORK THEORY (PROGRAM EVALUATION AND REVIEW TECHNIQUE)

Q.1] Write down the steps involved in the solution of network problem by using PERT?

Q.2] What is Optimistic time, Pessimistic time and Most likely time? Explain.

Q.3] Following table shows activities observed in a project with three time estimates.

1. Draw the network and find the critical path.

2. What is the probability of work completion in 51 days?

3. What duration will assure 99.9% probability of work completion?

Activity	t_o	t_m	t_p
1-2	8	10	12
2-3	0	0	0
1-3	4	5	12
2-5	4	6	8
3-4	10	12	14
4-5	2	4	6
4-7	13	14	15
5-6	4	4	4
5-7	6	7	11
6-7	3	4	5
7-8	16	16	16

The standard values of variance corresponding to its probability are as below:

Z	-0.9	-1.0	-1.1	3
P %	13.41	15.87	13.57	99.9

Q.4] The following table gives the activities involved in a construction project and other related information.

Activity	t_o	t_m	t_p
1-2	6	9	18
1-3	5	6	17
2-4	4	7	22

3-4	4	7	16
4-5	4	10	22
2-5	4	7	10
3-5	2	5	8

Determine:

1. The Expected time and variance for each activity.
2. The probability of completing the project in 32 days?
3. The expected project duration.

Z	0.40	0.41	0.42	0.43	0.44
P %	0.6554	0.6591	0.6628	0.6644	0.6700

Q.5] Table shows the activities observed in a project with their three time estimates. Find the work completion probability for 38 weeks. What will be the changes in answer, if the duration of the activity is changed to 2-3-4?

Activity	t_o	t_m	t_p
1-2	2	3	17
1-3	7	10	13
2-5	2	6	7
3-4	0	0	0
3-5	6	8	10
4-6	12	15	18
5-7	4	6	8
6-7	3	4	5
6-8	17	20	23
7-8	15	19	20

Q.6] Table given represents activity relations and three time estimates for the activities of a small project.Determine:

1. The Expected time and variance for each activity.
2. Standard deviation for the network.
3. The probability of completing the project within 30 days?

Activity	Predecessor Activity	t_o	t_m	t_p

A	-	4	8	12
B	-	1	4	7
C	-	8	12	16
D	A	3	5	7
E	A	3	6	9
F	B	3	6	9
G	C	6	8	10
H	G	4	6	8
I	E,F	4	8	12
J	D	2	5	8
K	H,I,J	4	10	16

Q.7] A project consists of 9 activities and the three time estimates are given below. Find the project completion time.

Activities		*Days*		
i	*j*	T_O	T_L	T_P
10	20	5	12	17
10	30	8	10	13
10	40	9	11	12
20	30	5	8	9
20	50	9	11	13
40	60	14	18	22
30	70	21	25	30
60	70	8	13	17
60	80	14	17	21
70	80	6	9	12

Q.8] A small project is composed of 7 activities whose time estimates are listed below. Activities are being identified by their beginning (i) and ending (j) node numbers.

Activities		Time in weeks		
i	j	t_o	t_l	t_p
1	2	1	1	7
1	3	1	4	7
1	4	2	2	8
2	5	1	1	1
3	5	2	5	14
4	6	2	5	8
5	6	3	6	15

1. Draw the network

2. Calculate the expected variances for each

3. Find the expected project completed time

4. Calculate the probability that the project will be completed at least 3 weeks than expected

5. If the project due date is 18 weeks, what is the probability of not meeting the due date?

Q.9] There are seven activities in a project and the time estimates are as follows:

Activities	Time in weeks		
	t_O	t_L	t_P
A	2	6	10
B	4	6	12
C	2	3	4
D	2	4	6
E	3	6	9
F	6	10	14
G	1	3	5

The logical of activities are:

1. Activities A and B start at the beginning of the project. 2. When A is completed C and D start. 3. E can start when B and D are finished. 4. F can start when B, C and D are completed and is the final activity. 5. G can start when F is finished and isthe final activity.

(a) What is the expected time of the duration of the project?

(b) What is the probability that project will be completed in 22 weeks?

DEPARTMENT OF MECHANICAL ENGINEERING

ACADEMIC YEAR 2017-18PART-II

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QUESTION BANK

LINEAR MODELS (FORMULATION AND GRAPHICAL METHOD)

Q.1] A man goes to market to purchase buttons. He needs at least 20 large buttons and at least 30 small buttons. The shopkeeper sells buttons in two forms ie. Boxes and Cards. A box contains 10 large and 5 small buttons and a card contains 2 large and 5 small buttons. Find the most economic way in which he should purchase the button, if the box costs rs. 25 paise and a card 10 paise only. Solve graphically. (May/June-2010)

Q.2] A farmer decides to start a poultry farm with rs.4000 he has. There are two types of hens in the market H1 & H2. The egg lying capacities are 6 and 8 per week respectively. The feed cost for both types is Rs. 0.5 Per day. Each H1 costs Rs. 40 and H2 Rs. 50. Farmer has a shed ready for hens where he can house maximum of 25 hens. Find graphically the no. of hens he should buy to maximize the weekly profit. Assume selling price of an egg is Rs. 1.50.

(April/May-2011)

Q.3] A Firm uses lathe, milling machine and a grinder to make two machine parts. The table below represents the machining time required for each part. The machining time available on different machines and profit on each machine part. Find the no. of part-I and part-II to be manufactured per week in order to maximize the profit. (Nov/Dec-2011)

Type of machine	Machining time required for the machined parts (Min.)		Machining time required per week(Min.)
	I	II	
Lathe	12	6	3000
Milling	4	10	2000
Grinding	2	3	900
Profit per unit	Rs. 40	Rs. 100	

Q.4] A company makes two types of leather belts. Belt A is a high quality belt and belt B is of lower quality. The respective profits areRs. 4 and Rs. 3 per belt. Each belt of type A requires twice as much as time as belt of type B and if all belts were of type B, the company

could make 1000 per day. The supply of leather is sufficient for only 800 belts per day (both A and B combined). Belt A requires a fancy buckle and only 400 per day are available. There are only 700 buckles available per day for belt B. Determine optimal product mix using graphical method. (May/June-2012)

Q.5] A company manufactures two products X and Y, which require the following resources. The resources are the capacities machine M1, M2, and M3. The available capacities are 50, 25, and 15 hours respectively in the planning period. Product X requires 1 hour of machine M2 and 1 hour of machine M3. Product Y requires 2 hours of machine M1, 2 hours of machine M2 and 1 hour of machine M3. The profit contribution of products X and Y are Rs.5/- and Rs.4/- respectively.

Q.6] A retail store stocks two types of shirts A and B. These are packed in attractive cardboard boxes. During a week the store can sell a maximum of 400 shirts of type A and a maximum of 300 shirts of type B. The storage capacity, however, is limited to a maximum of 600 of both types combined. Type A shirt fetches a profit of Rs. 2/- per unit and type B a profit of Rs. 5/- per unit. How many of each type the store should stock per week to maximi

ze the total profit? Formulate a mathematical model of the problem.

Q.7] A patient consult a doctor to check up his ill health. Doctor examines him and advises him that he is having deficiency of two vitamins, vitamin A and vitamin D. Doctor advises him to consume vitamin A and D regularly for a period of time so that he can regain his health. Doctor prescribes tonic X and tonic Y, which are having vitamin A, and D in certain proportion. Also advises the patient to consume at least 40 units of vitamin A and 50 units of vitamin daily. The cost of tonics X and Y and the proportion of vitamin A and D that present in X and Y are given in the table below. Formulate l.p.p. to minimize the cost of tonics.

Vitamins	*Tonics*		*Daily requirement in units.*
	X	*Y*	
A	2	4	40
D	3	2	50
Cost in Rs. per unit.	5	3	

Q.8] Maximize, Z = 5X + 7Y

Subjected to,

$X + Y \leq 4$

$3X + 8Y \leq 24$

$10X + 7Y \leq 35$ and Both X and $Y \geq 0$

Q.9] Minimize, $Z = 3a + 5b$

Subjected to,

$-3a + 4b \leq 12$

$2a - 1b \geq -2$

$2a + 3b \geq 12$

$a \geq 4$, $b \geq 2$ and both a and $b \geq 0$

Q.10] Maximize, $Z = 0.75\ a + 1b$

Subjected to,

$1a + 1b \geq 0$

$-0.5\ a + 1b \leq 1$ and both a and $b \geq 0$

Q.11] Solve graphically the following LPP: (Nov/Dec-2012)

Maximize, $Z = 80X_1 + 120\ X_2$

Subjected to,

$X_1 + X_2 \leq 9$,

$X_1 \geq 2$,

$X_2 \geq 3$,

$20X_1 + 50X_2 \leq 360$ and Both X_1 and $X_2 \geq 0$

Q.12] Solve graphically the following LPP: (Dec-2014)

Minimize, $Z = 600\ X_1 + 400\ X_2$

Subjected to,

$1500\ X_1 + 1500 X_2 \geq 20{,}000,$

$3000\ X_1 + 1000 X_2 \geq 40{,}000,$

$2000\ X_1 + 5000 X_2 \geq 44{,}000,$

Both X_1 and $X_2 \geq 0$

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QUESTION BANK

LINEAR MODELS (SIMPLEX, BIG MAND TWO PHASE METHOD)

Q.] Solve by Simplex method,

Maximize, $Z = 2X1 + X2 - 3X3 + 5X4$

Subjected to,

$X1 + 7X2 + 3X3 + 7X4 \leq 46,$

$3X1 - X2 + X3 + 2X4 \leq 8,$

$2X1 + 3X2 - X3 + X4 \leq 10,$

$X1, X2, X3, X4 \geq 0.$

Q.2] Solve by Simplex method,

Maximize, $Z = 3X1 + 2X2 + 5X3$

Subjected to,

$X1 + X2 + X3 \leq 9,$

$3X1 + 3X2 + 5X3 \leq 30,$

$2X1 - X2 - X3 \leq 8,$

$X1, X2, X3 \geq 0.$

Q.3] Solve by Simplex method,

Maximize, Z = -40X1 -100X2

Subjected to,

$10X1 + 5X2 \leq 250$,

$2X1 + 5X2 \leq 100$,

$2X1 + 3X2 \leq 90$,

$X1, X2 \geq 0$.

Q.4] Solve by Big M method,

Maximize, Z = 4X1 + X2

Subjected to,

$3X1 + X2 = 3$,

$4X1 + 3X2 \geq 6$,

$X1 + 2X2 \leq 3$,

$X1, X2 \geq 0$

Q.5] Solve by Big M method,

Maximize, Z = 3X1 - X2

Subjected to,

$2X1 + X2 \leq 3$,

$X1 + 3X2 \geq 3$,

$X1, X2 \geq 0$

Q.6] Solve by Big M method,

Maximize, $Z = X1 + 2X2 + 3X3 – X4$

Subjected to,

$X1 + 2X2 + 3X3 = 15,$

$2X1 + X2 + 5X3 = 20,$

$X1 + 2X2 + X3 + X4 = 10,$

$X1, X2, X3, X4 \geq 0$

Q.7] Solve by Two phase method,

Maximize, $Z = X1 + 2X2 + 4X3$ Subjected to,

$2X1 + X2 + X3 \leq 8,$

$3X1 + 2X2 + 3X3 \leq 21,$

$X1 + 2X2 + 4X3 \geq 26,$

$X1, X2, X3 \geq 0$

Q.8] Solve by Two phase method,

Maximize, $Z = 4X1 + 6X2 - 3X3$

Subjected to,

$X1 + X2 + X3 = 10,$

$X1 + X2 \geq 1,$

$2X1 + 3X2 + X3 \leq 13,$

$X1, X2, X3 \geq 0$

QUESTION BANK

SUBJECT: PROJECT MANAGEMENT AND OPERATIONS RESEARCH

CLASS : B E (Mechanical)

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