PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)
BSc DEGREE EXAMINATION MAY 2022
(Sixth Semester)

Branch – MATHEMATICS WITH COMPUTER APPLICATIONS

OPERATIONS RESEARCH

Time: Three Hours   Maximum: 75 Marks

SECTION-A (10 Marks)
Answer ALL questions
ALL questions carry EQUAL marks   (10 x 1 = 10)

1   At any iteration of the usual Simplex method, if there is at least one basic variable in the basis is at zero level and all $(Z_j - C_j) \geq 0$, the current solution is
(i) infeasible   (ii) unbounded
(iii) non-degenerate   (iv) degenerate

2   If dual has an unbounded solution, primal has
(i) an infeasible solution   (ii) an unbounded solution
(iii) a feasible solution   (iv) none of the above

3   The solution to a transportation problem with m-sources and n-destinations is feasible if the number of allocations are
(i) $m + n - 1$ (ii) $m + n + 1$ (iii) $m + n$ (iv) $m * n$

4   In an assignment problem involving four workers and three jobs, total number of assignments possible are
(i) 4   (ii) 3   (iii) 7   (iv) 12

5   When maximin and minimax values of the game are same, then
(i) there is a saddle point   (ii) solution does not exist
(iii) strategies are mixed   (iv) none of the above

6   The pay-off value for which each player in a game always selects the same strategy is called the
(i) equilibrium point   (ii) saddle point
(iii) both (i) and (ii)   (iv) none of the above

7   The slack for an activity in network is equal to
(i)LS-ES   (ii) LF-LS   (iii) EF-ES   (iv) EF-LS

8   The activity which can be delayed without affecting the execution of the immediate succeeding activity is determined by
(i)total float   (ii) free float
(iii) independent float   (iv) interfering float

9   When there is more than one server, customer behavior in which he moves from one queue to another is known as
(i)balking   (ii) jockeying
(iii) reneging   (iv) alternating

10 Multiple servers may be
(i)in series   (ii) in parallel
(iii) in combination of parallel and series   (iv) all the above

SECTION - B (25 Marks)
Answer ALL questions
ALL questions carry EQUAL Marks   (5 x 5 = 25)

11   a   An agriculturist has a farm with 125 acres. He produced Radish, Muttar and Potato. Whatever he raises is fully sold in the market. He gets Rs. 5 for Radish per kg., Rs. 4 for Muttar per kg. and Rs. 5 for Potato per kg. The average yield is 1,500 kg. of Radish per acre, 1,800 kg. of Muttar per acre and 1,200 kg of Potato per acre. To produce each 100 kg. of Radish and Muttar and to produce 80 kg. of Potato, a sum of Rs. 12.50 has to be used for manure. Labour required for each acre to raise the crop is 6 man-days for Radish and Potato each and 5 man-days for Muttar. A total of 500 man days of labour at a rate of Rs. 40 per man-day are available. Formulate this as a Linear Programming model so as to maximize the agriculturist's total profit.

<div align="center">OR</div>

     b   Use the graphical method to solve the following LPP:

Maximize $z = -x_1 + 2x_2$; subject to the constraints:

$$-x_1 + 3x_2 \leq 10, x_1 + x_2 \leq 6$$
$$\text{and } x_1 - x_2 \leq 2. \text{ and } x_1 \geq 0, x_2 \geq 0.$$

12   a   Explain the steps involved in Least Cost method

<div align="center">OR</div>

     b   A department head has four tasks to be performed and three subordinates, thesubordinates differ in efficiency. The estimate of the time each subordinate would take to perform is given in the matrix. How should he allocate the tasks one to eachman, so as to minimize the total man-hours?

Task	Men		
	1	2	3
I	9	26	15
II	13	27	6
III	35	20	15
IV	18	30	20

13   a   Solve the following game graphically:

<div align="center">Player B</div>

		B1	B2	B3	B4
Player A	A1	2	1	0	-2
	A2	1	0	3	2

<div align="center">OR</div>

     b   Two firms are competing for business under the condition so that one firm's gain is another firm's loss. Firm A's pay-off matrix is given below:

<div align="center">Firm B</div>

		No ad	Medium ad	Heavy ad
Firm A	No advertising	10	5	-2
	Medium advertising	13	12	15
	Heavy advertising	16	14	10

14   a   Draw a network diagram for the following data:

Activity   :   A   B   C   D   E   F   G   H   I   J

Preceding Activities :   None   A   A   B   A   B,E   C   D,F   G   H,I

OR

b   Construct the network diagram comprising activities B, C, . . . Q and N
such that the following constraints are satisfied:

$B < E, F;\ C < G, L;\ E, G < H;\ L, H < I;\ L < M;\ H < N;\ H < J;\ I, J < P;\ P < Q$

15   a   Explain the operating characteristics of a Queueing system.

OR

b   A TV repairman finds that the time spent on his jobs has an Exponential
distribution with mean 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 the repairman's expected idle
time each day? How many jobs are ahead of the average set just brought-in?

SECTION -C (40 Marks)
Answer ALL questions
ALL questions carry EQUAL Marks   (5 x 8 = 40)

16   a   Use two-phase simplex method to Maximize $z = 5x_1 - 4x_2 + 3x_3$ subject to
the constraints:

$$2x_1 + x_2 - 6x_3 = 20, 6x_1 + 5x_2 + 10x_3 \leq 76$$
$$8x_1 - 3x_2 + 6x_3 \leq 50, x_1, x_2, x_3 \geq 0.$$

OR

b   Use duality to solve the following L.P.P
Maximize $z = 2x_1 + x_2$ subject to the constraints:

$x_1 + 2x_2 \leq 10;\ x_1 + x_2 \leq 6;\ x_1 - x_2 \leq 2;\ x_1 - 2x_2 \leq 1;\ x_1, x_2 \geq 0.$

17   a   A company manufacturing air-coolers has two plants located at Mumbai
and Kolkata with a weekly capacity of 200 units and 100 units respectively.
The company supplies air-coolers to its 4 showrooms situated at Ranchi,
Delhi, Lucknow and Kanpur which have a demand of 75, 100, 100 and 30
units. The cost of transportation per unit (in Rs.) is shown in the following
table:

	Ranchi	Delhi	Lucknow	Kanpur
Mumbai	90	90	100	100
Kolkata	50	70	130	85

Plan the production programme so as to minimize the total cost of transportation.

OR

b   A machine operator processes five types of items on his machine each week,
and must choose a sequence for them. The set-up cost per change depends on
the item presently on the machine and the set-up to be made according to the
following table:

From item	To item				
	A	B	C	D	E
A	∞	4	7	3	4
B	4	∞	6	3	4
C	7	6	∞	7	5
D	3	3	7	∞	7
E	4	4	5	7	∞

18   a   Solve the following game:

Player B

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

OR

b   Two firms A and B have for years been selling a competitive product which forms a part of both firms' total sales. The marketing executive of firm A raised the question, "What should be the firm's strategies in terms of advertising the product in the market?" The market research team of firm A developed the following data for varying degrees of advertising:

    (i)   No advertising, medium advertising and large advertising for both firms will result in equal shares

    (ii)   Firm A with no advertising: 40% of the market with medium advertising by firm B and 25% of the market with large advertising by firm B.

    (iii)   Firm A using medium advertising: 70% of the market with no advertising by firm B and 45% of the market with large advertising by firm B.

    (iv)   Firm A using large advertising: 75% of the market with no advertising by firm B and 47.5% of the market with medium advertising by firm B.

(A) Based upon the foregoing information, answer the marketing executive's questions.

(B) What advertising policy should firm A pursue when consideration is given to the above factors: selling price Rs. 4 per unit; variable cost of product Rs.2.50 per unit; annual volume of 30,000 units from firm A: cost of annual medium advertising Rs. 5,000 and cost of annual large advertising Rs. 15,000? What contributions to the other fixed costs is available to the firm?

19   a   Distinguish between PERT and CPM.

OR

b   A project consists of a series of tasks labelled A, B, . . . H, I with the following relationship. Construct the network diagram having the following constraints:

$A < D, E; B, D < F; C < G; B, G < H; F, G < I$

Find also the minimum time of completion of the project, when the time (in days) of completion of each task is as following:

Task :	A	B	C	D	E	F	G	H	I
Time:	23	8	20	16	24	18	19	4	10

20 a   A tax consulting firm has four service stations in its office to receive people who have problems and complaints about their income, wealth and sales taxes. Arrivals follow a Poisson distribution and on average 80 persons in an 8-hour in a service day. Each tax advisor spends an irregular amount of time servicing the arrival which have been found to have an exponential distribution. The average service time is 20 minutes. Calculate the average number of customers in the system, average number of customers waiting to be serviced, average time a customer spends in the system, and average waiting time for a customer. Calculate how many hours each week a tax advisor spends performing his job. What is the probability that a customer has to wait before he gets service? What is the expected number of idle tax advisors at any specific time?

OR

b   A car servicing station has 3 stalls where service can be offered simultaneously. The cars wait in such a way that when a stall becomes vacant, the car at the head of the line pulls up to it. The station can accommodate at most four cars waiting at one time. The arrival pattern is Poisson with a mean of one car per minute during the peak hour. The service time is exponential with mean 6 minutes. Find the average number of cars in the service station during peak hours, the average waiting time and the average number of cars per hour that cannot enter the station because of full capacity.

Z-Z-Z   END