

## NO.1 INSTITUTE FOR IAS/IFOS EXAMINATIONS



# MATHEMATICS CLASSROOM TEST

## 2020-21

Under the guidance of K. Venkanna

# MATHEMATICS

LPP CLASS TEST

Date: 26 July-2020

Time: 03:00 Hours

Maximum Marks: 250

### INSTRUCTIONS

1. Write your Name & Name of the Test Centre in the appropriate space provided on the right side.
2. Answer must be written in the medium specified in the admission Certificate issued to you, which must be stated clearly on the right side. No marks will be given for the answers written in a medium other than that specified in the Admission Certificate.
3. Candidates should attempt All Question.
4. The number of marks carried by each question is indicated at the end of the question. Assume suitable data if considered necessary and indicate the same clearly.
5. Symbols/notations carry their usual meanings, unless otherwise indicated.
6. All questions carry equal marks.
7. All answers must be written in blue/black ink only. Sketch pen, pencil or ink of any other colour should not be used.
8. All rough work should be done in the space provided and scored out finally.
9. The candidate should respect the instructions given by the invigilator.
10. The question paper-cum-answer booklet must be returned in its entirety to the invigilator before leaving the examination hall. Do not remove any page from this booklet.

**READ INSTRUCTIONS ON THE  
LEFT SIDE OF THIS PAGE  
CAREFULLY**

Name: Mobile No. Test Centre Email.: 

I have read all the instructions and shall  
abide by them

Signature of the Candidate

I have verified the information filled by the  
candidate above

Signature of the invigilator

<b>Question</b>	<b>Page No.</b>	<b>Max. Marks</b>	<b>Marks Ob- tained</b>
<b>1.</b>		<b>10</b>	
<b>2.</b>		<b>20</b>	
<b>3.</b>		<b>15</b>	
<b>4.</b>		<b>15</b>	
<b>5.</b>		<b>20</b>	
<b>6.</b>		<b>20</b>	
<b>7.</b>		<b>20</b>	
<b>8.</b>		<b>17</b>	
<b>9.</b>		<b>20</b>	
<b>10.</b>		<b>20</b>	
<b>11.</b>		<b>16</b>	
<b>12.</b>		<b>18</b>	
<b>13.</b>		<b>12</b>	
<b>14.</b>		<b>15</b>	
<b>15.</b>		<b>12</b>	

**Total Marks**

1. Old hens can be bought at Rs. 2 each and young ones at Rs. 5 each. The old hens lay 3 eggs per week and the young ones lay 5 eggs per week, each egg being worth 30 paise. A hen (young or old) costs Re. 1 per week to feed. I have only Rs. 80 to spend for hens, how many of each kind should I buy to give a profit of more than Rs. 6 per week, assuming that I cannot house more than 20 hens. Formulate L.P.P. and solve it. **[10]**

2. (A) Obtain the dual of the LP problem :

Min.  $Z = x_1 + x_2 + x_3$  subject to the constraints :

$x_1 - 3x_2 + 4x_3 = 5$ ,  $x_1 - 2x_2 \leq 3$ ,  $2x_2 - x_3 \geq 4$ ;  $x_1, x_2 \geq 0$  and  $x_3$  is unrestricted.

- (B) Write the dual of the problem.

Min  $Z = 2x_2 + 5x_3$   
 Subject to  $x_1 + x_2 \geq 2$   
 $2x_1 + x_2 + 6x_3 \leq 6$   
 $x_1 - x_2 + 3x_3 = 4$   
 $x_1, x_2, x_3 \geq 0.$

[10+10=20]





3. A firm plans to purchase at least 200 quintals of scrap containing high quality metal X and low quality metal Y. It decides that the scrap to be purchased must contain at least 100 quintals of X-metal and not more than 35 quintals of Y-metal. The firm can purchase the scrap from two suppliers (A and B) in unlimited quantities. The percentage of X and Y metals in terms of weight in the scraps supplied by A and B is given below :

Metals	Supplier A	Supplier B
X	25%	75%
Y	10%	20%

The price of A's scrap is Rs. 200 per quintal and that of B's is Rs. 400 per quintal. Formulate this problem as LP model and solve it graphically to determine the quantities that the firm should buy from the two suppliers so as to minimize total purchase cost.

[15]





4. Solve the following LPP by simplex method.

Maximize  $Z = 4x_1 + 5x_2 - 3x_3 + 50$ , subject to the constraints :

$$x_1 + x_2 + x_3 = 10$$

$$x_1 - x_2 \geq 1$$

$$2x_1 + 3x_2 + x_3 \leq 40$$

$$x_1, x_2, x_3 \geq 0$$

[15]



5. (A) If  $x_1 = 2, x_2 = 3, x_3 = 1$  be a feasible solution of the following Linear Programming problem then find the basic feasible solution:

$$\text{Maximize } Z = x_1 + 2x_2 + 4x_3$$

$$\text{Subject to the constraints } 2x_1 + x_2 + 4x_3 = 11$$

$$3x_1 + x_2 + 5x_3 = 14 \text{ and}$$

$$x_1, x_2, x_3 \geq 0.$$

- (B) A pine-apple firm produces two products : canned pine-apple and canned juice. The specific amounts of material, labour and equipment required to produce each product and the availability of each of these resources are shown in the table given below :

	Canned juice	Pine-apple	Available resources
Labour(man hrs.)	3	2.0	12.0
Equipment(m / c hrs.)	1	2.3	6.9
Material(units)	1	1.4	4.9

Assuming one unit each of canned juice and canned pine-apple has profit margins of Rs. 2 and Re. 1 respectively. Formulate it as L.P. problem and solve it graphically.

**[10+10=20]**



6. The following table gives the cost for transporting material from supply points A, B, C and D to demand points E, F, G, H, and J.

		To				
		E	F	G	H	J
From	A	8	10	12	17	15
	B	15	13	18	11	9
	C	14	20	6	10	13
	D	13	19	7	5	12

The present allocation is 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.

- (a) Check if this allocation is optimum. If not, find an optimum schedule.  
 (b) If in the above problem, the transportation cost from A to G is reduced to 10, what will be the new optimum schedule ?

[20]





- 7 . (A) A firm has two bottling plants, one located at Coimbatore and, other at Chennai. Each plant produces three drinks, Coca-cola, Fanta, and Thumps-up named A, B, and C, respectively. The number of bottles produced per day are, as follows :

	Plant at	
	Coimbatore (E)	Chennai(F)
Coca-cola (A)	15,000	15,000
Fanta (B)	30,000	10,000
Thumps – up (C)	20,000	50,000

A market survey indicates that, during the month of April, there will be a demand of 200,000 bottles of Coca-cola, 400,000 bottles of Fanta, and 440,000 bottles of Thumps-up. The operating cost per day for plants at Coimbatore and Chennai is 600 and 400 monetary units respectively. For how many days each plant be run in April so as to, minimize the production cost, while still meeting the market demand ?

- (B) A department head has four subordinates, and four tasks to be performed. The subordinates differ in efficiency, and the tasks in their intrinsic difficulty. His estimate of the times each man would take to perform each task is given in the effectiveness matrix below. How should the tasks be allocated, one to a man, so as to minimize the total men hours ?

		Subordinates			
		I	II	III	IV
Task	A	8	26	17	11
	B	13	28	4	26
	C	38	19	18	15
	D	19	26	24	10

[10+10=20]







**8.** Solve the following transportation problem

		Destinations						Availability
		D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	D <sub>5</sub>	D <sub>6</sub>	
Factories	F <sub>1</sub>	2	1	3	3	2	5	50
	F <sub>2</sub>	3	2	2	4	3	4	40
	F <sub>3</sub>	3	5	4	2	4	1	60
	F <sub>4</sub>	4	2	2	1	2	2	30
Demand		30	50	20	40	30	10	

by finding the initial solution by “Matrix Minima method”.

**[17]**



9. (A) For each hour per day that Ashok studies mathematics, it yields him 10 marks and for each hour that he studies physics, it yields him 5 marks. He can study at most 14 hours a day and he must get at least 40 marks in each. Determine graphically how many hours a day he should study mathematics and physics each, in order to maximize his marks?

- (B) Find all the basic feasible solutions of the following problem:

$$2x_1 + 3x_2 + x_3 + x_4 = 8$$

$$x_1 - 2x_2 + 6x_3 - 7x_4 = -3$$

and choose the one which

$$\text{Maximize } Z = 2x_1 + 3x_2 + 4x_3 + 7x_4$$

[10+10=20]



10. A job shop has purchased 5 new machines of different type. There are 5 available locations in the shop where a machine could be installed. Some of these locations are more desirable than others for particular machines because of their proximity to work centres which would have a heavy work flow to and from these machines. Therefore, the objective is to assign the new machines to the available locations in order to minimize the total cost of material handling. The estimated cost per unit time of materials handling involving each of the machines is given below for the respective locations. Locations 1, 2, 3, 4 and 5 are not considered suitable for machines A, B, C, D and E respectively.

		Location (Cost in Rs.)				
		1	2	3	4	5
Machine	A	×	10	25	25	10
	B	1	×	10	15	2
	C	8	9	×	20	10
	D	14	10	24	×	15
	E	10	8	25	27	×

- (i) Find the optimal solution.  
(ii) How would the optimal solution get modified if location 5 is also unsuitable for machine A ?

[20]







11. A product is produced by four factories F1, F2, F3, F4. The unit production costs in them are Re. 1, Rs. 3, Re. 1 and Rs. 5 respectively. Their production capacities are : F1 – 50 units, F2 – 70 units, F3 – 30 units, F4 – 50 units. These factories supply the product to four stores S1, S2, S3 and S4, demands of which are 25, 35, 105 and 20 units respectively. Unit transport cost in rupees from each factory to each store is given in the table below. Determine the extent of derivatives from each of the factories to each of the stores so that the total production and transportation cost is minimum.

	$S_1$	$S_2$	$S_3$	$S_4$
$F_1$	2	4	6	11
$F_2$	10	8	7	5
$F_3$	13	3	9	12
$F_4$	4	6	8	3

[16]



**12.** Solve the following LPP by simplex method:

Maximize  $Z = x_1 + 2x_2$

Subject to conditions

$$-x_1 + 2x_2 \leq 8$$

$$x_1 + 2x_2 \leq 12$$

$$x_1 - 2x_2 \leq 3$$

$$x_1, x_2 \geq 0.$$

Obtain all alternative optimal basic feasible solution, if it exists.

**[18]**



13. Using the simplex method solve the LPP problem: Minimize  $Z = x_1 + x_2$ , subject to  $2x_1 + x_2 \geq 4$ ,  $x_1 + 7x_2 \geq 7$ , and  $x_1, x_2 \geq 0$ . **[12]**



14. Find the optimal solution of the following transportation problem.

	$D_1$	$D_2$	$D_3$	$D_4$	$D_5$	$D_6$	$a_i$
$O_1$	1	2	1	4	5	2	30
$O_2$	3	3	2	1	4	3	50
$O_3$	4	2	5	9	6	2	75
$O_4$	3	1	7	3	4	6	20
$b_j$	20	40	30	10	50	25	

[15]



























































































































































- 15.** Food X contains 6 units of vitamin A per gram and 7 units of vitamin B per gram and costs 12 paise per gram. Food Y contains 8 units of vitamin A per gram and 12 units of vitamin B and costs 20 paise per gram. The daily minimum requirements of vitamin A and vitamin B are 100 units and 120 units respectively. Find the minimum cost of product mix by Simplex method. **[12]**



## ROUGH SPACE



**OUR ACHIEVEMENTS IN IAS (FROM 2008 TO 2018)**

 KANISHAK KATARIA AIR-01 (2018)	 K. VARUN REDDY AIR-07 (2018)	 TANMAY V. SHARMA AIR-10 (2018)	 G.S. PRAJESH CHANDRA AIR-64 (2018)	 MANISHA RANA AIR-67 (2018)	 DALIP KUMAR AIR-73 (2018)	 KHUSHBOO GUPTA AIR-80 (2018)	 JAY SHIVANI AIR-81 (2018)	 ANCHAL SRIVASTAVA AIR-110 (2018)	 RAUSHAN KUMAR AIR-114 (2018)	 HIMANSHU PRAJAPATI AIR-124 (2018)	 AVDRESH DIXIT AIR-158 (2018)	 SUNEEL SHEORAN AIR-192 (2018)	
 AKASH SINGH AIR-193 (2018)	 ARCHITA V. CHANDAK AIR-206 (2018)	 AVINASH C. SANDILYA AIR-215 (2018)	 SACHIN BANSAL AIR-348 (2018)	 KATTA RAVI TEJA AIR-349 (2018)	 S. GAUTAM RAJ AIR-353 (2018)	 RAJAT BHARGAVA AIR-366 (2018)	 C. VISHNU CHARAN AIR-406 (2017)	 PANKAJ KUMAWAT AIR-443 (2018)	 SANJAY SAHU AIR-526 (2018)	 KUMAR ASHISH AIR-536 (2018)	 SHURUTI KAMBOJ AIR-586 (2018)	 AYUSH KUMAR AIR-598 (2018)	 AMIT KUMAWAT AIR-600 (2018)
 ATUL PRAKASH AIR-04 (2017)	 ANUBHAV SINGH AIR-08 (2017)	 SAGAR KUMAR AIR-13 (2017)	 DESHAL DAN AIR-82 (2017)	 PRADEEK JAIN AIR-86 (2017)	 SUNNY K SINGH AIR-91 (2017)	 RAHUL SINDHE AIR-95 (2017)	 MANISH K.R.S. AIR-138 (2017)	 RAM PRAKASH AIR-162 (2017)	 ARCHIT CHANDAK AIR-184 (2017)	 HARSHAVARDAN AIR-213 (2017)	 MAYANK MANISH AIR-214 (2017)	 K. VARUN REDDY AIR-225 (2017)	 SAURABH B. AIR-235 (2017)
 SUNEEL S. AIR-250 (2017)	 NIKHIL BANSAL AIR-255 (2017)	 AVINASH C. S. AIR-391 (2017)	 PRAJESH CHANDRA AIR-512 (2017)	 DALIP KUMAR AIR-609 (2017)	 PRINCE KUMAR AIR-772 (2017)	 UTSAV KAUSHAL AIR-14 (2016)	 MANISH GURWANI AIR-18 (2016)	 AKSHAY GODARA AIR-40 (2016)	 SWAPNIL KHARE AIR-43 (2016)	 VIKALP BHARGAVA AIR-85 (2016)	 VARUN SINGLA AIR-114 (2016)	 MANI AGARWAL AIR-126 (2016)	 SHASHANK C. AIR-130 (2016)
 SUMAN SHEKHAR AIR-133 (2016)	 K. VARUN REDDY AIR-166 (2016)	 CHINMAY MITTAL AIR-235 (2016)	 VISHAL RAJ AIR-242 (2016)	 PRAJESH CHANDRA AIR-264 (2016)	 ASEEM DALAL AIR-275 (2016)	 SINGH NAVRATTA A.C. AIR-334 (2016)	 NITHAN RAJ T.N. AIR-476 (2016)	 ATUL PRAKASH AIR-558 (2016)	 KUNAL DUDAWAT AIR-669 (2016)	 RAM PRAKASH AIR-832 (2016)	 SANGEETA MAHALA AIR-946 (2016)	 ESTHER AIR-1075 (2016)	 KUMBHAKAR Y. AIR-08 (2015)
 ASHISH SANGWAN AIR-12 (2015)	 SIDHARTH JAIN AIR-13 (2015)	 PRATAP SINGH AIR-15 (2015)	 VALLURU KRANTHI AIR-65 (2015)	 ATUL SHARMA AIR-118 (2015)	 KETAN BANSAL AIR-155 (2015)	 VARUN GUNTUPALLI AIR-183 (2015)	 PADMANABH B. AIR-194 (2015)	 SWAPNIL KHARE AIR-197 (2015)	 SHILPI AIR-198 (2015)	 AKHIL GOEL AIR-251 (2015)	 SAURABH KATIYAR AIR-334 (2015)	 PATEL KOMAL AIR-335 (2015)	 ANKIT AIR-492 (2015)
 UTSAV KAUSHAL AIR-500 (2015)	 AKSHAY GODARA AIR-605 (2015)	 MEET KUMAR AIR-646 (2015)	 KUNAL DUDAWAT AIR-699 (2015)	 NITHAN RAJ T.N. AIR-843 (2015)	 SURYA KANT P. AIR-886 (2015)	 PRATAP SINGH B. AIR-1060 (2015)	 NITISH K. AIR-08 (2014)	 GOWTHAM POTRU AIR-30 (2014)	 BHAVESH MISHRA AIR-58 (2014)	 K.Y. VIJAY AIR-143 (2014)	 ANKIT VERMA AIR-145 (2014)	 NIKHIL GOYAL AIR-159 (2014)	 VIJAY GODWA G.C. AIR-175 (2014)
 VALLURU KRANTHI AIR-230 (2014)	 SWAPNIL KHARE AIR-236 (2014)	 VARUN GUNTUPALLI AIR-261 (2014)	 PARTH JASWAL AIR-299 (2014)	 MANISH GURWANI AIR-322 (2014)	 ANURAG RAJ AIR-371 (2014)	 PARAS MANI T. AIR-433 (2014)	 AJIT PRATAP SINGH AIR-436 (2014)	 NIKHIL K.R. GARG AIR-608 (2014)	 RAJAT AGARWAL AIR-622 (2014)	 SAURABH KATIYAR AIR-763 (2014)	 PRATAP S. BHUKYA AIR-830 (2014)	 BIPIN KUMAR AIR-861 (2014)	 MEET KUMAR AIR-1150 (2014)
 AJIT JOHN JOSHUA AIR-78 (2013)	 SUMIT KUMAR AIR-81 (2013)	 B. SASHI KANT AIR-111 (2013)	 GOWTHAM POTRU AIR-318 (2013)	 RAVINDER SINGH AIR-333 (2013)	 ASHISH MODI AIR-350 (2013)	 PARAS M. TRIPATHI AIR-391 (2013)	 NIKHIL GOYAL AIR-399 (2013)	 NITISH K. AIR-547 (2013)	 KULRAJ SINGH AIR-552 (2013)	 VALLURU KRANTHI AIR-562 (2013)	 SANTOSH KUMAR AIR-1013 (2013)	 RAMESH RAJAN AIR-76 (2012)	 ANKIT VERMA AIR-247 (2012)
 B. SASHI KANT AIR-329 (2012)	 KRISHAN KANT AIR-550 (2012)	 VISHAL GARG AIR-560 (2012)	 PRADEEP MISHRA AIR-633 (2012)	 KETAN BANSAL AIR-655 (2012)	 SANJAY K.R. JAIN AIR-667 (2012)	 SANTOSH KUMAR AIR-849 (2012)	 MEET KUMAR AIR-944 (2012)	 HIMANSHU GUPTA AIR-07 (2011)	 ARIJIT MUKHERJEE AIR-25 (2011)	 AJAY SINGH TOMAR AIR-88 (2011)	 AWAKASH KUMAR AIR-168 (2011)	 GULNEET SINGH AIR-220 (2011)	 AJIT P. SINGH AIR-288 (2011)
 JAY YADAV AIR-372 (2011)	 RAVI VERMA AIR-485 (2011)	 MEGHA AGARWAL AIR-538 (2011)	 G.J. KRUPAKAR AIR-796 (2011)	 ABHISHEK MODI AIR-223 (2011)	 BHAGWATI P. KALAI AIR-154 (2010)	 AWAKASH KUMAR AIR-276 (2010)	 NALMEET AGARWAL AIR-362 (2010)	 AJIT P. SINGH AIR-497 (2010)	 SHAMBU KUMAR AIR-47 (2009)	 A. ARJUN AIR-140 (2009)	 NISHA GUPTA AIR-507 (2009)	 K.V.S.R. KISHORE AIR-575 (2008)	

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